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Maritime navigation and radiocommunication equipment and systems — Integrated navigation systems

Part 2: Modular structure for INS — Operational and performance requirements, methods of testing and required test results

National foreword

This British Standard is the UK implementation of EN 61924-2:2013. It is identical to IEC 61924-2:2012, incorporating corrigendum November 2013.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum November 2013 is indicated in the text by ⟦AC1⟩ ⟨AC1⟧.

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Maritime navigation and radiocommunication equipment and systems - Integrated navigation systems - Part 2: Modular structure for INS - Operational and performance requirements, methods of testing and required test results

(IEC 61924-2:2012)

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(CEI 61924-2:2012)

Navigations- und Funkkommunikationsgeräte und -systeme für die Seeschifffahrt - Integrierte Navigationssysteme - Teil 2: Modulare Struktur für INS - Betriebs- und Leistungsanforderungen, Prüfverfahren und geforderte Prüfergebnisse
(IEC 61924-2:2012)

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Foreword

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The text of the International Standard IEC 61924-2:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60812:2006	NOTE	Harmonized as EN 60812:2006 (not modified).
IEC 61924:2006	NOTE	Harmonized as EN 61924:2006 (not modified).
ISO 9241-12	NOTE	Harmonized as EN ISO 9241-12.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60945 + corr. April	2002 2008	Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results	EN 60945	2002
IEC 61162	Series	Maritime navigation and radiocommunication equipment and systems - Digital interfaces	EN 61162	Series
IEC 61162-1	2010	Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners	EN 61162-1	2011
IEC 61162-2	-	Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 2: Single talker and multiple listeners, high-speed transmission	EN 61162-2	-
IEC 61162-3	-	Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 3: Serial data instrument network	EN 61162-3	-
IEC 61162-450	-	Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 450: Multiple talkers and multiple listeners - Ethernet interconnection	EN 61162-450	-
IEC 61174	2008	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	EN 61174	2008
IEC 62065	2002	Maritime navigation and radiocommunication equipment and systems - Track control systems - Operational and performance requirements, methods of testing and required test results	EN 62065	2002
IEC 62288	2008	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	EN 62288	2008
IEC 62388	2007	Maritime navigation and radio-communication equipment and systems - Shipborne radar - Performance requirements, methods of testing and required test results	EN 62388	2008
IEC 62616 + corr. August	2010 2012	Maritime navigation and radiocommunication equipment and systems - Bridge navigational watch alarm system (BNWAS)	EN 62616	2010

Publication	Year	Title	EN/HD	Year
ISO 11674	2006	Ships and marine technology - Heading control systems	-	-
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/ICAO	-	International Aeronautical and Maritime Search and Rescue Manual (IAMSAR Manual) Volume 3	-	-
IMO MSC/ Circular 982	-	Guidelines on ergonomic criteria for bridge equipment and layout	-	-
IMO MSC.191(79)	-	Performance standards for the presentation of navigation-related information on shipborne navigational displays	-	-
IMO MSC.232(82)	-	Adoption of the revised performance standards for electronic chart display and information systems (ECDIS)	-	-
IMO MSC.252(83)	-	Performance Standards for Integrated Navigation Systems (INS)	-	-
IMO MSC.302(87)	-	Performance standards for Bridge Alert Management (BAM)	-	-

CONTENTS

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – INTEGRATED NAVIGATION SYSTEMS –

Part 2: Modular structure for INS – Operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61924 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.252(83). 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.

NOTE 1 IEC 61924:2006 specifies the minimum requirements for the design, manufacture, integration, methods of testing and required test results for an integrated navigation system to comply with the earlier IMO requirements of Resolution MSC 86(70), Annex 3. Integrated navigation systems in accordance with IEC 61924:2006 are not suitable for installation after 1 January 2011.

NOTE 2 All text of this standard, whose wording is identical to that in IMO Resolution MSC.252(83) will be printed in *italics* and the Resolution and paragraph number indicated between brackets.

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 61162 (all parts), *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

IEC 61162-1:2010*, 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 61162-3, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 3: Serial data instrument network*

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

IEC 61174:2008, *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 62065:2002, *Maritime navigation and radiocommunication equipment and systems – Track control systems – Operational and performance requirements, methods of testing and required test results*

IEC 62288:2008, *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 62388:2007, *Maritime navigation and radiocommunication equipment and systems – Shipborne radar – Performance requirements, methods of testing and required test results*

IEC 62616:2010, *Maritime navigation and radiocommunication equipment and systems – Bridge navigational watch alarm system (BNWAS)*

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/ICAO, *International Aeronautical and Maritime Search and Rescue Manual (IAMSAR Manual) Volume 3*

IMO MSC/Circ.982*, Guidelines on ergonomic criteria for bridge equipment and layout*

IMO MSC.191(79*), Performance standards for presentation of navigation-related information on shipborne navigational displays*

IMO MSC.232(82), *Revised performance standards for Electronic Chart Display and Information Systems (ECDIS)*

IMO MSC.252(83), *Performance Standards for Integrated Navigation Systems (INS)*

IMO MSC.302(87), *Performance standards for Bridge Alert Management (BAM)*

ISO 11674:2006, *Ships and marine technology – Heading control systems*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

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
aggregated alert
alert indicating the existence of multiple individual alerts of the same kind

3.1.4
aid to navigation
AtoN
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

3.1.5
alarm
the highest priority of an alert as defined in MSC.252(83). Announcing a situation or *condition requiring immediate attention*, decision *and* if necessary *action by the bridge team, to maintain the safe navigation of the ship*

3.1.6
alert
announcing abnormal situations and conditions requiring attention, decision and/or action. *Alerts are divided in three priorities: alarms, warnings and cautions*

3.1.7
alert announcements
visual and where applicable *acoustical presentation of alerts*

3.1.8
alert history list
accessible list of past alerts

3.1.9
alert management
concept for the harmonized regulation of the monitoring, handling, distribution and presentation of alerts on the bridge

3.1.10
announcement
visual and/or audible signal issued to the user by the system

3.1.11
automatic control functions
functions that include automatic heading, and/or track and/or speed control or other navigation related automatic control functions

3.1.12
backup
use of data, function and/or hardware of similar type and quality

3.1.13
Category A alerts
alerts where graphical e.g. radar, ECDIS, information at the task station directly assigned to the function generating the alert is necessary, as decision support for the evaluation the alert related condition

3.1.14
Category B alerts
alerts where no additional information for decision support is necessary besides the information which can be presented at the central alert management HMI

3.1.15
caution
lowest priority of an alert. Raising bridge team's *awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information*

3.1.16
collision avoidance
navigational task of detecting and plotting other ships and objects to avoid collisions

3.1.17
configuration in use
sub-systems (e.g. sensors and sources, MFD workstations, automatic control function, etc.) selected for use and tasks (e.g. collision avoidance, route monitoring, etc.) selected operative in each MFD

Note 1 to entry: This is a subset of the available configuration which is a subset of the complete system configuration.

3.1.18
conning position
place on the bridge with a commanding view and which is used by navigators when commanding, manoeuvring and controlling a ship

3.1.19
consistent common reference point
CCRP
location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge

3.1.20
consistent common reference system
CCRS
sub-system or function of an INS for acquisition, processing, storage, surveillance and distribution of data and information providing identical and obligatory reference to sub-systems and subsequent functions within an INS and to other connected equipment, if available

Note 1 to entry: Examples of reference are: coordinate system, time zone, chart datum and depth datum.

3.1.21
degraded condition
reduction in system functionality resulting from failure

3.1.22
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

3.1.23
entry field
location on a display for the input of data by the operator

Note 1 to entry: The requested information is usually alphanumeric.

3.1.24
essential functions
indispensable functions to be available as required for the relevant operational use

3.1.25
essential information
indispensable information to be available as required for the relevant functions

3.1.26
expected precision
deviation between the measured value and the true value that is normally not exceeded by a typical system

3.1.27
external safety related messages
data received from outside of the ship concerning the safety of navigation, through equipment listed in SOLAS chapter V and/or NAVTEX

3.1.28
failure analysis
logical, systematic examination of an item, including its diagrams or formulas, to identify and analyse the probability, causes and consequences of potential and real failures

3.1.29
fallback
use of data, function or hardware of degraded quality in relation to the failed one, e.g. dead reckoning for position information, heading control in case of a failure of track control

3.1.30
functionality
ability to perform an intended function

Note 1 to entry: The activity of performing a function normally employs a system of displays, controls and instrumentation.

3.1.31
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

3.1.32
human factor
workload, capabilities and limits of a user trained according to the regulations of the IMO

3.1.33
human machine interface
HMI
the part of a system an operator interacts with. The interface is the aggregate of means by which the users interact with a machine, device, and system (the system). The interface provides means for input, allowing the users to control the system and output, allowing the system to inform the users

3.1.34
indication
display of regular information and conditions, not part of alert management

3.1.35
integrated navigation system
INS
a composite navigation system which performs at least the following tasks: collision avoidance, route monitoring thus providing "added value" for the operator to plan, monitor and

safely navigate the progress of the ship. The INS allows meeting the respective parts of SOLAS regulation V/19 and supports the proper application of SOLAS regulation V/15

3.1.36
inspection
visual check of equipment or documentation

3.1.37
instance
unit/module on functional level which can generate, process and/or present alerts

3.1.38
integrity
ability of the INS to provide the user with information within the specified accuracy in a timely, complete and unambiguous manner, and alerts within a specified time when the system should be used with caution or not at all

3.1.39
integrity monitoring
ability of a system to provide the user with information within the specified accuracy in a timely, complete and unambiguous manner, and to present warnings and indications within a specified time when the system should be used with caution or not at all

3.1.40
known hazard
hazard retrieved from a database (including navigational charts and nautical publications) or manually input and which is available to the INS

3.1.41
latency
time interval between an event and its result, including time for reception, processing, transmission and display

3.1.42
leg
ship's intended ground track between two waypoints

3.1.43
man-over-board mode
MOB
display mode for operations and actions of a ship after a Man-over-board accident happened (release of safety equipment, e.g., life buoy and life belt, performance of a return manoeuvre etc.)

3.1.44
manufacturer
organisation responsible for the production of all or some of the parts of the INS, including the responsibility that these parts meet their appropriate international standards

Note 1 to entry: A manufacturer may also be the system integrator.

3.1.45
marking
visual or logical indication of the status of displayed or transferred information

3.1.46
mode
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 and/or its sensors

3.1.47
mode awareness
the 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

3.1.48
multifunction display
MFD
a single visual display unit that can present, either simultaneously or through a series of selectable pages, information from more than a single function of an INS

3.1.49
navigation
process of planning, executing, monitoring and recording the progress of a safe and expeditious voyage of a vessel

3.1.50
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

3.1.51
navigation control data
task that provides information for the manual and automatic control of the ship's movement on a task station

3.1.52
one equipment concept
the equipment which is recognized as one type of equipment by integrating the function of mandatory equipment of SOLAS of a plural number

Note 1 to entry: This is the concept by which single equipment may be recognized as integrating the functions of a plurality of IMO performance standards for which mandatory SOLAS carriage requirements apply.

3.1.53
operational modes
modes of operation depending on the sea area

3.1.54
operational/functional modules
modules comprising the operational/functional requirements for navigational systems

3.1.55
part
individual INS subsystem, equipment or functional module

3.1.56
partial integrations
smaller integrations which are not covering the tasks "route monitoring" and "collision avoidance"

3.1.57
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

3.1.58
performance check
functional check to show that the system or component is still operational without investigating all details of its functionality

3.1.59
plausibility of data
the quality representing if data values are within the normal range for the respective type of data

3.1.60
processing
event that an instance in the system with additional knowledge is monitoring incoming alerts and is aggregating or revaluating those alerts via a command action

Note 1 to entry: Processing describes a system-released activity not an operator activity. An operator triggered acknowledgement in this context is not "processing".

3.1.61
primary navigation data
data of own ship's position, speed through water, speed over ground, course over ground, heading, time and if available, depth, provided by selected sensors, to be used in the system for processing the navigational information

3.1.62
redundancy
use of data, function or hardware of equal type and quality

3.1.63
responsibility transferred
alert state which represents the result of a harmonized risk evaluation between an individual alert originator (e.g. sensor) and a function within the INS with system knowledge and alert revaluation capabilities (e.g. CCRS)

Note 1 to entry: The harmonized risk evaluation does not change the priority of the original alert at the originator.

Note 2 to entry: Requirements for unambiguity of alert states and for consistent presentation are given within this standard.

3.1.64
responsibility transfer
transition of the state of an alert to the state “responsibility transferred”

3.1.65
route
representation of a voyage or passage geographically defined by a point of departure, a point of arrival and usually by intermediate waypoints

Note 1 to entry: The route may include time of departure and/or ship's speed as well as parameters and limits for safe navigation such as off-track/cross-track limit, turn radius, time references, etc. as defined in IMO Resolution A.893(21).

3.1.66
route monitoring
the navigational task of continuous surveillance of own ships position in relation to the pre-planned route and the waters

3.1.67
safety related automatic functions
automatic functions that directly impinge on hazards to ship or personnel, e.g., target tracking

3.1.68
search and rescue mode
display mode for operations of a ship involved in search and rescue actions

3.1.69
selected route or track
route or track which has been chosen for monitoring the performance of the navigation

Note 1 to entry: The term “track” is typically used for systems that have automatic track control capability.

3.1.70
sensor
a navigational aid (measuring device), with or without its own display, processing and control as appropriate, automatically providing information to operational systems or INS

3.1.71
sensor/source modules
modules comprising the sensor/source requirements

3.1.72
ship’s primary movement
the longitudinal directional, lateral directional and heading-rotational movement of the ship

3.1.73
simple operator action
a procedure achieved by no more than two hard-key or soft-key actions, excluding any necessary cursor movements, or voice actuation using programmed codes or equivalent alternative means

3.1.74
single operator action
a procedure achieved by no more than one hard-key or soft-key action, excluding any necessary cursor movements, or voice actuation using programmed codes, or equivalent alternative means

3.1.75
situation awareness
the mariner’s perception of the navigational and technical information provided, the comprehension of their meaning and the projection of their status in the near future, as required for timely reaction to the situation. Situation awareness includes mode awareness

3.1.76
source
a device, or location of generated data or information (e.g. chart database), which is part of the INS automatically providing information to INS

3.1.77
system alerts
alerts related to equipment failure or loss (system failures)

3.1.78
system data
data that is used by the system for the processing and display of essential information

Note 1 to entry: System data of the same type is from a similar type of source. System data, at least for primary navigation data, has been checked for integrity.

3.1.79
system function
navigational tasks of an INS such as route planning, route monitoring, collision avoidance, navigation control data, status and data display, and alert management

3.1.80
system integrator
the organization responsible for ensuring that the INS complies with the requirements of this standard

3.1.81
system position
position calculated in the INS out of at least two positioning sensors

3.1.82
task station
multifunction display with dedicated controls providing the possibility to display and operate any navigational tasks. A task station is part of a workstation.

3.1.83
track
path to be followed over ground

3.1.84
track control
control of the ship movement along a track in conformance with MSC 74(69) Annex 2

3.1.85
validity

property of information as conforming to specified criteria, and the marking of information such as being “valid” or “invalid” (i.e. “good” or “no good”) for its intended use

3.1.86
vessel
water craft of any description, including non-displacement craft, wing in ground craft and seaplanes, used or capable of being used as a means of transportation on water

3.1.87
voyage
execution of all aspects of the operation of a craft in journeying from the point of departure to the final destination

Note 1 to entry: A voyage may consist of one or more passages.

