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**Navigations- und Funkkommunikationsgeräte und -systeme für die Seeschifffahrt –
Integrierte Navigationssysteme –
Betriebs- und Leistungsanforderungen, Prüfverfahren und geforderte Prüfergebnisse (IEC 61924:2006);
Deutsche Fassung EN 61924:2006, Text Englisch**

Maritime navigation and radiocommunication equipment and systems –
Integrated navigation systems –
Operational and performance requirements, methods of testing and required test results
(IEC 61924:2006);
German version EN 61924:2006, text in English

Matériels et systèmes de navigation et de radiocommunication –
Systèmes de navigation intégrés –
Exigences opérationnelles et de fonctionnement, méthodes d'essai et résultats exigibles
(CEI 61924:2006);
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Nationales Vorwort

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Für diese Norm ist das nationale Arbeitsgremium K 738 „Elektronische Navigationsinstrumente“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (<http://www.dke.de>) zuständig.

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Vorwort

Der Text des Schriftstücks 80/433/FDIS, zukünftige 1. Ausgabe von IEC 61924, ausgearbeitet von dem IEC/TC 80 „Maritime navigation and radiocommunication equipment and systems“ wurde der IEC-CENELEC Parallelen Abstimmung unterworfen und von CENELEC am 2006-06-01 als EN 61924 angenommen.

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Anerkennungsnotiz

Der Text der Internationalen Norm IEC 61924:2006 wurde von CENELEC ohne irgendeine Abänderung als Europäische Norm angenommen.

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INTRODUCTION

International Standard IEC 61924 has been developed by IEC Technical Committee 80 to clarify the IMO Resolution MSC 86(70) Annex 3 Recommendation on Performance Standards for an Integrated Navigation System (INS). This standard provides adequate requirements, methods of tests and required test results to facilitate type approval.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – INTEGRATED NAVIGATION SYSTEMS – OPERATIONAL AND PERFORMANCE REQUIREMENTS, METHODS OF TESTING AND REQUIRED TEST RESULTS

1 Scope

This International Standard specifies the minimum requirements for the design, manufacture, integration, methods of testing and required test results for an integrated navigation system (INS) to comply with the International Maritime Organization (IMO) requirements of Resolution MSC 86(70) Annex 3. (See Annex A).

This standard aims to resolve conflicts that may occur from the differences in the requirements of the relevant IMO Performance Standards for individual navigational aids when forming part of the INS.

All text of this standard, whose meaning is identical to that in IMO Resolution MSC 86(70) Annex 3 will be printed in *italics* and the Resolution and paragraph number indicated between brackets.

This standard is applicable to an INS, that is any *combination of navigational aids that provides functions beyond the general intent defined in the respective performance standards adopted by the Organization for individual equipment* (MSC 86(70) Annex 3, 2.1).

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

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 61174:2001, *Maritime navigation and radiocommunication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results*

IEC 61209:1997, *Maritime navigation and radiocommunication equipment and systems – Integrated bridge systems (IBS) – Operational and performance requirements, methods of testing and required test results*

IEC 62065:2002, *Maritime navigation and radiocommunication equipment and systems – Track control systems – Operational and performance requirements, methods of testing and required test results*

IMO A.224(VII) as amended by MSC.74(69) Annex 4, *Performance standards for echo-sounding equipment*

IMO A.424 (XI), *Performance standards for gyro-compasses*

IMO A.529 (XIII), *Accuracy standards for navigation*

IMO A.694(17), *General requirements for shipborne radio equipment forming part of the Global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO A.815(19), *World-wide radionavigation system*

IMO A.821(19), *Performance standards for gyro-compasses for high speed craft*

IMO A.823(19), *Performance standards for automatic radar plotting aids*

IMO A.824(19), *Performance standards for devices to indicate speed and distance*

IMO A.830(19), *Code on alarms and indicators*

IMO A.893(21), *Guidelines for voyage planning*

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

IMO MSC.64 (67) Annex 1, *Recommendation on performance standards for integrated bridge systems (IBS)*

IMO MSC.64 (67) Annex 4, *Recommendation on performance standards for radar equipment*

IMO MSC 86(70) Annex 3, *Performance standards for an integrated navigation system (INS)*

ISO 11674: 2000, *Ships and marine technology – Heading control systems*

3 Terms, definitions and abbreviations

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

3.1 Terms and definitions

3.1.1

accuracy

degree of conformance between the estimated or measured parameter value at a given time and its true parameter value at that time

3.1.2

added value

functionality and information, which are provided by the INS, in addition to the requirements of the performance standard for the individual equipment

3.1.3

aid to navigation

any device or system external to a vessel intended to assist a navigator to determine position or safe course, or to warn of hazards to navigation

3.1.4**alarm**

audible signal or audible and visual signal announcing a condition requiring immediate attention or user action

3.1.5**alarm management**

functions provided by an INS for harmonising, processing, monitoring and distributing audible and visual announcements and their acknowledgement, silencing and cancelling operations

NOTE The alarm management function administers different levels of announcements: alarms, warnings and indications.