3.1.88
warning
announcing a situation or *condition requiring attention but no-immediate attention or action by the bridge team. Warnings are presented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so, if no* forward-looking decision is made or *action is taken*

3.1.89
waypoint
geographically defined position used as reference for navigation along a leg, track or route

3.1.90
workstation
the combination of all job-related items, including the console with all devices, equipment and the furniture, to fulfil certain tasks. Workstations for the Bridge are specified in MSC/Circ.982

3.2 Abbreviations

BAM Bridge Alert Management
CAM Central Alert Management
EBL Electronic Bearing Line
ETA Estimated Time of Arrival
ETD Estimated Time of Departure
EUT Equipment Under Test
FMEA Failure Mode and Effect Analysis
IMO International Maritime Organization
IEC International Electrotechnical Commission
ISO International Organization for Standardization
MSC Maritime Safety Committee
OOW Officer Of the Watch
PS Performance Standards
SMCP Standard Marine Communication Phrases
SOLAS Safety Of Life At Sea
VRM Variable Range Marker

4 MSC resolutions

4.1 General

The following resolutions made it necessary to supply this standard.

(MSC.252(83)/2.1.1) *An INS comprises navigational tasks such as "Route planning", "Route monitoring", "Collision avoidance", "Navigation control data", "Navigation status and data display" and "Alert management", including the respective sources, data and displays which are integrated into one navigation system. These tasks are described in* 7.2.

(MSC.252(83)/2.1.2) *An INS is defined as such if work stations provide multifunctional displays integrating at least the following navigational tasks/functions:*

- *"Route monitoring"*
- *"Collision avoidance"*

and may provide manual and/or automatic navigation control functions.

(MSC.252(83)/2.1.3.1) *An alert management is a part of the INS. The scope and the requirements of the alert management are specified in module C* (Clause 8).

NOTE IMO in 2010 adopted new performance standards for Bridge Alert Management in Resolution MSC.302(87). This resolution states in paragraph 3.6 that it shall take precedence over the requirements of MSC.252(83). Where applicable the requirements of MSC.302(87) are considered and marked with a note.

(MSC.252(83)/2.1.3.2) *The presentation of navigation control data for manual control* as specified in 7.2.5.2 of this standard *is part of the INS.*

(MSC.252(83)/2.1.4) *Other navigational tasks/functions may also be integrated in the INS.*

(MSC.252(83)/2.2.1) *The tasks are allocated to, and operated by the operator on, a defined set of multi-functional "task stations".*

(MSC.252(83)/2.2.2) *The scope of an INS may differ dependent on the number and kind of tasks integrated.*

(MSC.252(83)/2.2.3) *Configuration, use, operation and display of the INS is situation-dependent on:*

- ship *underway, at anchor, and moored,*
- *manual and automatic navigation control in different waters,*
- *planned routine navigation and special manoeuvres.*

4.2 Purpose of integrated navigation systems

The following considerations, based on Resolution MSC.252(83), are dealt with in this standard.

(MSC.252(83)/1.1) *The purpose of integrated navigation systems (INS) is to enhance the safety of navigation by providing integrated and augmented functions to avoid geographic, traffic and environmental hazards.*

(MSC.252(83)/1.2) *By combining and integrating functions and information the INS provides "added value" for the operator to plan, monitor and/or control safety of navigation and progress of the ship.*

(MSC.252(83)/1.3) *Integrity monitoring is an intrinsic function of the INS. The INS supports safety of navigation by evaluating inputs from several sources, combining them to provide information giving timely alerts of dangerous situations and system failures and degradation of integrity of this information.*

(MSC.252(83)/1.4) *The INS presents correct, timely, and unambiguous information to the users and provides subsystems and subsequent functions within the INS and other connected equipment with this information.*

(MSC.252(83)/1.5) *The INS supports mode and situation awareness.*

(MSC.252(83)/1.6) *The INS aims to ensure that, by taking human factors into consideration; the workload is kept within the capacity of the operator 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.252(83)/1.7) *The INS aims to be demonstrably suitable for the user and the given task in a particular context of use.*

(MSC.252(83)/3.1.1) *The purpose of these performance standards is to support the proper and safe integration of navigational functions and information.*

(MSC.252(83)/3.1.2) *The purpose is in particular:*

- *to allow the installation and use of an INS instead of stand-alone navigational equipment onboard ships; and*
- *to promote safe procedures for the integration process;*

both for

- *comprehensive integration; and*
- *partial integration,*

of navigational functions, data and equipment.

(MSC.252(83)/3.1.3) *These standards supplement for INS functional requirements of the individual Performance Standards adopted by the* IMO*.*

4.3 Application

The following considerations concerning the application have been included in this standard.

(MSC.252(83)/3.2.1) *These performance standards are applicable to systems where functions/equipment of at least the navigational tasks mentioned in (MSC.252(83)/2.1.2) are combined.*

(MSC.252(83)/3.2.2) *If further tasks are integrated, the requirements of these standards should apply to all additional functions implemented in the INS.*

(MSC.252(83)/3.3.1) *These performance standards are based on a modular concept which should provide for individual configurations and for extensions, if required.*

(MSC.252(83)/3.3.2) *These standards contain four modules:*

- *Module A* (Clause 6) *for the requirements for the integration of navigational information,*
- *Module B* (Clause 7) *for the operational/functional requirements for INS based on a task-related structure,*
- *Module C* (Clause 8) *for the requirements of the Alert management, and*
- *Module D* (Clause 9) *for the Documentation requirements.*

(MSC.252(83)/3.4.1) *Modules A* (Clause 6) *, C* (Clause 8)*, D* (Clause 9) *and* 7.1, 7.3, 7.8, *of Module B* (Clause 7) *are applicable for any INS.*

(MSC.252(83)/3.4.2) *Additionally, for each task integrated into the INS, the INS should fulfil both:*

- *the requirements of the respective tasks as specified in module B and*
- *the relevant modules of performance standards for stand-alone equipment as specified in Table 1.*

Table 1 – Applicable modules of performance standards of stand alone equipment

INS Tasks and functions (Sub-clauses of this standard)	***Additionally applicable modules of specific equipment standards for task integrated into the INS. The modules are specified in the appendices of these performance standards, if not specified in the equipment standards.***
Collision avoidance (7.2.4)	*Radar PS (Res. MSC.192(79)) (Modules specified in Annex* A*)* *Module A: "Sensor and Detection"* *Module B: "Operational requirements"* *Module C:" Interfacing"*
Route planning (7.2.2) *Route monitoring (7.2.3)*	*ECDIS PS (Res. MSC.232(82))* *Module A: "Database"* *Module B: "Operational and functional requirements"*
Track control (7.2.5.3 and 7.3.2, 7.3.3)	*Track Control PS Res. MSC.74(69), Annex 2 (See Clause A.2*). *Module B: "Operational and functional requirements"*

(MSC.252(83)/3.5.1) *These standards may allow for accepting INS to substitute for some carriage requirements of navigational equipment as equivalent to other means under SOLAS regulation V/19. In this case, the INS should comply with:*

- *these performance standards; and*
- *for the relevant tasks of these performance standards, with the applicable modules of the equipment performance standards as specified in Table 2.*

Table 2 – Applicable modules of other standards for INS to substitute for individual equipment

Allow for accepting the INS as	***INS in compliance with***	
	Tasks and functions (*Subclauses *of this standard)	***Applicable modules of specific equipment standards as specified in the Appendices of the document***
Radar system	*Collision avoidance* (7.2.4)	*Radar PS (Res. MSC.192(79))* *(Modules specified in* Annex A*)* *Module A: "Sensor and Detection"* *Module B: "Operational requirements"* *Module C:"Design and Technical requirements"*
ECDIS	*Route planning* (7.2.2) *Route monitoring* (7.2.3)	*ECDIS PS (Res. MSC.232(82))* *Module A: "Database"* *Module B: "Operational and functional requirements"*
Heading control system (HCS)	*Navigation control data* (7.2.5) *or Navigation status and data display* 7.2.7.	*Res. A.342, as amended – MSC.64(67),* *Annex 3*
Track control system, (TCS)	*Navigation control data and track control* (7.2.5.3 and 7.3.2, 7.3.3)	*Track Control Res. MSC.74(69), Annex 2 (Modules specified in* Annex A*)* *Module B: "Operational and functional requirements"*
Presentation of AIS data	*Collision avoidance* (7.2.4) *Navigation control data* (7.2.5)	*MSC.74 (69), Annex 3*
Echo sounding system	*Route monitoring* (7.2.3)	*MSC.74(69), Annex 4*

Allow for accepting the INS as	***INS in compliance with***	
	Tasks and functions (*Subclauses *of this standard)	***Applicable modules of specific equipment standards as specified in the Appendices of the document***
EPFS	*Navigation control data* (6.2.5) *or Navigation status and data display* (7.2.7)	*GPS Res. A.819(19), as amended,* *MSC.112(73)* *or GALILEO, Res. MSC.233(82)* *or GLONASS, Res. MSC.53(66), as amended MSC.113(73)*
SDME	*Navigation control data* (7.2.5) *or Navigation status and data display* (7.2.7)	*Res. MSC.96(72)*
NOTE Additional equipment not listed above can be included into the INS.		

NOTE (MSC.252(83)/3.7.1) *The workstation design, layout and arrangement is not addressed in this performance standards, but in MSC/Circ.982.* Guidance on familiarisation documentation is given in Annex B.

5 Test requirements and results

5.1 General

The manufacturer shall declare the equipment to be tested and the tasks and functions that it performs. The equipment under test (EUT) shall be installed in compliance with the manufacturer's installation manual. Where equipment is divided the entire configuration shall be tested together.

The manufacturer shall declare the

- physical parts involved,
- location of tasks and functions,
- general data flow between physical and/or logical parts,
- dependencies between tasks and functions.

NOTE Typical examples are hardware overviews down to the lowest replaceable unit, block diagrams or high functional level software descriptions.

5.2 Exceptions for tests previously performed

Where parts of an INS have been tested and documented as meeting individual International Standards (for example through individual type approvals), there is no requirement to repeat such testing. In such cases, corresponding documentation (for example certificates, test reports) shall be provided.

5.3 Test site

Unless otherwise stated all tests in this standard are to be executed in a laboratory environment with a simulator arrangement.

A simulator arrangement with the following characteristics is required:

- capable of providing position, speed, heading, time and depth simultaneously from multiple sources including different sensor locations;
- capable of simulating own ship manoeuvres;
- capable of simulating failures in sensors and sources (see Annex C);

- capable of simulating corrupt and implausible data;
- capable of simulating disturbances and jumps within and between sensors;
- capable of simulating set and drift;
- capable of simulating AIS targets and other AIS messages;
- capable of simulating radar collision avoidance scenarios as target scenario simulator defined in IEC 62388;
- capable to perform the testing according the individual equipment testing requirements if testing of equipment is required for this standard (see Annex A).

The resolution and accuracy of the simulated signals shall be in accordance with the applicable International Standards. The output signals shall comply with IEC 61162 and with the types of interfaces supported by the EUT according to the manufacturer's declarations.

5.4 Methods of test

This standard is organized so that each group of requirements is immediately followed by a clause identifying the method(s) of test. The test terminology is derived from ISO 9241-12 on test of visual displays. Guidance on testing is provided in Annex G.

6 Module A – Requirements for integration of navigational information

6.1 Interfacing and data exchange

6.1.1 Combination, processing and evaluation of data

6.1.1.1 Requirement

As a minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.1.1) *An INS* shall *combine, process and evaluate data from connected sensors and sources*.

6.1.1.2 Methods of test and required results

Covered by tests in 6.1.2 to 6.7.

6.1.2 Availability, validity and integrity

6.1.2.1 Requirement

As a minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.1.2) *The availability, validity and integrity of data exchange within the INS and from connected sensors and sources* shall *be monitored.*

Unavailable data shall be detected and indicated within a time period which is related to the process requirements and described in the manufacturer's documentation.

6.1.2.2 Methods of test and required results

Refer to manufacturer's documentation about data exchange within the INS and from connected sensor/sources. Select randomly 5 examples and confirm by observation that unavailable data is detected and indicated.

Tests for validity and integrity are covered by 6.3.1 and 6.5.

6.1.3 Failure of data exchange

6.1.3.1 Requirement

(MSC.252(83)/5.1.3) *A failure of data exchange* shall *not affect any independent functionality.*

6.1.3.2 Methods of test and required results

Test for failure of data exchange is covered by 7.6.1.2.

6.1.4 Interfaces in general

6.1.4.1 Requirement

(MSC.252(83)/5.1.4) *Interfacing to, from, and within the INS* shall *comply with international standards for data exchange and interfacing as appropriate.*

NOTE Information flowing within the EUT may contain proprietary data.

The INS shall support the IEC 61162 series interfaces as given in Annex F as a minimum. In addition, suitable alternative input or output interfaces may be used.

6.1.4.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that all standard input and output interfaces as given in Annex F are present. Confirm by observation that at least every required sentence in Annex F is checked once to conform to the IEC 61162 series and that every physical interface conforms to the IEC 61162 series.

6.1.5 Interface to alert management

6.1.5.1 Requirement

(MSC.252(83)/5.1.5) *The interface(s)* shall *comply with the interface requirements of the alert management as described in Module C* (Clause 8) *of these performance standards.*

6.1.5.2 Methods of test and required results

See 8.9 and 8.10.

6.2 Accuracy

6.2.1 Requirement

(MSC.252(83)/5.2.1) *INS data* shall *comply with the accuracy and resolution required by applicable performance standards of the* IMO (See Table 2).

The accuracy and resolution of data derived within INS i.e. within the CCRS, distributed within INS and provided by INS shall not be degraded below applicable performance standards of the IMO.

6.2.2 Methods of test and required results

Confirm by observation that data in the following list is correct to the specified resolution when displayed within the EUT and when available in output interfaces of the EUT:

- latitude and longitude with at least 3 decimals resolution for minutes;
- speed through water and speed over ground with at least 1 decimal resolution for knots;
- heading with at least 1 decimal resolution for degrees;

- time with at least 1 second resolution;
- depth with at least 1 decimal resolution for metres.

6.3 Validity, plausibility, latency

6.3.1 Validity

6.3.1.1 Requirement

(MSC.252(83)/5.3.1.1) *Data failing validity checks* shall *not be used by the INS for functions dependent on these data, unless for cases where the relevant performance standards specifically allow use of invalid data. There* shall *be no side effects for functions not depending on this data.*

(MSC.252(83)/5.3.1.2) *When* CCRS output *data used by the INS for a function becomes invalid, or unavailable,* at least *a warning* shall *be given.* Higher priority alerts shall be given where required, see 8.3.2.1 and Table C.2 (classification of the alerts).

When CCRS output *data not actually in use by the INS becomes invalid, or unavailable, this* shall *be indicated at least as a caution.* Loss of data which requires attention and which does not result in a hazardous situation shall lead into a caution i.e. data is redundantly available or only used for display reasons, see 8.3.2.1.

When input data from sensor or source used by CCRS becomes invalid, or unavailable, this shall be indicated as a caution.

Validity checks shall include the evaluation of relevant empty data fields, status or mode fields (e.g. states, modes and qualities such as "valid", "invalid", “simulation”, “manual input”, “estimated (dead reckoning)”, “no fix”, “standby”).

6.3.1.2 Methods of test and required results

Refer to manufacturer’s documentation to identify 8 cases in which the EUT evaluates input data as invalid based on relevant empty data fields or content of status, mode or quality fields. Confirm by observation that the EUT provides at least a caution to indicate invalid data.

Refer to the manufacturer’s FMEA documentation (see 9.3.1) to identify whether the EUT has any capability to use data failing validity checks. If such invalid data are used, check that the relevant performance standards specifically allow use of that data and confirm by analytical evaluation that such functionality does not cause side effects for functions not depending of this data.

Confirm by observation that when input data from sensor or source used by CCRS becomes invalid, or unavailable, then EUT provide a caution within a time period which is related to the process requirements and described in the manufacturer’s documentation.

Refer to the manufacturer’s FMEA documentation to identify 2 cases in different functions in which invalid, or unavailable, CCRS output data selected for use by the EUT causes changed conditions which require immediate attention but which are not immediately hazardous. Confirm by observation that the EUT provides a warning within a time period which is related to the process requirements and described in the manufacturer’s documentation.

Refer to the manufacturer’s FMEA documentation to identify 2 cases in different functions in which invalid, or unavailable, CCRS output data selected for use by the EUT will not result in any hazardous situation. Confirm by observation that the EUT provides a caution within a time period which is related to the process requirements and described in the manufacturer’s documentation.

Refer to the manufacturer's FMEA documentation to identify 2 cases in different functions in which invalid, or unavailable, CCRS output data is not selected for use by the EUT. Confirm by observation that the EUT provides a caution within a time period which is related to the process requirements and described in the manufacturer's documentation.

If the EUT includes automatic control functions refer to the manufacturer's FMEA documentation to identify 2 cases in each automatic control function in which invalid, or unavailable, CCRS output data selected for use by the EUT may cause a situation requiring immediate attention, decision and if necessary action to avoid any kind of hazardous situation (e.g. loss of essential information used by an automatic control function). Confirm by observation that the EUT provides an alarm within a time period which is related to the process requirements and described in the manufacturer's documentation.

6.3.2 Plausibility

6.3.2.1 Requirement

(MSC.252(83)/5.3.2.1) *Received or derived data that is used or distributed by the INS* shall *be checked for plausible magnitudes of values.*

Two kinds of checks for plausible magnitudes shall be carried out.

- Checks that a value is within plausible range.
- Checks that operative modes or states are matching when they are reported by more than one sentence from a single sensor/source or function (e.g. GGA and VTG sentences reporting equal operative states of a single EPFS).

(MSC.252(83)/5.3.2.2) *Data which has failed the plausibility checks* shall *not be used by the INS and* shall *not affect functions not dependent on these data.*

If data are not passing the plausibility check they are considered as "invalid" and will be treated as described in 6.3.1.

6.3.2.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that input data which are used by the INS and its tasks and functions have defined plausible ranges and defined matching criteria for operative modes and states.

Confirm by observation that data not passing the plausibility check is not used by the INS.

6.3.3 Latency

6.3.3.1 Requirement

(MSC.252(83)/5.3.3.1) *Data latency (timeliness and repetition rate of data) within the INS* shall *not degrade the functionality specified in the relevant performance standards.*

6.3.3.2 Methods of tests and required results

Refer to manufacturer's documentation to identify the allowed latency for each task and function within the EUT. Confirm by analytical evaluation of manufacturer's documentation that the manufacturer has identified all cases for which the latency may be an issue when fulfilling the relevant performance standards.

Refer to manufacturer's documentation to identify 3 cases within the INS for which latency is important. Confirm by observation that data latency does not degrade the functionality specified within the relevant performance standards.

6.4 Consistent common reference system (CCRS)

6.4.1 Consistency of data

6.4.1.1 Requirement

As a minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.4.1.1) *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.252(83)/5.4.1.2) *Details of the source and the method of processing of such data* shall *be provided for further use within INS.*

(MSC.252(83)/5.4.1.3) *The CCRS* shall *ensure that all parts of the INS are provided with the same type of data from the same source* and all parts of the INS apply the provided data.

NOTE Same type from same source means equal value and equal origin. For performance reasons the EUT may have parallel data distribution paths for different uses with different update rates (see Annex E). The CCRS principle is what is described in the definition of the CCRS (3.1.20).

Connected data such as latitude+longitude, COG+SOG and set+drift shall originate from same source.

6.4.1.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that

- the EUT uses the CCRS principle to distribute navigation data to all relevant parts of the system,
- all relevant parts of the system apply the distributed data based on the CCRS principle,
- details of the source and the method of processing of such data are provided for further use within INS.

Confirm also by observation that the above is true at least for primary navigational data.

Refer to manufacturer's documentation to identify whether parallel data distribution paths have been implemented. If implemented, confirm by observation that parallel distribution paths have methods to ensure that all part of the INS receive the same data from the same source.

Confirm by observation that all connected data such as latitude+longitude, COG+SOG and set+drift originate from the same source.

6.4.2 Consistent common reference point (CCRP)

6.4.2.1 Requirement

(MSC.252(83)/5.4.2.1) *The INS* shall *use a single consistent common reference point for all spatially related information. For consistency of measured ranges and bearings, the recommended reference location* shall *be 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.*

The integrity monitoring process within the INS is related to a single consistent common reference point to get correct results.

Alternative reference locations may be used for local display, calculation and measurements. Affected information shall be clearly indicated or distinctively obvious. This information shall not be distributed outside the system.

If provided, performance of any automatic control function shall not be adversely affected by selection of alternative reference locations.

Location of the CCRP shall be provided to equipment outside of the INS (see POS sentence in Annex F).

NOTE 1 An example of a temporarily specified alternative reference location may be the reference for radar presentation (CCRP versus radar antenna position).

NOTE 2 An example of a permanently assigned alternative reference location may be the location used by track control (ship specific installation parameter).

6.4.2.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that:

- installation process supports the CCRP concept e.g. the installation manual includes description of offset adjustments for connected sensors providing spatially related data;
- recommendation is available in the installation manual that the conning position is used for the CCRP.

Confirm by observation of the results according to Annex H that:

- calculation of information from the relevant sensors to the consistent common reference point is made correctly for CCRS outputs (see Annex F), EBL, VRM, AIS targets, course and speed;
- if an alternative reference location is provided, observe that, when used, the affected information is clearly indicated or distinctively obvious;
- if any automatic control function is provided and if an alternative reference location is provided, confirm by observation for each automatic control function that upon changing reference location the performance of the automatic control function is not adversely affected.

Select the CCRP as the reference location on all workstations. Confirm by observation that the following items within the EUT are presented using the same reference point:

- own ship's position;
- EBL, VRM, cursor and range rings;
- target range and bearing;
- closest point of approach (CPA);
- time to closest point of approach (TCPA);
- parallel index lines;
- course over ground;
- speed (speed over ground and speed through water).

In above condition confirm by observation that all other items within the EUT are presented using either:

- the same reference point as above; or
- a permanently assigned alternative reference location that is clearly indicated or distinctively obvious.

If provided, select a temporarily specified alternative reference point as the reference location on a single task station. Confirm by observation that the following items within the task station are presented using the same reference point:

- own ship's position;
- EBL, VRM, cursor and range rings;
- target range and bearing;
- closest point of approach (CPA);
- time to closest point of approach (TCPA);
- parallel index lines;
- course over ground;
- speed (speed over ground and speed through water).

In above condition confirm by observation that all other items within the task station are presented using either:

- the temporarily specified alternative reference location as above clearly indicated; or
- a permanently assigned alternative reference location that is clearly indicated or distinctively obvious.

Confirm by observation that the output data in interfaces of the EUT include the POS sentence, see Annex F, and are referenced either to the CCRP or a permanently assigned alternative reference location and not affected by selection of an alternative reference point.

6.4.3 Consistency of thresholds

6.4.3.1 Requirement

(MSC.252(83)/5.4.3.1 *The INS* shall *support the consistency of thresholds for monitoring and alert functions.*

(MSC.252(83)/5.4.3.2) *The INS* shall *ensure by automatic means that consistent thresholds are used by different parts of an INS, where practicable.*

Cross track limit threshold for monitoring route shall be common for track control (IEC 62065) and route monitoring (IEC 61174).

(MSC.252(83)/5.4.3.3) *A caution may be given when thresholds entered by the bridge team differ from thresholds set in other parts of the INS.*

6.4.3.2 Methods of test and required results

Confirm by observation that the following thresholds are consistent:

- depth below keel (IEC 61174);
- safety depth (IEC 61174);
- safety contour (IEC 61174);
- look ahead time or distance (IEC 61174);
- look ahead passing distance (IEC 61174);
- cross track limit for monitoring route is common for track control (IEC 62065) and route monitoring (IEC 61174);
- limits used for verification of monitored route against safety contour and areas or objects of interest (IEC 61174);
- CPA/TCPA (IEC 62388);

- if provided BCR/BCT (IEC 62388);
- approach time to critical point (IEC 61174);
- if provided, track control limits such as low speed, course difference, early course change indication, end of track (IEC 62065);
- if provided and activated, heading control limits such as off-heading, heading monitor (ISO 11674).

If users are allowed to select inconsistent thresholds then confirm by observation that a caution is given when a different threshold is entered into a part of EUT and that this is clearly indicated as long as a different threshold is in use.

6.5 Integrity monitoring

6.5.1 Requirement

As minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.5.1) *The integrity of data* shall *be monitored and verified automatically before being used, or displayed.*

(MSC.252(83)/5.5.2) *The integrity of information* shall *be verified by comparison of the data derived independently from at least two sensors and/or sources, if available.*

(MSC.252(83)/5.5.3) *The INS* shall *provide manual or automatic means to select the most accurate method of integrity monitoring from the available sensors and/or sources.*

(MSC.252(83)/5.5.4) *A clear indication of the sensors and sources of data selected for integrity monitoring* shall *be provided.*

(MSC.252(83)/5.5.5) *The INS* shall *provide a warning, if integrity verification is not possible or failed.*

The results of integrity monitoring shall be:

- Passed = integrity verification passed.
- Failed = integrity verification not passed.
- Doubtful = integrity verification not possible.

The system shall provide at least the following methods for integrity monitoring:

- position: comparison between two EPFS;
- position: comparison between EPFS and dead reckoning using ship’s heading and SDME;
- heading: comparison between two heading sensors.

The system shall provide at least one of the following methods for integrity monitoring:

- speed through water: comparison between two STW sensors;
- speed through water: comparison with a SOG from SDME;
- speed through water: comparison with a SOG from EPFS.

The system shall provide at least one of the following methods for integrity monitoring:

- speed and course over ground: comparison between two longitudinal/transversal ground speeds from SDME together with a heading;
- speed and course over ground: comparison with a STW sensor together with a heading sensor;

- speed and course over ground: comparison with a SOG and COG from EPFS.

The system shall provide at least one of the following methods for integrity monitoring:

- depth: comparison with a second depth sensor,
- depth: comparison with data from largest available ENC chart.

The system shall provide at least one of the following methods for integrity monitoring:

- time: comparison with a second EPFS sensor,
- time: comparison with internal clock.

The system may provide the following methods for integrity monitoring:

- heading: comparison between heading sensor and COG sensor when SOG is high enough for reliable comparison.

Other equivalent methods may be provided for integrity monitoring

(MSC.252(83)/5.5.6) *Data which fails the integrity monitoring function or data where integrity monitoring is not possible* shall *not be used for automatic control systems/functions.*

In the above cases for track control the fall-back arrangements specified in IEC 62065 for unavailable sensor data are to be followed.

If integrity monitoring of heading data or speed data is not possible the requirements of paragraph MSC.252(83)/12.7 for fallback arrangements and maintaining minimum basic operation should be followed for heading control (see 7.7.8.4). In case the integrity monitoring fails and the system is not able to determine the faulty source the operator should select the source manually.

6.5.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that each mandatory method is provided and which additional methods are available.

Confirm by observation that the EUT provides either manual or automatic means to select the most accurate method for integrity monitoring.

Confirm by observation that the EUT provides clear indication of sensors and sources of data selected for integrity monitoring.

Confirm by observation of each available method that:

- with simulated errors (disturbances, jumps) exceeding the thresholds in use the integrity monitoring works as documented by manufacturer;
- the EUT provides a warning when the result of integrity monitoring of data from sensors/sources in use is failed;
- the EUT provides a warning when integrity monitoring of data from sensors/sources in use is not possible.

If automatic control systems/functions are provided, then confirm by observation that when data fails the integrity monitoring or when integrity monitoring of data is not possible, this results in appropriate (i.e. as specified in related equipment standard) fall-back arrangements for unavailable sensor data.

6.6 Marking of data

6.6.1 Requirement

As a minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.6.1) *The data* shall *be marked with the source and the results of validity, plausibility checks and integrity monitoring to enable subsequent functions to decide whether their input data complies with their requirements or not.*

Table 3 defines the marking of data that has been checked for validity, plausibility and integrity within the INS.

Table 3 – Marking of data

Validity check	Plausibility check	Integrity monitoring	INS data marking			Remark
			Validity flag or Status flag or Mode indicator (e.g. GLL)	Plausibility status (e.g. NSR)	Integrity status (e.g. NSR)	
Fail	Fail	Not possible	Invalid	No	Failed	Data cannot be used within INS
Fail	Pass	Not possible	Invalid	Yes	Failed	Data cannot be used within INS unless relevant performance standards specifically allow use of invalid data
Pass	Fail	Not possible	Invalid	No	Failed	Data cannot be used within INS
Pass	Pass	Not possible due to lack of second sensor, source or method	Valid	Yes	Doubtful	Data cannot be used for automatic control function(s)
Pass	Pass	Fail	Valid	Yes	Failed	Data cannot be used for automatic control function(s)
Pass	Pass	Pass	Valid	Yes	Passed	Data is suitable for any use
NOTE For “data cannot be used for automatic control function(s)”, see 6.5.1.						

6.6.2 Methods of tests and required results

Confirm by observation of displays that all parts of the INS use the data as marked with source, validity, plausibility and integrity.

Confirm by observation that the sentences described in Annex I are provided.

6.7 Selection of sensors and sources

6.7.1 Requirement

As a minimum this subclause is applicable for primary navigational data.

(MSC.252(83)/5.7.1) *INS* shall *provide two user selectable sensor/source selection modes when multiple sensors/sources are available; manual sensor/source selection mode and automatic sensor/source selection mode.*

(MSC.252(83)/5.7.2) *In manual sensor/source selection mode it* shall *be possible to select individual sensors/sources for use in the INS. In case a more suitable sensor/source is available this* shall *be indicated.*

(MSC.252(83)/5.7.3) *In automatic sensor/source selection mode, the most suitable sensors/sources available* shall *be automatically selected for use in the INS. It* shall *further be possible to manually exclude individual sensors/sources from being automatically selected.* The manufacturer shall declare the criteria and procedures for selecting and deselecting the most suitable sensors/sources (see 9.1).