3.1.6**announcement**

visual or audible signal issued to the user by the system

3.1.7**automatic control system**

control system that may include a heading, track or speed control system

3.1.8**conning position**

place on the bridge with a commanding view and which is used by navigators when commanding, manoeuvring and controlling a ship

3.1.9**consistent common reference point**

location in a ship to which all measurements such as own ship's position, target range, bearing, relative course, relative speed, pitch and yaw are referred. Typically, this is the conning position on the bridge, but may, for example be the origin of the reference axes of the ship

3.1.10**consistent common reference system****CCRS**

sub-system (or function) of an INS for acquisition, processing, storage and distribution of data and information, providing identical and obligatory reference to sub-systems within an INS. The CCRS is the means to ensure that all parts of the INS use the same source and values for a specific type of system data and essential information, for example own ship position, speed through water, heading, time, etc.

3.1.11**detected hazard**

hazard identified by a sensor (for example, radar or echo sounder) or reported by a communication device (for example AIS or NAVTEX) and which is available to the INS

3.1.12**entry field**

location on a display for the input of data by the operator. The requested information is usually alphanumeric

3.1.13**essential information**

information required for the fundamental functions of the INS. This includes as a minimum position, speed, heading and time

3.1.14

expected precision

deviation between the measured value and the true value that is normally not exceeded by a typical system

3.1.15

functionality

ability to perform an intended function. The activity of performing a function normally employs a system of displays, controls and instrumentation

3.1.16

hazard

objects or conditions potentially dangerous to navigation, possibly leading to grounding or collision, that may be detected by a sensor, reported by a communication device, retrieved from a database or manually input to the INS

3.1.17

indication

visual information about the condition of a system or equipment

3.1.18

inspection

visual check of the equipment or documentation

3.1.19

integrated navigation system

combination of systems or functions of navigational aids that are interconnected to increase safe and efficient navigation when used by suitably qualified personnel

3.1.20

integrity

property of information as being accurate and valid with regard to specified requirements and verified by comparing data from more than one independent source

3.1.21

integrity monitoring

ability of a system to provide the user with information within the specified accuracy in a timely, complete and unambiguous manner, and alarms and indications within a specified time when the system should be used with caution or not at all

3.1.22

known hazard

hazard retrieved from a database (including navigational charts and nautical publications) or manually input and which is available to the INS

3.1.23

latency

time interval between an event and its result, including time for reception, processing, transmission and display

3.1.24

leg

the ship's intended ground track between two waypoints

3.1.25**manufacturer**

organisation responsible for the production of all or some of the parts of the INS, including the responsibility that these parts meet their individual international standards. A manufacturer may also be the system integrator

3.1.26**marking**

visual or logical indication of the status of displayed or transferred information

3.1.27**mode**

the setting of a group of parameters determining the behaviour (operational modes) or the Human Machine Interface (HMI) (display modes) or the control functions (control modes) of the equipment or its sensors

3.1.28**mode awareness**

perception of the mariner regarding the currently active Modes of Control, Operation and Display of the INS including its subsystems, as supported by the presentations and indications at an INS display or workstation

3.1.29**multifunction display**

single visual display unit that can present, either simultaneously or through a series of selectable pages, information from more than one operation of a system

3.1.30**navigation**

process of planning, executing, monitoring and recording the progress of a safe and expeditious voyage of a vessel

3.1.31**navigational aid**

ship-borne device that complies with its relevant International Standard(s), for example instrument, method or chart, intended to assist in the navigation of a ship.