6.7.2 Methods of test and required results

Confirm by observation and inspection of the content of the operating manuals (see 9.1) that:

- the EUT provides two alternative methods for selection of sensors/sources to be used: manual and automatic mode;
- in manual mode an indication is provided when a more suitable sensor/source is available;
- in automatic mode the EUT automatically selects between sensors/sources according to the manufacturer's description;
- it is possible to manually exclude individual sensors/sources from being automatically selected and used.

7 Module B – Task related requirements for Integrated Navigation Systems

7.1 Description

(MSC 252/6.1) *The design of the INS should ease the workload of the bridge team and pilot in safely and effectively carrying out the navigation functions incorporated therein,* compared to an equivalent set of standalone non-integrated equipment.

(MSC 252/6.2) *The integration should provide all functions, depending of the task for which the INS is used and configured, to facilitate the tasks to be performed by the bridge team and pilot in safely navigating the ship.*

(MSC 252/6.3) *Each part of the INS should comply with all applicable requirements adopted by the IMO, including the requirements of* this standard*.*

NOTE 1 For guidance, see 4.3, Table 1 and Table 2.

(MSC 252/6.4) *When functions of equipment connected to the INS provide facilities in addition to* this standard*, the operation and, as far as is reasonably practicable, the malfunction of such additional facilities should not degrade the performance of the INS below the requirements of this standard.*

(MSC 252/6.5) *The integration of functions of individual equipment into the INS should not degrade the performance below the requirements specified for the individual equipment by the* IMO

(MSC 252/6.6) *Alerts should be generated and presented according to Module C* (Clause 8).

NOTE 2 The IMO alert requirements above may be different from the requirements available in the individual performance standards. This standard describes what to do within the EUT of the INS. If there are differences regarding alerts between individual equipment performance standards and the INS performance standard, the INS performance standard overrides the individual performance standards for the EUT of the INS.

7.2 Task and functional requirements for an INS

7.2.1 General

7.2.1.1 Requirement

(MSC 252/7.1.1) *The configuration of the INS* shall *be modular and task-oriented. The navigational tasks of an INS are classified as "Route planning", "Route monitoring", "Collision avoidance", "Navigation control data", "Status and data display" and "Alert management". Each of these tasks comprises the respective functions and data.*

(MSC 252/7.1.2) *All tasks of an INS* shall *use the same electronic chart data and other navigational databases such as routes, maps, tide information.*

(MSC 252*/7.1.3) If Electronic Navigational Charts (ENCs) are available, they* shall *be used as common data source for INS.*

(MSC 252/7.1.4) 7.2.2 to 7.2.5 *and* 7.2.7 *apply, if the respective task is integrated into the INS.*

NOTE The CCRS principle also applies to ENC charts and updates, routes for monitoring and user created navigation material (such as "Radar maps" (IEC 62388:2007, 8.10), "Symbols, lines, areas and text notes" (IEC 61174:2008, 5.5.1) etc.).

7.2.1.2 Methods of test and required results

Confirm by analytical evaluation that the system meets each requirement.

7.2.2 Task "Route planning"

7.2.2.1 ECDIS performance standards related mandatory functions and data

7.2.2.1.1 Requirement

(MSC 252/7.2.1)*The INS* shall *provide the Route planning functions and data as specified in Module A and B of the revised ECDIS performance standards (Resolution MSC.232(82)).* (See IEC 61174.)

7.2.2.1.2 Methods of test and required results

Confirm by observation that the system provides the Route planning functions and data as specified in Module A and B of the valid ECDIS performance standards and related IEC standards.

7.2.2.2 Procedures for voyage planning

7.2.2.2.1 Requirement

(MSC 252/7.2.2)*The INS* shall *be capable of supporting procedures for relevant parts of voyage planning, as adopted by the* IMO *Resolution A.893(21) Guidelines for voyage planning*:

(A.893(21)/3.2) *The detailed voyage or passage plan* shall *include the following factors:*

1 *the plotting of the intended route or track of the voyage or passage on appropriate scale charts: the true direction of the planned route or track* shall *be indicated, as well as all areas of danger, existing ships' routeing and reporting systems, vessel traffic services, and any areas where marine environmental protection considerations apply;*

2 *the main elements to ensure safety of life at sea, safety and efficiency of navigation, and protection of the marine environment during the intended voyage or passage; such elements* shall *include, but not be limited to:*

2.1 safe speed, having regard to the proximity of navigational hazards along the intended route or track, the manoeuvring characteristics of the vessel and its draught in relation to the available water depth;

2.2 necessary speed alterations en route, e.g., where there may be limitations because of night passage, tidal restrictions, or allowance for the increase of draught due to squat and heel effect when turning;

2.3 minimum clearance required under the keel in critical areas with restricted water depth;

2.4 positions where a change in machinery status is required;

2.5 course alteration points, taking into account the vessel's turning circle at the planned speed and any expected effect of tidal streams and currents;

2.6 the method and frequency of position fixing, including primary and secondary options, and the indication of areas where accuracy of position fixing is critical and where maximum reliability must be obtained;

7.2.2.2.2 Methods of test and required results

Confirm by analytical evaluation that the system is capable of supporting the relevant procedures as described above.

7.2.2.3 Additional mandatory functions

7.2.2.3.1 Requirement

(MSC 252/7.2.3) *The INS* shall *provide means for*

- *administering the route plan (store and load, import, export, documentation, protection),*
- *having the route check against hazards based on the planned minimum under keel clearance specified by the mariner,*
- *checking of the route plan against manoeuvring limitation, if available in the INS, based on parameters turning radius, rate of turn (ROT), wheel-over and course changing points, speed, time, ETAs,*
- *drafting and refining the route plan against meteorological information if available in the INS*

NOTE "If available in the INS" means if this option is supported by EUT, the manufacturer shall declare which functions are available.

7.2.2.3.2 Methods of test and required results

Execute successively the following steps:

- create a new route plan "Test 1" and store it in the EUT;
- create another new route plan "Test 2" including at least a segment with a water depth less than 10 m, store it in the EUT and then export it to a removable media (e.g. memory stick, floppy disk, etc.) as supported by the EUT;
- load the already stored route plan "Test 1" for use in the EUT and confirm by observation that the content of it is as before storing of it;
- import route plan "Test 2" from removable media for use in the EUT and;
- either view, print or create a printable file from the route plan "Test 2";
- protect the route plan "Test 2" against changes. After protection try to add a new waypoint;
- confirm by observation that user is informed that changing of protected route plan is not allowed;
- unprotect the route plan "Test 2";

- confirm by observation that now adding a waypoint is possible;
- set safety contour as 10 m and perform check of route plan “Test 2”;
- confirm by observation that the system is able to detect and display this violation of the safety contour.

If check against manoeuvring limitations is available in the EUT, execute successively the following steps:

- confirm by observation that the EUT is able to detect a turning radius which is less than possible for the ship;
- confirm by observation that the EUT is able to detect a planned speed higher than the maximum available for the ship or lower than the minimum acceptable speed for the available steering system;
- set planned speed as 80 % of maximum available for the ship;
- confirm by observation that the EUT is able to detect a turning radius which will require a higher rate of turn than is possible for the ship when sailing at 80 % of the maximum speed;
- confirm by observation that the EUT is able to detect if two waypoints both with 90° and 1,0 NM radius turns are so close to each other that the wheel-over or course change point for the second waypoint is before the end of turn of the first waypoint;
- set planned speed as 80 % of maximum available for the ship;
- confirm by observation that the EUT is able to inform the user that it is impossible to meet the selected ETA for the given ETD.

If check against meteorological information is available in the EUT, execute successively the following steps:

- confirm by observation that the EUT is able to draft a suitable route between two user given waypoints which is able to benefit from favourable items (e.g. wind, current, etc.) and able to avoid unfavourable items (e.g. wind, current, waves, etc.) as specified in the operator manual provided by the manufacturer;
- confirm by observation that the EUT allows the user to refine the drafted route plan by changing criteria to judge favourable and unfavourable conditions and by accepting user input of non-changeable waypoint locations.

7.2.3 Task “Route monitoring”

7.2.3.1 Mandatory functions

7.2.3.1.1 Requirements

(MSC 252/7.3.1) *The INS* shall *provide the route monitoring functions and data as specified in Module A and B in the ECDIS performance standards.*

7.2.3.1.2 Methods of tests and required results

Confirm by observation that the system provides the route monitoring functions as specified in Module A and B of the valid ECDIS performance standards and related IEC standards.

7.2.3.2 Additional mandatory functions

7.2.3.2.1 Requirements

(MSC 252/7.3.2) *The INS* shall *provide capability for*

- *optionally overlaying radar video data on the chart to indicate navigational objects, restraints and hazards to own ship in order to allow position monitoring evaluation and object identification,*

NOTE "Optionally" means "possible user selection".

- *determination of deviations between set values and actual values for measured under-keel clearance and initiating an under-keel clearance alarm, if fitted,*

NOTE "If fitted" means "it has to be supported by the EUT".

- *the alphanumeric display the present values of Latitude, Longitude, heading, COG, SOG, STW, under-keel clearance, ROT (measured or derived from change of heading),*
- *AIS reports of AtoNs,*

and if track control is integrated into the INS,

- *it* shall *be possible to include the planned track and to provide, monitor and display the track related and manoeuvring data.*

7.2.3.2.2 Methods of tests and required results

Confirm by observation that the system provides the capability to select optionally the overlay of radar video data on the chart.

Confirm by observation or by inspection of manufacturer's documentation that the system provides the capability to determine the deviations between set values and actual values for measured under-keel clearance and the possibility to initiate and present an under-keel clearance alarm.

Confirm by observation that the system provides the capability to display alphanumerically the present values of latitude, longitude, heading, COG, SOG, STW, under-keel clearance, ROT (measured or derived from change of heading).

Confirm by observation that the system provides the capability to display AIS reports of AtoNs.

If track control is integrated into the INS, confirm by observation that it is possible:

- to select the planned track for route monitoring;
- to provide, monitor and display the track related and manoeuvring data.

7.2.3.3 Optional functions

7.2.3.3.1 Requirements

(MSC 252/7.3.3) *For navigational purposes, the display of other route-related information on the chart display is permitted, e.g.*

- *tracked radar targets and AIS targets*
- *AIS binary and safety-related messages*
- *initiation and monitoring of man-over-board and SAR manoeuvres (search and rescue and man-over-board modes)*
- *NAVTEX*
- *tidal and current data*
- *weather data*
- *ice data*

The manufacturer shall declare which functions, data or AIS messages are available.

7.2.3.3.2 Methods of test and required results

Confirm by observation that the system provides the optional functions, data or AIS messages as specified by the manufacturer.

7.2.3.4 Search and rescue mode

7.2.3.4.1 Requirement

(MSC 252/7.3.4.1) *If available, it* shall *be possible to select on the route monitoring display a predefined display mode for a "search and rescue" situation that can be accessed upon simple operator command.*

The manufacturer shall declare which functions are available.

(MSC 252/7.3.4.2) *In the search and rescue mode, a superimposed graphical presentation of the datum (geographic point, line, or area used as a reference in search planning), initial most probable area for search, commence search point and search pattern chosen by the operator (expanding square search pattern, sector search pattern or parallel track search pattern) with track spacing defined by him* shall *be presented.*

The IMO IAMSAR Manual Volume 3 shall be used as reference for the search pattern.

7.2.3.4.2 Methods of test and required results

If a search and rescue mode is provided by the manufacturer confirm by observation that the system meets the requirements in the following manner:

- select the display of an IAMSAR search pattern by a simple operator command;
- define the geographic point, area or line to be used as reference in search planning;
- adjust the search pattern and area of search by the operator;
- confirm by observation that the search pattern is correctly presented in the route monitoring display.

Confirm by inspection of manufacturer documentation that the equipment manual describes the basis for calculations of the search and rescue mode, if that search and rescue mode is provided.

7.2.3.5 Man-over-board (MOB) mode

7.2.3.5.1 Requirement

(MSC 252/7.3.5.1) *If available it* shall *be possible to select on the route monitoring display a predefined display mode for a "man-over-board" situation, that can be accessed upon simple operator command.*

The manufacturer shall declare which functions are available.

(MSC 252/7.3.5.2) *In the man-over-board mode a superimposed graphical presentation of a operator selectable man-over-board manoeuvre* shall *be presented.*

(MSC 252/7.3.5.3) *The man-over-board position* shall *be memorised by a simple operator action.*

(MSC 252/7.3.5.4) *An urgency manoeuvring procedure* shall *be available at the display taking set and drift into consideration.*

As a minimum the updated range and bearing display of the estimated MOB position information based on set and drift and initial MOB position shall be presented.

As a minimum the updated display of estimated MOB position information based on set and drift and initial MOB position shall be presented.

7.2.3.5.2 Methods of test and required results

If available, confirm by observation that the predefined MOB display mode meets the requirements in the following manner.

- Select the MOB display mode by a simple operator command.
- Save the initial MOB position by a simple operator command.
- Show initial and estimated MOB position in conformance with IEC 62288.
- Show distance and bearing to the estimated MOB position.

7.2.4 Task “Collision Avoidance”

7.2.4.1 Radar performance standards related mandatory functions and data

7.2.4.1.1 Requirement

(MSC 252/7.4.1) *The INS* shall *provide the collision avoidance functions and data as specified in Module A and B of the Radar performance standards.* Refer to Annex A for definition of these modules.

7.2.4.1.2 Methods of test and required results

Confirm by inspection of documented evidence that the EUT conforms to the relevant parts of IEC 62388:2007. Refer to Annex A.1, for list of the relevant parts.

7.2.4.2 Additional mandatory functions

7.2.4.2.1 Requirement

(MSC 252/7.4.2.1) *It* shall *be possible to present less information of ENC database objects than specified in MSC.232(82) for display base*.

It shall be possible to remove some or all of following categories or layers of ENC data, but not individual objects within each category/layer:

- coastline (high water);
- own ship's safety contour;
- isolated underwater dangers of depth less than the safety contour which lie within the safe water defined by the safety contour;
- isolated above water dangers which lie within the safe water defined by the safety contour such as fixed structures, overhead wires, etc.

7.2.4.2.2 Methods of test and required results

Confirm by observation that the EUT allows the presentation of less ENC data than that specified for the display base in MSC.232(82), by selecting layers listed above. Confirm by observation that it is not possible to remove individual objects.

7.2.4.3 Target association and target data integration

7.2.4.3.1 Requirement

(MSC 252/7.4.2.2) *If target information from multiple sensors/sources (radar and AIS; 2 radar sensors) are provided on one task station:*

- *the possibility of target association* shall *be provided for mutual monitoring and to avoid the presentation of more than one symbol for the same target,*
- *the association of AIS and radar targets* shall *follow the requirements of Resolutions MSC.192(79) and MSC.191(79),*
- *common criteria* shall *be used for raising target related alerts, e.g., CPA/TCPA.*

The target association shall be performed on all provided sensors/sources. Means such as hysteresis shall be applied to the association criteria in order to prevent unwanted association or disassociation. For practical applications, it shall be permitted to vary the association and disassociation criteria from the default values. The user manual shall describe the association parameters and options.

The selection of priority for association of single sources shall be valid for the whole EUT. The selection can be modified by operator action for the whole EUT at any nominated task station which displays associated targets.

The threshold of association shall be consistent within the INS.

NOTE Target association, including threshold of association and priority of association (i.e. which symbol is used for associated target), is a system wide function. A task station may display associated targets or targets from a single source. If associated targets are displayed then they are identical at every task station which displays the associated targets.

7.2.4.3.2 Methods of test and required results

IEC 62388:2007, 10.8.2 (Association and priority) defines four scenarios for associating tracked targets and AIS targets. This section reuses these scenarios to simulate a target from two different radar sensors.

Two independent Target Scenario Simulators (TSS) are required and they shall conform to the requirements of IEC 62388:2007, Annex F with the exceptions that support for target fading is not required and that only one tracked target is required from each simulator. Sensor errors are not simulated in this test. One TSS is set to provide radar data as defined in the TT column of the scenarios in IEC 62388:2007, 10.8.2 and the other TSS is set to provide data following the same position and velocity as the target defined in the AIS column of the scenarios.

The methods of test and required results are as follows:

a) confirm by observation that target association is provided and that, when targets are associated, a single symbol is presented for each target in all task stations which are selected to display associated targets;

b) ensure target association is enabled on the EUT. Ensure that the default association criteria are selected. Use the TSSs to generate the required radar sensor data for association scenario 1. Tracked targets should be acquired (manually or automatically) as soon as practical after the start of the test. On all task stations within the EUT that provide target information from multiple radar sensors, confirm by observation that the requirements of test scenario 1 are met. Note that it is acceptable for the targets to be associated when the elapsed time is 0 min;

c) repeat test b) for association scenario 2. Note that it is acceptable for the targets to be associated when the elapsed time is 0 min;

d) repeat test b) for association scenario 3;

e) repeat test b) for association scenario 4. Note that it is acceptable for the targets to be associated when the elapsed time is 0 min;

f) confirm by observation that, if an association disable function is provided while target information from more than one radar source is provided on one task station, the association function can be enabled and disabled for the radar targets;

g) if target information from more than one radar source is provided on one task station, confirm by observation while performing target association test scenarios 1-4 that the target disassociation algorithm meets the requirements of target disassociation and in addition, demonstrates that means has been provided in order to limit the function from hunting (indecisions) in the association/disassociation process;

h) if target information from more than one radar source is provided on one task station, confirm by observation that no alarm is raised when the radar targets are disassociated;

i) if target information from more than one radar source is provided on one task station, confirm by observation that when the radar targets are disassociated the disassociated targets have unique identifiers;

j) confirm by inspection of manufacturer's documentation that the user manual describes the parameters and options for associating radar targets;

k) confirm by inspection of documented evidence that the association of AIS and radar targets is in accordance with IEC 62388:2007, 10.8.2;

l) confirm by observation that common criteria are used for raising target related alerts at the task station;

m) confirm by observation that association threshold parameters are consistent in every task station of the EUT.

7.2.4.4 Target identifier

7.2.4.4.1 Requirement

(MSC 252/7.4.2.3) *For identical targets unique and identical target identifiers* shall *be used for presentation on all INS displays. Where a target from more than one source can be presented on one display the identifier* shall *be amended as required. Amended target identifiers* shall *be used for all INS display presentations.*

NOTE Example of "amended as required". Two radars track different targets, which are displayed in common display. Technical tracking identifiers in first radar are 2, 5 and 10. Technical tracking identifiers in second radar are 1, 5 and 6. As identifier 5 is available in both radars, the target identifier 5 given from second radar is amended to identifier 11 for common display.

Local target identifiers may be provided in addition to the unique identifier used for presentation on all INS displays. Where provided, local target identifiers shall be distinct from the unique identifier. Local identifiers shall only be presented on the individual task station to which they apply. The operator shall be able to switch off the presentation of the local identifiers.

7.2.4.4.2 Methods of test and required results

If the EUT does not provide the capability to display target information from multiple sensors/sources on a single task station then the tests c, d, e, f, g and h are not applicable.

a) Using the simulators defined in 7.2.4.3.2, simulate several physical targets by providing AIS data to the EUT for each of these targets. Confirm by observation that:
   - a unique (i.e. different) identifier is used for each simulated AIS target;
   - the unique identifier is identical on all workstations that present the target.

b) Switch off the AIS target simulation. Simulate several physical targets by providing radar sensor data to the EUT. Confirm by observation that:
   - a unique identifier is used for each simulated radar target;
   - the unique identifier is identical on all workstations that present the target.

c) Simulate several physical targets by providing both AIS and radar data to the EUT for each physical target. Ensure that the simulated AIS and radar data are sufficiently matched so as to meet the EUT's criteria for target association. Switch on target association, allowing sufficient time for the association to take place. (Refer to manufacturer's documentation as required.) Confirm by observation that:

- a unique identifier is used for each physical target, the identifier being amended as required to ensure that it is unique;
- the unique identifier is identical on all workstations that present the target;
- the unique identifier is not affected by change of presentation priority between radar and AIS data.

d) If the EUT provides an option to switch target association off, switch it off and repeat the above test. Confirm by observation that:

- on workstations with association switched off, each physical target is presented by both an AIS target and a radar target;
- each target presented has a unique identifier, amended as required to ensure that it is unique;
- the unique identifier is identical on all workstations that present the target.

e) Repeat test c) with the simulated AIS and radar data including at least 2 unmatched radar data so that they do not meet the EUT's criteria for target association. Confirm by observation that:

- a single unique identifier is used for each physical target which is matched as well as unique identifier for each physical unmatched targets, the identifier being amended as required to ensure that it is unique;
- the AIS and tracked targets corresponding to each physical target are assigned different identifiers allowing them to be differentiated;
- the identifiers used to present each target are identical on all workstations that present the target.

f) Simulate several physical targets by the provision of radar data to the EUT from two different radar sensors for each physical target. Ensure that the simulated radar data is sufficiently matched to meet the EUT's criteria for target association; in order to achieve this it may be sufficient to supply the same data to two inputs. Switch on target association and allow sufficient time for the association to take place. (Refer to manufacturer's documentation as required.) Confirm by observation that:

- a unique identifier is used for each physical target, the identifier being amended as required to ensure that it is unique;
- the unique identifier is identical on all workstations that present the target.

g) If the EUT provides an option to switch target association off, switch it off and repeat the above test. Confirm by observation that:

- on workstations with association switched off and which have the capability to display radar targets from more than one radar sensor, each physical target is presented by two radar targets;
- each target presented has a unique identifier, amended as required to ensure that it is unique;
- the unique identifier is identical on all workstations that present the target.

h) Repeat test f) with the data from the two different radar sensors including at least 2 unmatched radar targets so that they do not meet the EUT's criteria for target association. Confirm by observation that:

- a single unique identifier is used for each physical target which is matched as well as a unique identifier for each physical unmatched targets, the identifier being amended as required to ensure that it is unique;
- the tracked targets corresponding to each physical target are assigned different identifiers allowing them to be differentiated;

- the identifiers used to present each target are identical on all workstations that present the target.

i) If the EUT provides local identifiers, confirm by observation that:

- the local target identifiers are distinguishable from the unique identifier;
- local identifiers are only presented on the individual task station to which they apply;
- it is possible to deselect the display of local identifiers.

7.2.4.5 Combined radar signals

7.2.4.5.1 Requirement

(MSC 252/7.4.2.4) *A display may present combined radar signals from more than one radar source. The malfunctions of this additional facility* shall *not degrade the presentation of the radar source selected as primary*, unless the primary source is the one that fails. Selection between *the primary and the other source(s)* shall *be indicated as such.*

7.2.4.5.2 Methods of test and required results

Confirm by observation or by inspection of documented evidence that the system meets the requirements according IEC 62388:2007, 14.4.3 (Combining radar).

7.2.4.6 Optional functions

7.2.4.6.1 Requirement

(MSC 252/7.4.3) *Optionally, the following information may be displayed:*

- *true scaled ship symbols and CPA/TCPA and bow crossing range (BCR) / bow crossing time (BCT) related to the real dimensions;*
- *chart data from the common database of INS: traffic-related object layers.*

7.2.4.6.2 Methods of test and required results

If optional functions are provided, confirm by observation that the system meets each requirement.

7.2.5 Task “Navigation Control Data”

7.2.5.1 General

(MSC 252/7.5.1) *To support the manual and automatic control of the ship‘s primary movement*, *the INS navigation control task* shall *provide the following functionality:*

- *display of data for the manual control of the ship‘s primary movement*
- *display of data for the automatic control of the ship‘s primary movement*
- *presentation and handling of external safety related messages,* e.g. AIS safety-related and binary messages, NAVTEX. These messages shall be stored for viewing purposes as specified by the manufacturer.

7.2.5.2 Presentation of navigation control data for manual control

7.2.5.2.1 Requirement

(MSC 252/7.5.2.1) *For manual control of the ship‘s primary movement the INS navigation control display* shall *allow at least to display the following information:*

- *under keel clearance (UKC) and UKC profile*
- *STW, SOG, COG*

- *position*
- *heading, ROT (measured or derived from change of heading)*
- *rudder angle*
- *propulsion data*
- *set and drift, wind direction and speed (true and/or relative selectable by the operator), if availabl*
- *the active mode of steering or speed control*
- *time and distance to wheel-over or to the next waypoint*
- *safety related messages e.g AIS safety-related and binary messages, NAVTEX.*

7.2.5.2.2 Methods of test and required results

Confirm by observation that the system provides display capability for each data item described in 7.2.5.2.1 in accordance with the requirements of IEC 62288 for display of information.

7.2.5.3 Presentation of navigation control data for automatic control

NOTE This function is optional, as described in 4.1 (MSC.252(83)/2.1.3.2) *and* (MSC.252(83)/2.1.4).

7.2.5.3.1 Requirement

(MSC 252/7.5.3.1) *For automatic control of the ship's primary movement, the INS navigation control display* shall *allow at least and as default the display of the following information:*

- *all information listed for manual control*
- *set and actual radius or rate of turn to the next segment.*

The set value is for next turn or current turn under execution. The actual value is current measured value.

7.2.5.3.2 Methods of test and required results

Confirm by observation that the system provides all information listed for manual control, set and actual radius or rate of turn to the next segment in accordance with the requirements of IEC 62288 for display of information.

7.2.5.4 Presentation of navigation control data

7.2.5.4.1 Requirement

(MSC.252/7.5.4) The navigation control data shall *be presented:*

- *in digital and where appropriate in analogue form, e.g., mimic elements, logically arranged on and around a symbolic outline of a ship*
- *if applicable, together with their "set – values"*
- *if applicable and on demand together with a history presentation to indicate the trend of the parameter.*

Parameter is considered as data.

7.2.5.4.2 Methods of test and required results

Confirm by observation that the system provides display capability for each data item described in 7.2.5.4.1 in accordance with the requirements of IEC 62288 for display of information.

7.2.6 Task “Alert management“

NOTE (MSC 252/7.6.1) *Scope, operational requirements and alert-related requirements are specified in Module C (Clause 8) of this standard.*

7.2.7 Task “Status and data display“

7.2.7.1 Mandatory data display functions

7.2.7.1.1 Requirement

(MSC 252/7.7.1) *The INS* shall *provide the following data display functions:*

- *presentation of mode and status information*
- *presentation of the ship‘s static, dynamic and voyage-related AIS data*
- *presentation of the ship’s available relevant measured motion data together with their “set-values”*
- *presentation of received safety related messages, such as AIS safety-related and binary messages, NAVTEX*
- *presentation of INS configuration*

NOTE The INS configuration includes information about all subsystems and sensors installed, ready for use and currently in use.

- *presentation of sensor and source information.*

7.2.7.1.2 Methods of test and required results

Confirm by observation that the system is able to present mode information including information whether or not the system is in a non normal mode of operation (e.g. simulation mode, service mode, training mode (see 7.4.3)).

Confirm by observation that the system is able to present status information (ON/OFF, availability, degradation, integrity), e.g. for the status of automated functions, systems and /or subsystems (see also 7.4.3).

Confirm by observation that the system is able to present data and status information (ON/OFF, integrity, validity, plausibility) provided by the sensors and sources.

Confirm by observation that the system is able to present ship‘s static, dynamic and voyage-related AIS data.

Confirm by observation that the system is able to present ship’s available relevant measured motion data together with their “set-values” (heading, course/speed, rate-of-turn, turn radius).

Confirm by observation that the system is able to present received safety related messages, such as AIS safety-related and binary messages and NAVTEX messages.

Confirm by observation that the system is able to present INS configuration including: integrated tasks, integrated automated control functions, connected and selected sensors and sources and consistent a common reference point.

7.2.7.2 Mandatory data management functions

7.2.7.2.1 Requirement

(MSC 252/7.7.2) The INS shall *provide the following management functions:*

- *setting of relevant parameters*
- *editing AIS own ship‘s data and information to be transmitted by AIS messages.*

7.2.7.2.2 Methods of test and required results

Confirm by observation that the EUT allows the setting of relevant parameters for the items listed in 7.2.7.1.1 as specified in manufacturer's documentation.

Confirm by observation that the system allows the editing of the AIS own ship's data and the information to be transmitted by AIS messages.

7.2.7.3 Optional data display functions

(MSC 252/7.7.3) *The INS may provide on demand:*

- *tidal and current data*
- *weather data, ice data*
- *additional data of the tasks Navigation control data and Route monitoring and AIS target data.*

The manufacturer shall declare which data is available for presentation on demand.

7.2.7.4 Methods of test and required results

Confirm by observation that the system provides the optional data as specified in manufacturer's documentation.

7.3 Functional requirements for INS task stations

7.3.1 Number of task stations

7.3.1.1 Description

(MSC 252/8.1.1) *The number of task stations on the bridge depends on the tasks integrated into the INS. It* shall *support the simultaneous operation and presentation of at least the minimum set of tasks necessary to meet the carriage requirements of SOLAS regulation V/19.*

The manufacturer shall declare which carriage requirements of SOLAS V/19 the EUT is able to fulfil.

(MSC 252/8.1.2) *To specify the required number of task stations the required backup arrangements as mandated by the carriage requirements of SOLAS regulation V/19* shall *be taken into account.*

(MSC 252/8.2) *For each tasks of:*

- *route monitoring,*
- *collision avoidance,*
- *navigation control data,*

a task station shall *be provided for* each task*, if the respective task is part of the INS.*

(MSC 252/8.3) *For the tasks of:*

- *Route planning,*
- *status and data display, and*
- *alert management,*

means shall *be provided to operate the tasks at least at one of the task stations referred to on paragraph MSC.252/8.2 or at least at another additional task station at the choice of the bridge team and pilot.*

(MSC 252/8.4) *For the task "Route planning", a separate remote task station may be provided.*

NOTE The minimum required number of task stations are as follows if the relevant tasks are provided by the EUT:

- Task station 1 (Main purpose: Route monitoring)
- Task station 2 (Main purpose: Collision avoidance)
- Task station 3 (Main purpose: Navigational control data)
- Task station 4 (Main purpose: Backup, if required by backup arrangement under SOLAS regulation V/19)

(MSC 252/8.5) *The allocation of the tasks to the task stations* shall *be sufficiently flexible, to support all navigational situations, and* shall *be sufficiently simple to support team working and awareness of operator roles. The selection of the task at the task station* shall *be possible by a simple operator action.*

7.3.1.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the manufacturer has declared which carriage requirements of SOLAS V/19 the EUT fulfils.