3.1.32**part**

individual INS subsystem, equipment or functional module

3.1.33**passage**

process of moving a ship from one place to another by navigating through a certain area within a certain period of time and in compliance with certain environmental and legal provisions

3.1.34**performance check**

functional check to show that the system or component is still operational without investigating all details of its functionality

3.1.35**plausibility**

quality of being believable or trustworthy

3.1.36

primary navigation data/information

data of own ship's position, speed, heading, time and, in case of INS(B) and if available depth, provided by selected sensors, to be used in the system for processing the navigational information

3.1.37

route

representation of a voyage or passage geographically defined by a point of departure, a point of arrival and usually by intermediate waypoints. It may include time of departure and/or ship's speed as well as parameters and limits for safe navigation such as off-track limit, turn radius, time references, etc. and as defined in IMO Resolution A.893(21)

3.1.38

selected route or track

route or track which has been chosen for monitoring the performance of the navigation. The term "track" is typically used for systems that have automatic track control capability

3.1.39

sensor

navigational aid, with or without its own display and control as appropriate, automatically providing information to the INS

3.1.40

situation awareness

perception of the mariner regarding the prevailing nautical situation and the currently active or available system resources, as supported by the presentations and indications at an INS display or workstation. It includes mode awareness

3.1.41

system data

data that is used by the system for the processing and display of essential information. System data of the same type is from the same source. System data, at least for primary navigation information, has been checked for integrity

3.1.42

system integrator

organisation responsible for ensuring that the INS complies with the requirements of this standard

3.1.43

track

geographical representation of the movement actually performed by the ship, or, in case of a track control system, the path (over ground) to be (automatically) followed

3.1.44

validity

conformity of information with formal and logical criteria, or the marking of data as being good or no good (valid or invalid) for the intended use

3.1.45

vessel

water craft of any description, including non-displacement craft, WIG craft and seaplanes, used or capable of being used as a means of transportation on water

3.1.46**voyage**

execution of all aspects of the operation of a craft in journeying from the point of departure to the final destination. A voyage may consist of one or more passages

3.1.47**warning**

signal announcing a condition requiring non-immediate attention for precautionary reasons

3.1.48**waypoint**

geographically defined position used as reference for navigation along a leg, track or route

3.1.49**workstation for INS or INS workstation**

workstation at which display or operator control functions are provided to meet the requirements of this standard. An INS workstation need not be a physical part of the INS. It may just be the location where the necessary displays and controls are situated

3.2 Abbreviations

AIS	Automatic identification system
ARPA	Automatic radar plotting aid
ATA	Automatic tracking aid
AtoN	Aid to navigation
CCRS	Consistent common reference system
COG	Course over ground
DR	Dead reckoning
ECDIS	Electronic chart display and information system
EUT	Equipment under test
EPA	Electronic plotting aid
EPFS	Electronic position fixing system
GNSS	Global navigation satellite system
HCS	Heading control system
HMD	Heading measuring device
HMI	Human machine interface
IBS	Integrated bridge system
IMO	International Maritime Organization
IEC	International Electrotechnical Commission
INS	Integrated navigation system
ISO	International Organization for Standardization
LORAN	Long range navigation system
MSC	Marine Safety Committee
OOW	Officer in charge of the navigational watch (Officer of the Watch)
RAIM	Receiver autonomous integrity monitoring
ROT	Rate of turn
SDME	Speed and distance measuring equipment
SOG	Speed over the ground

SOLAS	Safety of life at sea
THD	Transmitting heading device

4 Functional requirements and application

NOTE Clarification of minimum requirements is given in Annex B.

4.1 General

In addition to meeting the relevant requirements of Resolution A.694(17) to which IEC 60945 is associated, the INS shall comply with the requirements of the IMO Performance Standards MSC 86(70) Annex 3, as clarified in this standard.

4.1.1 Purpose

The purpose of this standard is to support proper and safe integration of navigational equipment and information. (MSC 86(70) Annex 3, 2.2).

4.1.2 Purpose of an integrated navigation system (INS)

The purpose of an integrated navigation system (INS) is to provide 'added value' to the functions and information needed by the officer in charge of the navigational watch (OOW) to plan, monitor or control the progress of the ship (MSC 86(70) Annex 3, 1.1).

A functional description shall be provided with a description of how the INS "added value" is achieved.

4.1.3 Compliance

Each part of the INS shall comply with the applicable requirements adopted by IMO, including the requirements of IMO resolution MSC 86(70) Annex 3. Parts executing multiple operations shall meet the requirements specified for each individual function they can control, monitor or perform. (MSC 86(70), 4.1.2).

A sensor or part thereof is not part of the INS if it only supplies data and does not perform other functions of the INS as required by this standard.

An actuator and its associated control system or part thereof (for example steering gear control system, propulsion control system, fin stabilising system) is not part of the INS if it only receives data or commands and does not perform other functions of the INS as required by this standard.

4.1.4 Equipment required

The INS consists of the equipment that provides the functions going beyond the general intent of independent equipment and international standards and the additional equipment required to meet this standard.

4.1.5 Mode and situation awareness

The INS supports mode and situation awareness. (MSC 86(70) Annex 3, 1.2) within the scope of functions provided by the relevant category of INS(A), (B), or (C).

4.1.6 Three INS categories

If a combination of navigational aids has been determined to be an INS as per 4.1.4, one of the following INS categories applies.

4.1.7 INS(A)

The requirements of this standard for *INS(A)* (see Clause 5) are applicable to any *INS* that provides the minimum functional requirements of the *INS*, including a consistent common reference system. (MSC 86(70) Annex 3, 2.3.1). The *INS(A)*, as a minimum, provides the information of position, speed, heading and time, each clearly marked with an indication of integrity (MSC.86(70), 4.1.7).

4.1.8 INS(B)

The requirements of this standard for *INS(B)* (see Clause 6) are applicable to any *INS* that, in addition to the functional requirements of *INS(A)*, provides the information needed for decision support in avoiding hazards (MSC 86(70) Annex 3, 2.3.2). The *INS(B)* automatically, continually and graphically indicates the ship's position, speed and heading and, where available, depth (see note) in relation to the planned route as well as to known and detected hazards (MSC.86(70), 4.1.8).

An *INS(B)* is any *INS* that includes a (geo-) graphical display for decision support in avoiding hazards, such as a radar, radar plotting aid or ECDIS, if:

- the additional functionality resulting from the combination of navigational aids goes beyond the general intent as defined in the respective performance standard;
- the category *INS(C)* as per 4.1.9 does not apply.

NOTE "where available, depth" means: if an echo sounder with suitable interface is installed and in use.

4.1.9 INS(C)

The requirements of this standard for *INS(C)* (see Clause 7) are applicable to any *INS* that, in addition to the functional requirements of *INS(B)*, provide the automatic control functions of heading, track or speed (MSC 86(70) Annex 3, 2.3.3), and monitor the performance and status of these controls (MSC 86(70) Annex 3, 4.1.9).

4.1.10 Requirements for all categories

The requirements of this clause are applicable to all three categories of *INS*, except where otherwise stated. The requirements specific to *INS(A)*, *INS(B)* and *INS(C)* are detailed in Clauses 5, 6 and 7 respectively. The relevant category of the *INS* shall be declared.

4.1.11 Passage execution

The function of passage execution in an Integrated Bridge system (*IBS*), as defined by IMO in Resolution MSC.64(67) Annex 1 and related IEC 61209, may be performed by an *INS* which should at least be an *INS(B)* (MSC.86(70), 1.5).

4.1.12 Safety of navigation support

The *INS* supports safety of navigation by evaluating inputs from several independent and different sensors, combining them to provide information giving timely warnings of potential dangers and degradation of integrity of this information. Integrity monitoring is an intrinsic function of the *INS* (MSC 86(70) Annex 3, 1.3) as required by its category *INS(A)*, (B), or (C).

4.1.13 Consideration of human factors

The *INS* aims to ensure that, by taking human factors into consideration, the work load is kept within the capacities of the OOW and other mariners on the bridge in order to enhance safe and expeditious navigation and to complement the mariner's capabilities, while at the same time to compensate for their limitations (MSC 86(70) Annex 3, 1.4), as required by its category of *INS(A)*, (B) or (C).

4.2 Basic functions

4.2.1 Combination, processing and evaluation

The *INS* shall *combine, process and evaluate data from all sensors in use* (MSC 86(70) Annex 3, 4.1.5) for obtaining information of speed, heading, position and time for the purposes of the integrity evaluation specified in 4.7.

4.2.2 Mode and situation awareness

The *INS* shall *support mode and situation awareness* (MSC 86 (70) Annex 3, 1.2) and shall fulfil this requirement through functional integration, processing and display by providing:

- validated data, where possible, of all connected navigation sensors (see 4.4.3);
- the specified *INS* information and its status, including modes of operation and display;
- changes to this information and appropriate alarms and indications, as required by the *INS* category.

4.3 Functional integration

The *INS* shall *provide functional integration meeting the following requirements* (MSC 86(70) Annex 3, 4.1.16) of this subclause.

4.3.1 Multifunction display

Where a display or control is presented on a multifunction display unit then these shall be *redundantly available* (MSC 86(70) Annex 3, 4.1.16.1). The failure of a single multifunction display shall not result in the loss of a function mandated by the carriage requirements of SOLAS.