Confirm by inspection of manufacturer's documentation that the EUT configuration allows a sufficient number of task stations to:

- allow the simultaneous presentation of all tasks for carriage requirements to be fulfilled;
- meet the required backup arrangements for carriage requirements to be fulfilled.

For each task of:

- Route planning,
- Collision avoidance,
- Navigational control data,

confirm by observation that sufficient numbers of task stations are provided to support simultaneous operation and presentation of above tasks.

For the tasks:

- Route planning,
- Status and data display, and
- Alert management,

confirm by observation that it is possible to operate these tasks from one of the task stations provided.

Confirm by observation that it is possible to select (a) different task(s) on a task station with a simple operator action.

NOTE The tasks which can be provided on a task station by the EUT, as declared by the manufacturer, are

- route monitoring,
- collision avoidance,
- navigation control data,
- route planning,
- status and data display,
- alert management,
- automatic steering control.

This is not a limitation, also other additional tasks for the EUT can be provided, as declared by the manufacturer.

7.3.2 Track control

7.3.2.1 Requirement

(MSC 252/8.6*) If the function of track control is implemented in the INS*, the track control system shall conform with MSC.74(69), Annex 2 Module B: Operational and functional requirements. Refer to Annex A for definition of Module B and

(MSC 252/8.6.1*) it* shall *be possible to display the planned route graphically on the task stations for:*

- *"Route monitoring", and/or*
- *"Collision avoidance".* and

(MSC 252/8.6.2) *the control and operation of this function by the user* shall *be possible via the task stations for:*

- *"Route monitoring", and/or*
- *"Collision avoidance".*

7.3.2.2 Methods of test and required results

If the function of track control is implemented the following tests shall be performed.

Confirm by inspection of documented evidence that the EUT is in compliance with IEC 62065.

Confirm by observation that control and operation is possible from the "Route monitoring" and/or "Collision avoidance" task stations.

Confirm by observation that the active route used for track control is displayed graphically on the task station from which track control is operated.

7.3.3 Automatic control functions

7.3.3.1 Task station with control

7.3.3.1.1 Requirement

(MSC 252/8.7.1) *Only one, clearly indicated task station* shall *be in control of an automatic function and only one task station* shall *at any time be assigned to accept control commands. It* shall *clearly be indicated to the bridge team and pilot, if not otherwise obvious, which task station is in control of these functions.*

(MSC 252/8.7.2) *It* shall *be possible to take over the control from a task station. In this case the set control values and limits* shall *remain unchanged* for the control functions.

(MSC 252/8.7.3) *The information relevant for the selected control function* shall *be available for continuous display, at least upon a single operator command, and* shall *in be presented when an automatic control function is activated or changed.*

NOTE If individual IMO performance standards require continuous display of items related to an automatic control function, then they are displayed at least in one display of the workstation of the EUT. This workstation is the one which contains the task station in control of the automatic control function. When an automatic control function is activated or changed the relevant information is available in the display of the task station in control of the automatic control function.

7.3.3.1.2 Methods of test and required results

Confirm by observation for each automatic control function within the EUT (e.g. autopilot, speedpilot, track control etc.) that:

- only one task station is in control of an automatic control function;

  NOTE 1 If more than one automatic control function is available in the EUT then it is permissible for each automatic control function to be on a separate task station.

- the task station in control of the automatic control function is clearly indicated;
- if an alternative task station takes over the control of the automatic control function then all values and limits of the automatic control function remain unchanged;
- information relevant for the selected automatic control function is available for continuous display either permanently or on demand by single operator action and whenever the user activates or changes anything related to the selected automatic control function.

NOTE 2 Values related to installation, tuning, setup, etc. of an automatic control function are not required to be always available or to be available by single operator action.

7.3.3.2 Override

7.3.3.2.1 Requirement

(MSC 252/8.7.4.1) *It* shall *be allowed by a single operator action to override or by-pass any automated function* to restore manual control*, regardless of the operational mode and the failure status of the INS.*

NOTE 1 It is acceptable for the single operator action to be performed outside of the EUT as long as the EUT provides an interface through which it can be informed that the override has occurred.

NOTE 2 An example of by-pass of automated function is the use of wheel to set manual rudder angle (= FU = follow up) when the autopilot was in control. An example of override of automated function is the use of NFU (= non follow up) override to control directly rudder pumps.

(MSC 252/8.7.4.2) *The INS* shall *resume automatic functions only after an appropriate message and intentional operator action, considering all necessary starting conditions.*

7.3.3.2.2 Methods of test and required results

Confirm by observation for each automatic control function within EUT (e.g. autopilot, speedpilot, track control etc.) that

- for each operational mode of the automatic control function it is possible to perform override or by-pass by a single operator action,
- for each system failure scenario as described by the manufacturer in the FMEA it is possible to perform override or by-pass by single operator action,
- the EUT does not resume the automatic control function automatically from override or by-pass mode and that the relevant task station takes command of the automatic control function only after operator request and after considering the start conditions.

7.4 Functional requirements for displays of INS

7.4.1 General

7.4.1.1 Requirement

(MSC 252/9.1.1) *The INS* shall *comply with the presentation requirements adopted by the* IMO in MSC.191(79) and SN/Circ.243.

(MSC 252/9.1.2) *All essential information* shall *be displayed clearly and continuously. Additional navigational information may be displayed, but* shall *not mask, obscure or degrade essential information required for the display by its primary task, as specified in this performance standards.*

“Essential information” is information directly related to the safe navigation of the vessel. Tasks “Route monitoring”, “Collision avoidance”, “Navigation control data” and “Alert

management" are sources of essential information. Tasks "Route planning" and "Navigation status and data display" are for planning or support and therefore they belong to "Additional navigational information".

Essential information for "Route monitoring" is information required by the ECDIS standard (see IEC 61174) and the monitored route that is:

- monitored route and own ship's position displayed graphically over the chart whenever the display covers the area (IEC 61174:2008, 4.10.3);
- a warning indication when SENC data from private source is displayed (see IEC 61174:2008, 4.3.2);
- a chart display at least 270 mm by 270 mm including presentation of safety contour (see IEC 61174:2008, 4.3.4 and 4.9.2);
- an indication when a chart is displayed at a larger scale than that contained in the ENC (see IEC 61174:2008, 4.5);
- an indication when a larger scale ENC than the displayed ENC is available (see IEC 61174:2008, 4.5);
- an indication when a chart display does not show all categories of standard display (see IEC 61174:2008, 4.9.5);
- North arrow (see IEC 61174:2008, 5.9.1);
- an indication if chart material other than ENC is displayed (see IEC 61174:2008, 5.5.2.2 and 6.8.2);
- an indication when operating in RCDS mode (see IEC 61174:2008, G.3.6), if available;
- vector mode, time and stabilization (see IEC 62288:2008, 5.4.6.1);
- range scale (see IEC 62288:2008, 6.1.3.1).

Essential information for "Collision avoidance" is information that requires permanent display by the radar standard (see IEC 62388) that is:

- gain or signal threshold level (see IEC 62388:2007, 5.4.2.1);
- status for gain and all anti-clutter sea controls (see IEC 62388:2008, 5.4.3.1);
- status of anti-clutter rain control (see IEC 62388:2008, 5.4.4.1);
- radar video image (echoes) and tracked targets and AIS targets (see IEC 62388:2008, 6.10.1.1);
- range scale (see IEC 62388:2008, 8.2.1.1);
- motion and orientation mode (see IEC 62388:2008, 9.4.4.1);
- vector mode, time and stabilization (see IEC 62388:2008, 10.5.5.1);
- an indication if chart material other than ENC is displayed (see IEC 62388:2008, 11.1.1.1), if available;
- radar system status as master or slave (see IEC 62388:2008, 14.4.4.2);
- an indication of failed sensor/source input for heading, speed through the water, course and speed over ground, position, radar video and AIS (see IEC 62388:2008, 15.2.1 to 15.2.7).

Essential information for "Navigation control data" is:

- display of data required for manual control of the ship's primary movement (see 7.2.5.2.1);
- when automatic control is used display of data required for automatic control of ship's primary movement (see 7.2.5.3.1).

Essential information for "Alert management" is:

- an indication if there are unacknowledged alerts and a value indicating the total number of unacknowledged alerts.

(MSC 252/9.1.3) *The INS* shall *be capable of displaying data available from the sensors.*

(MSC 252/9.1.4) *The information* shall *be displayed together with the indication of its source (sensor data, result of calculation or manual input), unit of measurement and status, including mode.*

(MSC 252/9.1.5) *Display and update of essential information available in the equipment as well as safety related automatic functions* shall *not be inhibited due to operation of the equipment.*

7.4.1.2 Methods of test and required results

For testing of IEC 62288, see 7.5.3.2.

For the task route monitoring:

- Confirm by observation that the EUT meets requirements of IEC 62288:2008, 6.3.1.2 b) and 6.3.2.2 a) and IEC 61174:2008, 4.3.2, 4.3.4, 4.9.2, 4.10.3, 4.5, 4.9.5, 5.5.2.2, 5.9.1, 6.8.5 e) and G.3.6, if applicable;
- Confirm by observation that the user can remove all information so that only the chart information contained in the Display Base, the own ship position and the active route (including route related information) remain whenever the display covers that area.

  NOTE This is a case in addition to the one given in IEC 62288:2008, 6.3.2.2.a).

For the task collision avoidance:

- Confirm by observation that the EUT meets requirements of IEC 62288:2008, 6.2.1, 5.4.6.1, 6.1.3.1 and IEC 62388:2007, 5.4.2.1, 5.4.3.1, 5.4.4.1, 6.10.1.1, 8.2.1.1, 9.4.4.1, 10.5.5.1, 11.1.1.1, 14.4.4.2 and 15.2.1 to 15.2.7.

For the task navigation control data:

- Confirm by observation that for manual control the presentation of the information specified in 7.2.5.2.1 is not degraded, masked or obscured by other presented information;
- Confirm by observation that for automatic control the presentation of the information specified in 7.2.5.3.1 is not degraded, masked or obscured by other presented information.

For the task alert management:

- Confirm by observation that essential alert related information presented on the central alert management HMI is not degraded, masked or obscured by other presented information.

Confirm by observation that the EUT is capable to display data available from sensors/sources.

Confirm by observation that the displayed information (e.g. data directly from sensors/sources and derived such as by CCRS) is presented together with an indication of its source (e.g. sensor data, result of calculation or manual input), with the unit of measurement, the status of the information (e.g. integrity, validity, plausibility) and applicable mode information.

Confirm by observation that the display and update of essential information as well as safety related automatic functions are not inhibited due to the operation of equipment by a user. This

should be tested for each of the above mentioned tasks by means of applicable user operations selected from the following list:

- changing a range scale;
- taking a bearing or range;
- changing the colour scheme from day to night;
- entering data;
- acquiring target information;
- changing from one task to another;
- acknowledging an alert;
- overriding an automatic function;
- temporarily suppressing information;
- displaying a route or route related information;
- selecting additional information for presentation on the operational display area;
- displaying safety related messages;
- setting default values.

7.4.2 Default display configurations and operational modes

7.4.2.1 Requirement

(MSC 252/9.2.1) *The INS* shall *offer default display configurations for the tasks route monitoring and collision avoidance selectable at each task station to provide the bridge team and pilot with a standardized display. This configuration* shall *be accessible by a simple operator action. The basic requirements for these display configurations are specified in* Annex D*.*

The INS shall require confirmation (for example “Do you want to perform this although it will change system wide thresholds such as CPA, TCPA etc. in every workstation?”) when performing selection of default display configuration (see 6.4.3.1 for consistency of thresholds and see 7.5.4.1 for manual inputs that may cause unintended results).

(MSC 252/9.2.2) *The INS* shall *provide operational modes for open sea, coastal, confined waters (pilotage, harbour berthing, anchorage).*

The manufacturer shall declare the functions involved in the operational modes for open sea, coastal and confined waters and the means for the generation of content and settings.

(MSC 252/9.2.3) *It is recommended that the INS provides means to generate pre-defined or operator-defined display modes, that are optimally suitable to the navigation task.*

If provided, the manufacturer shall declare the functions involved and the means for generation of the content and settings for pre-defined and operator-defined display modes.

(MSC 252/9.2.4) *When switching the task from one task station to another, the current display configuration* shall *be maintained*, if required by the operator.

NOTE “Switching” means duplicating a task or moving a task from one task station to another task station.

7.4.2.2 Methods of test and required results

Confirm by observation that the EUT offers default display configurations for the tasks route monitoring and collision avoidance as specified in Annex D and as clarified in the requirements.

Confirm by observation that the default display configurations can be selected with a simple operator action at each task station.

Confirm by observation that the EUT offers the possibility to select operational modes for open sea, coastal and confined waters.

Refer to manufacturer's documentation to identify operational settings for each operational mode provided. Confirm by observation that it is possible to adjust the operational settings and the content of operational modes for open sea, coastal and confined waters.

If provided, refer to manufacturer's documentation to identify any operator-defined and pre-defined operational modes other than open sea, coastal and confined waters. Confirm by observation that it is possible to adjust the operational settings and the content of pre-defined and operator-defined display modes.

Confirm by observation that it is possible to keep the configuration at least for the parameters provided in Annex D (display settings) when switching a task from one task station to another.

7.4.3 Mode and status awareness

7.4.3.1 Requirement

(MSC 252/9.3.1) *The operational mode in use* shall *be clearly indicated to the bridge team and pilot.*

NOTE Examples of operational modes are open sea, coastal, confined waters (pilotage, harbour berthing, anchorage).

(MSC 252/9.3.2) *If the* system *mode in use is not the normal mode, to fully perform the functions required for the INS, this* shall *be clearly indicated.*

Example of system *modes other than the normal mode are:*

- *degraded condition modes, in which the INS cannot fully perform all functions*
- *"service modes"*
- *simulation mode*
- *training (familiarization) mode*
- *other modes, in which the INS cannot be used for navigation.*

The manufacturer shall declare which system modes the EUT provides other than the normal mode.

(MSC 252/9.3.3) *If the system is in a degraded condition this* shall *be sufficiently clear that the bridge team and pilot can understand the nature of the failure and its consequences.*

(MSC 252/9.3.4) *The INS* shall *indicate the operational status of automated functions and integrated components, systems and/or subsystems.*

7.4.3.2 Methods of test and required results

Confirm by observation that the operational mode in use is clearly indicated. Change the operational mode and confirm by observation that there is a clear indication.

Select each system mode other than the normal mode based on the manufacturer's declaration. Confirm by observation that each system mode is clearly indicated.

For degraded system conditions, confirm by observation that the nature of the failure and its consequences are indicated to the operator. This should be tested for system degradations caused by failure or loss of sensor input as mentioned in 7.7.3, 7.7.4, 7.7.6 and 7.7.8, as applicable.

Confirm by observation that the operational status of automated functions and integrated components, systems and/or subsystems is indicated.

7.4.4 Information display

7.4.4.1 Requirement

(MSC 252/9.4.1) *It* shall *be possible to display the complete system configuration, the available configuration and the configuration in use.*

(MSC 252/9.4.2 *The INS* shall *provide the means to display the type of data, source and availability.*

NOTE 1 Source above is an identification of the sensor providing the data.

(MSC 252/9.4.3) *The INS* shall *provide the means to display the type of function and availability.*

NOTE 2 Above is related to functions provided by the EUT.

(MSC 252/9.4.4) *The INS* shall *provide the means to display the device identification and its availability.*

NOTE 3 Above is related to physical devices within the EUT.

(MSC 252/9.4.5) *Ships and system related parameters and settings* shall *be displayed on demand.*

All information listed above shall be displayed at least on demand.

7.4.4.2 Methods of test and required results

Confirm by observation that the complete system configuration, the available system configuration and the system configuration in use can at least be presented on demand and that these include information about all installed subsystems and connected sensors, about all subsystems ready for use, about connected sensors/sources providing the EUT with data and about all subsystems and sensors/sources currently in use.

Disconnect one of the sensors/sources and confirm by observation that the configuration display reflects the changes.

NOTE The configuration may be presented either graphically or as a list.

Confirm by observation that the type of data, source and availability can be displayed at least on demand on the EUT.

Change one of the data sources and confirm by observation that the display reflects the changes.

Confirm by observation that the type of function and availability can be displayed at least on demand on the EUT.

Change the availability of one function (e.g. disconnect a required sensor or information source) and confirm by observation that the display reflects the changes.

Confirm by observation that the device identification and its availability can be displayed at least on demand on the EUT.

Disconnect one device and confirm by observation that the display reflects the changes.

Confirm by observation that the ship's and system related parameters and settings of the given configuration can be displayed at least on demand on the EUT.

Change at least 5 of the ship's and system related parameters and confirm by observation that the display reflects the changes (see 7.7.5).

7.5 Human machine interface

7.5.1 General

7.5.1.1 Requirement

(MSC 252/10.1.1) *For the design and layout of human machine interface (HMI) of the INS, MSC/Circ.982 and relevant guidance on application of SOLAS regulation V/15 adopted by the* IMO in MSC SN.1/Circ.265 shall *be taken into account.*

Standards IEC 60945 and IEC 62288 include rules on how to meet ergonomic criteria of MSC/Circ.982. The HMI of the EUT shall fulfil these IEC standards.

(MSC 252/10.1.2) *Integrated graphical and alphanumeric display and control functions* shall *adopt a consistent human machine interface (HMI) philosophy and implementation.*

(MSC 252/10.1.3) *The design and implementation of the INS* shall *ensure that it is simple to operate by a trained user.*

7.5.1.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation (e.g. a style book) that the manufacturer uses a consistent HMI philosophy as guideline for the design of integrated graphical and alphanumeric display and control functions.

Confirm by inspection of manufacturer's documentation that the integrated graphical and alphanumeric display and control functions conform to the documented HMI philosophy of the manufacturer as defined in MSC/Circ. 982 and IMO SN1/Circ.265 (IEC 60945 and IEC 62288) at least for items as listed below:

- capability to decline or override any automatic control function, if automatic control function is provided (see 7.3.3.2);
- support to address failures of automatic control functions, if an automatic control function is provided (see 7.7);
- there are means to rapidly correct erroneous inputs or commands related to ship control; wherever possible, an "undo" function is provided (see 7.5.4);
- there are checks in the HMI to prevent erroneous data or control inputs (see 7.5.4);
- there is a continuous indication of the current operative mode and it is simple to select another operative mode (see 7.4.3);
- failures are indicated in a clear and unambiguous manner (see Clause 8);
- presentation of information including symbols, abbreviations and coding is according to MSC.191(79) (see IEC 62288) and (see 7.4.1);
- where standardized symbols are not available, information, symbols and coding are visually representative and consistent when compared to standardized symbols. The used symbols are not in conflict with symbols specified on SN/Circ.243 (see IEC 62288).

7.5.2 System design

7.5.2.1 Requirement

(MSC 252/10.2.1) *The design of the system* shall *facilitate the tasks to be performed by the bridge team and pilot in navigating the ship safely under all operational conditions*.

NOTE Fulfilling this standard proves that the above requirement is met.

(MSC 252/10.2.2) *The configuration of the equipment and presentation of information at workstations* shall *permit observation or monitoring by the bridge team and pilot under all operating conditions.*

(MSC 252/10.2.3) *The design of the system* shall *avoid the potential single point failure by one person during operation, and* shall *minimize the risk of human error.*

This applies to unintended operator action which has irreversible consequences.

MSC 252/10.2.4) *The operation of the system* shall *be designed to avoid distraction from the task of safe navigation.*

7.5.2.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the design of the system avoids the potential single point failure by one person during operation and that the design minimizes the risk of human error (see 7.5.4).

7.5.3 Display

7.5.3.1 Requirement

(MSC 252/10.3.1) *Information* shall *be presented consistently within and between different sub-systems. Standardized information presentation, symbols and coding* shall *be used according to Resolution MSC.191(79).*

7.5.3.2 Methods of test and required results

Confirm by observation that each task available in the EUT uses a consistent presentation within and between tasks.

Confirm by inspection of documented evidence or by observation that the EUT meets each requirement of IEC 62288.

7.5.4 Input

7.5.4.1 Requirement

(MSC 252/10.4.1) *The INS* shall *be so designed that the requested manual inputs are consistent throughout the system and can be easily executed.*

(MSC 252/10.4.2) *The INS* shall *be designed that the basic functions can be easily operated.*

(MSC 252/10.4.3) *Complex or error-prone interaction with the system* shall *be avoided.*

NOTE 1 Basic functions such as taking bearings, setting course, etc., normally avoid complex interaction.

(MSC 252/10.4.4) *For manual inputs that may cause unintended results, the INS* shall *request confirmation before acceptance, thus providing a plausibility check.*

The confirmation request shall include guidance about consequences.

(MSC 252/10.4.5) *Checks in the dialogue and in the input handling* shall *be provided to prevent erroneous data or control inputs.*

NOTE 2 The above is achieved for example by limiting the possible/allowed input range.

(MSC 252/10.4.6) *Wherever possible, an "undo" function* shall *be provided.*

7.5.4.2 Methods of test and required results

Confirm by observation that:

- the design, function, location, arrangement and presentation of manual inputs are consistent across the EUT and that they enable simple and efficient execution of commands;
- all basic operational controls permit normal adjustments to be easily performed throughout the EUT;

  NOTE 1 Basic functions such as taking bearings, setting course, etc., normally avoid complex interaction.
- the EUT attempts to prevent ascertainable user-action error from occurring;
- all actions within the EUT that may cause unintended (irreversible) results require a confirmation before proceeding;

  NOTE 2 Some examples. Deletion of a stored Route. Processing of user request use long time. Action causes loss of multiple tracked targets.
- the EUT prevents an operation or warns an operator when attempting an input that leads to invalid operation of the equipment;
- the EUT provides UNDO options where possible.

7.6 INS Back-up requirements and redundancies

7.6.1 General

7.6.1.1 Requirement

(MSC 252/11.1.1*) Adequate back-up arrangements* shall *be provided to ensure safe navigation in case of a failure within the INS.*

(MSC 252/11.1.1.1) *In case of failure of one part or function of the INS, including network failures, it* shall *be possible to operate each other individual part or function separately; at least the requirements specified for individual equipment adopted by the* IMO shall *be met, as far as applicable.*

(MSC 252/11.1.1.2) *The back-up arrangement* shall *enable a safe take-over of the INS functions and ensure that an INS failure does not result in a critical situation.*

(MSC 252/11.1.2) *The failure of a single task station* shall *not result in the loss of a function mandated by the carriage requirements of SOLAS.*

(MSC 252/11.1.3) *In case of a breakdown of one task station, at least one task station* shall *be able to take over the tasks.*

(MSC 252/11.1.4) *The failure or loss of one hardware component of the INS* shall *not result in the loss of any one of the INS tasks:*

- *Route planning*
- *Route monitoring*

- *Collision avoidance*
- *Navigation control data*
- *Status and data display*
- *Alert management.*

Where track control is an INS function, this would not require the duplication of track control, *heading control or autopilot.*

NOTE 1 See 7.7.8.4 for fallback arrangement of heading control.

(MSC 252/11.1.5) *The INS* shall *allow that the back-up component automatically (if possible) takes over the operation of the primary component* in a safe way*.*

NOTE 2 The back-up component or arrangement is assumed to provide a functional level similar to the primary component. Minor functional differences are accepted.

7.6.1.2 Methods of test and required results

As per FMEA document in 9.3.1 for 7 separate test cases in turn, simulate a failure of one part, function or hardware component within the EUT and confirm by observation that the results declared in the FMEA document are that all the tasks listed below remain operational (MSC 252/11.1.1.1, 11.1.1.2 and 11.1.4). After each test reset the EUT to full operational state.

- Route Planning
- Route Monitoring
- Collision avoidance
- Navigational control data
- Status and data display
- Alert Management

As per FMEA document in 9.3.1 simulate a failure of each task station listed in b) 1), 2) and 3) below in turn and confirm by observation that the results declared in the FMEA document are that (MSC 252/11.1.2 and 11.1.3):

a) loss of any one task station listed in b) 1), 2), and 3) below does not result in loss of the following tasks:
   1) Route Planning
   2) Route Monitoring
   3) Collision avoidance
b) loss of a task station listed in 1) to 3) and associated tasks, as declared by the manufacturer with that task station, does not prohibit another task station to take over the task(s) associated with the failed task station.
   1) Route Monitoring task station
   2) Collision avoidance task station
   3) Navigational control data task station

After each test reset the EUT to full operational state.

As per FMEA document in 9.3.1 for every primary component listed below in 4) to 8) in turn, simulate a failure and confirm by observation that the results declared in the FMEA document are that the INS allows the back-up component to automatically (if possible) take over the operation of the primary component in a safe way (MSC 252/11.1.5). After each test reset the EUT to full operational state.

4) Electronic position fixing
5) Heading measurement
6) Speed measurement
7) Radar including transceiver and antenna
8) Chart database

7.6.2 Hardware redundancies (back-up)

7.6.2.1 Requirement

(MSC 252/11.2.1*) For the following sensors/sources of an INS, an approved back-up* shall *be available for the INS:*

- *electronic position fixing*
- *heading measurement*
- *speed measurement*
- *radar*
- *chart database*

NOTE 1 "Approved" is understood as "fully type approved equipment", "part of type approved equipment" (e.g. for radar and chart database) or equipment accepted by flag country administration.

NOTE 2 A measurement of speed over ground meets backup requirement for measurement of speed through water or vice versa.

7.6.2.2 Methods of test and required results

Confirm by inspection of the installation manual that it includes a description of sensors/sources to be connected to the INS and a description of backup sensor/source requirements for

- electronic position fixing,
- heading measurement,
- speed measurement.

Confirm by observation that the EUT includes backup sensor/source for

- radar,
- chart database.

7.7 System failures and fallback arrangement

7.7.1 General description

(MSC 252/12.1) *The INS* shall*, after a failure, and when the back-up activation is not successful support the availability of essential information and functions through the use of appropriate fallback arrangements.*

NOTE Detailed requirements, methods of test and required results are described in 7.7.8.

7.7.2 Restored operation

7.7.2.1 Requirement

(MSC 252/12.2) *Normal operation, after use of a fallback arrangement,* shall *only be restored upon confirmation by the operator.*

NOTE 1 Examples of not allowable automatic restore:

- task – no collision avoidance was available because all radars were in failure; when one radar becomes available, it is not allowed to start operation without operator activation (i.e. the operator changes the radar from standby to normal operation);
- function – no target association available because communication between units were in failure; when communication resumes, it is not allowed that the target association starts without operator activation (i.e. the operator selects target association for use);
- sensor – no heading sensor available has caused change from heading control to manual control; when heading resumes, it is not allowed that heading control starts without operator activation (i.e. the operator selects heading control for use).

NOTE 2 Restoring operation means for example switching from heading control back to track control.

7.7.2.2 Methods of test and required results

Methods of test and required results are described in 7.7.8.

7.7.3 Failure or change of sensor for automatic control function

7.7.3.1 Requirement

(MSC 252/12.3.1) *The failure or change of a sensor* shall *not result in sudden changes of control commands or loss of manoeuvring control. This may be accomplished by appropriate integrity checks using the information from several sources.*

(MSC 252*/12.3.3) If sensors or sources are not able to provide necessary ship status or navigation data for automatic control functions, a dead reckoning procedure* shall *provide the missing information, as far as practicable.*

7.7.3.2 Methods of test and required results

For each automatic control system within the EUT, perform the following tests.

Refer to the manufacturer's documentation. Simulate discrepancy between the data of the respective pair of sensors involved in the change sensor scenario as described below:

Simulate data discrepancies on the maximum accepted threshold value of the respective integrity monitoring function.

Change sensor for the above case by operating the EUT and confirm by observation that:

- there are no sudden control commands (example: no sudden change of rudder order);
- there is no loss of manoeuvring control.

For relevant sensors or sources (EPFS, SDME, heading sensor and time sensor, if used by the EUT), simulate a failure by disconnecting the sensor or source from the EUT or by switching off the internal sensor or source of the EUT and confirm by observation that

- a dead reckoning procedure provides the missing information, as far as practicable,
- switch over to dead reckoning procedure does not result in sudden changes of control commands or loss of manoeuvring control.

7.7.4 Failure of sensor

7.7.4.1 Requirement

(MSC 252/12.3.2) *In case of a sensor or source failure, the system* shall *provide an alert and indicate (an) alternative sensor(s) or source(s), as available.*

7.7.4.2 Methods of test and required results

The following tests are to be performed at least for

- EPFS,
- SDME,
- Heading sensor,
- Time sensor, if used by the EUT.

Simulate sensor or source failure by disconnecting the sensor or source from the EUT or by switching off the internal sensor or source of the EUT and confirm by observation that

- the EUT provides an alert to indicate the failed input sensor or source,
- the EUT indicates availability of an alternative sensor or source, if applicable.

7.7.5 Storage of system related parameters

7.7.5.1 Requirement

(MSC 252/12.4) *All system related parameters and settings* shall *be stored in a protected way for reconfiguration of the INS.*

NOTE System parameters are parameters used for setup and configuration of the EUT. Operative selections made by the end user are not regarded as being part of the system parameters.

7.7.5.2 Methods of test and required results

Confirm by observation that system parameters and settings are stored in a protected way and that these can be applied to EUT on demand.

7.7.6 Safe response to malfunction

7.7.6.1 Requirement

(MSC 252/12.5) *The automatic response to malfunctions* shall *result in the safest possible configuration accompanied by an alert.*

For the Route monitoring, Collision avoidance and Heading/Track control tasks the safest possible configuration including respective alerts is defined by MSC 252/12.7.2.1, 12.7.2.2, 12.7.2.3 and 12.7.2.4 (see 7.7.8).

Task Navigation control data shall clearly indicate if data is not available for display because of a malfunction.

Task Status and data display shall clearly indicate if data is not available for display because of a malfunction.

For safety related messages from AIS or NAVTEX, when historical data received before the malfunction are displayed then the display shall indicate malfunction of the real-time reception.

NOTE Refer to individual equipment standards for methods on how to detect malfunction.

7.7.6.2 Methods of test and required results

Required tests for task Route Monitoring, Collision avoidance and Heading/track control are described in 7.7.8.

As per FMEA document in 9.3.1, simulate a failure that causes loss of data for task navigation control data. Confirm by observation that the EUT clearly indicates that the data is not available.

As per FMEA document in 9.3.1, simulate a failure that causes loss of data for task status and data display. Confirm by observation that the EUT clearly indicates that the data is not available.