4.4 Interfacing and data exchange

Interfacing to, and from, the INS shall comply with International Standards, namely IEC 61162 series, as appropriate and applicable (MSC 86(70) Annex 3, 7) as follows:

4.4.1 Interfacing stand-alone equipment

Stand-alone equipment, for which performance standards adopted by IMO exist, when connected to the INS, shall comply with the IEC 61162 series as applicable, for data exchange and interfacing (MSC 86(70) Annex 3, 4.1.12). Where no suitable IEC 61162 interface is defined, an alternative interface may be used. Details about the available interfaces and functions supported thereby shall be included in the installation manual. Where the datum reference sentence (DTM) is received in accordance with IEC 61162-1 then it shall be evaluated and processed accordingly.

4.4.2 Plausibility checks

Received or derived data that is used or distributed by the *INS* shall be checked for plausible magnitudes of values.

Examples:

- heading of 361° is not plausible;
- magnitudes of actual velocity greater than the maximum ship's speed are not plausible (plausibility check with known parameter of ship's dynamics);
- magnitude of actual ROT greater than the maximum ship's ROT is not plausible (plausibility check with known parameter of ship's dynamics).

Data which has failed the plausibility checks shall not be used by the INS and this shall not affect functions not dependent on these data (see Table 1).

4.4.3 Validity checks

Validity of the data shall be provided for each part to be integrated (MSC 86(70) Annex 3, 4.1.16.2).

The data received, used or distributed by the INS shall be checked for validity marking by the sensor. Data that has failed the validity checks shall not be used by the INS and this shall not affect functions not dependent on these data (see Table 1).

4.4.4 Integrity of data exchange

The integrity of the data exchange within the INS shall be ensured (MSC 86(70) Annex 3, 4.1.14) (see Table 1).

4.4.5 Data output

Data output from the INS shall comply with the IEC 61162 series as applicable. The sentences specified in Annex C of this standard shall be provided. Where no suitable IEC 61162 interface is defined proprietary sentences or an alternative interface may be used. Details about the available interfaces shall be included in the installation manual.

Where interfaces with IEC 61162-1 sentences are used:

- positional information shall be transmitted in the WGS84 datum using the datum reference sentence (DTM) in accordance with IEC 61162-1;
- system data and other data checked for integrity, modified or generated by the INS shall be transmitted with the talker identifier "IN"; otherwise the talker identifier of the source shall be used.

4.5 Accuracy and performance

As a minimum, the accuracy and other properties of information shall meet the requirements of the resolutions adopted by IMO¹ for the individual navigational aids connected to or forming part of the system. Additionally the INS shall not degrade the accuracy of the data provided by the sensors (MSC 86(70) Annex 3, 4.2.4).

NOTE Other properties may include update rate, range, resolution, validity, etc. as specified in the relevant standards.

4.6 Consistent common reference system (CCRS)

The INS shall ensure that the different types of information are distributed to the relevant parts of the system, applying a 'consistent common reference system' for all types of information (MSC 86(70) Annex 3, 4.1.6).

Information from the CCRS shall be:

- referenced to same place and time;
- compensated for latency as defined in 4.6.1;
- checked for validity;
- checked for plausibility.

¹ IMO Resolutions A.529(13) and A.815(19)

The data shall be presented with a warning when it is not possible to perform the calculations required in a) and b). The data shall be marked as invalid if the tests c) or d) fail in accordance with Table 1.

The CCRS shall ensure that all parts of the INS are provided with the same type of data from the same source.

Ground velocity shall have its components (i.e. COG and SOG) derived from the same source.

Where data is presented that is not part of the CCRS, it shall be clearly identified as such.

4.6.1 Latency of data

Data latency shall be consistent with the data requirements of the individual parts (MSC 86(70) Annex 3, 4.1.13) and their relevant international standards.

4.6.2 Consistent common reference point

The INS shall use a single consistent common reference point for all spatially related information. For consistency of observed and measured ranges and bearings, the recommended reference location is the conning position.

Alternative reference locations may be used where clearly indicated or distinctively obvious.

The selection of an alternative reference point shall not affect the integrity monitoring process.

4.7 Integrity monitoring

The integrity of essential information shall be monitored and verified automatically before essential information is displayed or used (MSC 86(70) Annex 3, 4.1.11).

The integrity of data from different sensors shall be evaluated prior to distribution to other parts of the INS or to external devices (MSC 86(70) Annex 3, 4.1.5).

The INS shall provide capabilities to select the most accurate method of integrity monitoring from the available sensors.

The INS shall be capable of manual or automatic selection of sources for integrity monitoring.

A clear indication of the sources of data selected for integrity monitoring shall be provided. The INS shall be capable of accepting multiple sensor inputs for sensors providing the following data:

- heading;
- speed through water;
- EPFS position;
- time (e.g. from GNSS);
- velocity over ground (e.g. from EPFS).

Where RAIM is used for integrity monitoring, this shall be indicated.