For safety related messages from AIS or NAVTEX first send safety related messages from the simulator, then simulate an interface failure. Confirm by observation that when historical data received before malfunction is displayed then the malfunction of the real-time reception of AIS or NAVTEX interface is clearly indicated.

7.7.7 Alert management

7.7.7.1 Requirement

(MSC 252/12.6.1) *System failures* shall *be alerted according to the requirements described in Module C* (Clause 7).

(MSC 252/12.6.2) *Loss of system communication between the alert management and the navigational systems and sensors* shall *be indicated as a warning at the central alert management HMI* and shall remove any existing alerts from those navigational systems and sensors.

(MSC 252/12.6.3) *A system failure of the alert management or the loss of system communication between the alert management and the navigational functions, sources and/or sensors,* shall *not lead to the loss of the alert announcement functionality of the individual navigational functions, sources/sensors.*

7.7.7.2 Methods of test and required results

NOTE 1 A navigational task is associated with one or more navigational functions or system. IMO has not presented a list of navigational functions or systems associated with each navigational task. For the tests below navigational task is used as substitute of navigational function or navigational system.

Following manufacturer instructions, generate at least one unacknowledged alert and cause a loss of communication between central alert management HMI and navigational tasks (i.e. collision avoidance, route monitoring, route planning, heading control, track control etc.) or sensors in turn within the EUT.

NOTE 2 Depending on whether or not a task or equipment (e.g. sensor) is part of EUT loss of communication can be done by disconnecting equipment or simulator, or may require further manufacturer instructions.

Confirm by observation that the central alert management HMI indicates an appropriate warning and that any existing related alert is removed from the central alert management HMI.

Following manufacturer instructions, cause a system failure of the central alert management HMI. Then cause failures for each sensor connected to the EUT and cause functional alerts (e.g. dangerous target, safety contour, different geodetic datum) for each navigational task (i.e. collision avoidance, route monitoring, Route planning, heading control, track control, etc.) in turn within the EUT.

Confirm by observation that the EUT announces each alert.

Cause a communication failure between the central alert management HMI of the EUT and the rest of the system. Then cause failures for each sensor/source connected to the EUT and cause functional alerts (e.g. dangerous target, safety contour, different geodetic datum) for each navigational task (i.e. collision avoidance, route monitoring, route planning, heading control, track control etc.) in turn within the EUT.

Confirm by observation that the EUT announces each alert.

NOTE 3 In this test the role of a sensor connected to the EUT is to cause an alert related to loss of sensor data inside the EUT.

7.7.8 Fallback for navigational information failure

7.7.8.1 General

7.7.8.1.1 Requirement

(MSC 252/12.7.1) *In the event of failures of navigational information and to maintain minimum basic operation,*

- *there* shall *be a permanent indication of the failed input information and the fallback activated,*
- *the respective actions of the alert management* shall *be activated, and*
- *the fallback arrangements listed* in 7.7.8.2, 7.7.8.3, and 7.7.8.4 shall *be provided.*

7.7.8.1.2 Methods of test and required results

Cause a failure of navigational information by simulating sensor or source failure(s), by disconnecting sensor or source from the EUT or by switching off the internal sensor or source within the EUT and confirm by observation that

- a permanent indication of failed input is provided,
- the activated fallback method is indicated (example: Dead reckoning is indicated for failed position, manual control is indicated for failed gyro heading for heading control, etc.),
- the EUT indicates the appropriate (see Clause 8) alerts.

7.7.8.2 Route monitoring

7.7.8.2.1 Requirement

(MSC 252/12.7.2.1) *Failure of heading information (Azimuth Stabilization)*

The INS shall *display own ship‘s position and over-ground-motion vector in the chart and not the ship‘s heading line.*

NOTE SDME as source of over-ground motion requires also availability of heading. To satisfy the display of the over-ground-motion vector the EUT is assumed to receive also over-ground motion information from the EPFS (e.g. VTG or RMC sentence).

(MSC 252/12.7.2.2) *Failure of course and speed over ground information.*

The INS shall *display own ship‘s position and heading line.*

7.7.8.2.2 Methods of test and required results

Simulate heading failure and confirm by observation that the EUT displays own ship’s position and over-ground-motion vector on the chart without ship’s heading line.

Simulate course and speed over ground sensor or source failure by disconnecting all COG/SOG sensors or sources from the EUT or by switching off the internal COG/SOG sensors or sources within the EUT and confirm by observation that the EUT displays own ship’s position and heading line without any ship vector.

NOTE This test may be done by simulating failure of course and speed over ground information from every position sensor and from every SDME sensor or source.

7.7.8.3 Collision avoidance

7.7.8.3.1 Requirement

(MSC 252*/12.7.3) In the case of failure of:*

- *Heading information*
- *Speed through the water information*
- *Course and speed over ground information*
- *Position input information*
- *Radar video input information*
- *AIS input information*

the INS shall *operate as defined in the operational Module B4 of the proposed modular structure for radar performance standards as set out in* Annex A*.*

7.7.8.3.2 Methods of test and required results

Confirm by inspection of documented evidence that the EUT meets the requirements of IEC 62388:2007, 14.1.1.2, 15.1.3.2, 15.1.4.2 and 15.2.

7.7.8.4 Heading/Track control

7.7.8.4.1 Requirement

(MSC 252/12.7.4) *The requirements for the applicable control function as specified in the individual performance standards* shall *apply.*

7.7.8.4.2 Methods of test and required results

For heading control confirm by inspection of documented evidence that the EUT meets the requirements of ISO 11674 for fallback of heading or speed source.

For track control confirm by inspection of documented evidence that the EUT meets the requirements of IEC 62065:2002, 4.5.

7.8 Technical requirements

7.8.1 General

7.8.1.1 Requirement

(MSC 252/13.1.1) *In addition to meeting the relevant requirements of Resolution A.694(17)* and the related standard IEC 60945*, the INS* shall *comply with the requirements of* this standard*.*

(MSC 252/13.1.2) *Means* shall *be provided to monitor and to display hardware malfunctions of the INS. Alerts* shall *be provided in case of malfunctions.*

7.8.1.2 Methods of test and required results

As per FMEA document in 9.3.1 cause a hardware component not essential for central alert management to malfunction. Confirm by observation that the EUT indicates an appropriate alert.

As per FMEA document in 9.3.1 cause enough hardware components required by central alert management for proper operation to malfunction. Confirm by observation that the EUT indicates clearly that it has a problem with central alert management.

Confirm by inspection of documented evidence that the EUT meets the requirements of IEC 60945.

7.8.2 Hardware and/or processors

7.8.2.1 Requirements for sensor, actuator or controller being part of the EUT

7.8.2.1.1 Sensor

(MSC 252/13.2.1.1) *A sensor or part thereof is not part of the INS, if it only supplies raw data.*

NOTE Raw data is data as required to be available by the individual equipment standard.

(MSC 252/13.2.1.2) *Processing of raw data from sensors may be part of the INS.*

(MSC 252/13.2.1.3) *In* the *case* where *sources perform functions of the INS these functions and interfaces* shall *conform with the relevant parts of* this standard*.*

7.8.2.1.2 Actuator and controller

(MSC 252/13.2.2) *An actuator, controller or part thereof 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 these standards.*

7.8.2.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation (see 9.1, Installation manual and 9.2) that the EUT, as declared in 5.1 includes sensors, actuators, controllers or part thereof, if they perform functions of the INS as required by these standard.

7.8.2.3 Software

7.8.2.3.1 Requirement

(MSC 252/13.3.1) *The operational software* shall *fulfil the requirements of the relevant international standards related to maritime navigation and communication equipment.*

7.8.2.3.2 Methods of test and required results

Confirm by inspection of documented evidence that the operational software fulfils the requirements of IEC 60945:2002, 4.2.3.

7.8.3 Power supply

7.8.3.1 Requirement

(MSC 252/13.4.1) *Power supply requirements applying to parts of the INS as a result of other IMO requirements* shall *remain applicable.*

(MSC 252/13.4.2) *The INS including the sensors for position, speed, heading and depth* shall *be supplied:*

.1 *from both the main and the emergency source of electrical power with automated changeover through a local distribution board with provision to preclude inadvertent shutdown; and*

.2 *from a transitional source of electrical power for a duration of not less than 45 s.*

7.8.3.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation (see 9.1, Installation manual) that a statement is provided to indicate that:

INS and relevant sensors shall be connected to main and emergency source as defined in SOLAS regulation II/I part D.

INS and following sensors/sources:

- at least one position sensor;
- at least one speed sensor;
- at least one depth sensor;
- at least one heading sensor;
- at least one radar including transceiver and antenna;

shall be supplied from a transitional source of electrical power for a duration of not less than 45 s.

NOTE 1 This statement is only required in the manual if the transitional source (e.g. UPS) is not included within the INS.

If the transitional source (e.g. UPS) is within the EUT then remove or switch off the main and emergency power and confirm by observation that operation of the EUT continues uninterrupted operation for a period of at least 45 s.

NOTE 2 These requirements do not extend to steering gear or any other automatic control functions external to the INS.

7.8.4 Power interruptions and shutdown

7.8.4.1 Requirement

(MSC 252/13.5.1) *After a power interruption full functionality of the INS* shall *be available after recovery of all subsystems. The INS* shall *not increase the recovery time of individual subsystem functions after power restoration.*

For all functions within the EUT the manufacturer shall declare the recovery time. The declared recovery time shall conform to the applicable performance standards, where available. The recovery time for the function collision avoidance is defined in IEC 62388.

(MSC 252/13.5.2) *If subjected to a power interruption the INS* shall*, upon restoration of power, maintain the configuration in use and continue automated operation, as far as practicable. Automatic control functions* shall *only be restored upon confirmation by the operator.*

NOTE Automated operation refers to automatic sensor/source selection mode (see 6.7.1).

7.8.4.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the manufacturer has declared recovery time limits and that the recovery time limits conform to the applicable performance standards, where available.

Record the configuration in use (any automatic control to be enabled and selected). Remove or switch off the main and emergency power including any transitional source. After expiration of transitional power (if applicable), wait a further 5 min and restore power. Confirm by observation that:

- recovery time for all individual subsystem functions is as specified by the manufacturer;
- full functionality of the INS is available after all subsystems have recovered.

Activate functions requiring manual activation. Confirm by observation that:

- the configuration in use prior to removal of power has been maintained by the EUT, as far as practicable;
- if any automated operation was selected prior to power interruption, then it continues as far as practicable;
- any automatic control function is reinstated only upon confirmation by the operator.

7.8.5 Data communication interface and protocols

7.8.5.1 Requirement

(MSC 252/13.6.1) *Standardized and approved data communication interfaces and protocols* shall *be used where possible.*

7.8.5.2 Methods of test and required results

Tests for communication interfaces are covered by 6.1.4.

7.8.6 Installation

7.8.6.1 Requirement

(MSC 252/13.7.1) *The INS* shall be capable of being *installed so that it can meet the requirements of the relevant International Standards.*

(MSC 252/13.7.2) *The INS* shall *be installed taking into account the guidelines in MSC/Circ.982 and relevant guidance on application of SOLAS regulation V/15, adopted by the* IMO SN1/Circ.265*.*

7.8.6.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation (see 9.1, Installation manual) that a statement is provided to indicate that the INS navigation tasks are capable of fulfilling carriage requirements for

- route monitoring (Res. MSC.232(82)),
- collision avoidance (Res. MSC 192(79));

and for optional functions, if included within the EUT such as

- heading control system (Res. A.342(IX) as amended by MSC.64(67) Annex 3),
- track control (Res. MSC.74(69) Annex 2),
- presentation of AIS data (Res. MSC.74(69) Annex 3),
- echo sounding system (Res. MSC.74(69) Annex 4),
- EPFS (Res. A819(19), as amended or Res. MSC.112(73) or Res. MSC.113(73) or Res. MSC.115(73) or previous three resolutions combined with Res. MSC.114(73) or Res. MSC.233(82)),
- SDME (Res. MSC.96(72)).

NOTE Additional equipment not listed above can be included into the INS.

Confirm by inspection of manufacturer's documentation (see 9.1) that a statement is provided to indicate that the installation of INS should be in accordance with

- IMO SOLAS regulation V/15: Principles relating to bridge design, design and arrangement of navigational systems and equipment and bridge procedures,
- MSC/Circ.982: Guidelines on ergonomic criteria for bridge equipment and layout,
- Sn.1/Circ.265: Guidelines on the application of SOLAS regulation V/15 to INS, IBS and Bridge design,
- SN.1/Circ.288: Guidelines for bridge equipment and systems, their arrangement and integration (BES).

8 Module C – Alert management

8.1 Description

8.1.1 Purpose of alert management

(MSC 252/14.1) *The purpose of the alert management is to enhance the handling, distribution and presentation of alerts within an INS.*

8.1.2 Scope of alert management

(MSC 252/15.1) *To enhance the safety of navigation these performance standards provide requirements for the treatment of alerts within an INS and its associated individual operational/ functional-modules and sensor/source-modules.*

NOTE "Associated" means equipment/ functions/ modules that are defined as part of the INS or any navigational equipment/ function/ module required to be interfaced to an INS (see Annex F).

(MSC 252/15.2) *The alert management harmonizes the priority, classification, handling, distribution and presentation of alerts, to enable the bridge team to devote full attention to the safe navigation of the ship and to immediately identify any abnormal situation requiring* decision, attention or *action to maintain the safe navigation of the ship.*

(MSC 252/15.3) *These performance standards specify a central alert management HMI to support the bridge team in the immediate identification of any abnormal situation* requiring decision, attention or action, *of the source and reason for the abnormal situation and support the bridge team in its decisions for the necessary actions to be taken.*

(MSC 252/15.4) *The alert management architecture and the acknowledgement concept specified, avoid unnecessary distraction of the bridge team by redundant and superfluous audible and visual alarm announcements and reduces the cognitive load on the operator by minimizing the information presented to which is necessary to assess the situation.*

(MSC 252/15.5) *The alert management should support the proper application of SOLAS regulation V/15.*

(MSC 252/15.6) *The architecture of the module of the performance standards is kept extendable to allow to include further alerts on the bridge and the development of performance standards for a bridge alert management.*

8.1.3 Application of alert management

(MSC 252/16.1) *These performance standards are applicable to any navigational aid within an INS and its associated individual operational/functional-modules and sensor/source-modules.*

(MSC 252/16.2) *In addition to meeting the requirements of these performance standards the INS alert management should comply with the relevant requirements of* MSC.128(75) (see IEC 62616), and MSC.191(79) (see IEC 62288).

(MSC 252/16.3) *The general principles of these standards as described in paragraphs 19* (8.3) *and 20* (8.4) *of these performance standards should apply to all alerts presented on the bridge, as far as practicable.*

8.2 General requirements

8.2.1 Provisions

8.2.1.1 Requirement

(MSC 252/18.1) *The alert management* shall *provide:*

- *the means used to draw the attention of the bridge team to the existence of abnormal situations,*
- *the means to enable the bridge team to identify and address that condition,*
- *the means for the bridge team and pilot to assess the urgency of different abnormal situations in cases where more than one abnormal situation has to be handled,*
- *the means to enable the bridge team to handle alert announcements, and*
- *the means to manage all alert related states in a distributed system structure in consistent manner.*

8.2.1.2 Methods of test and required results

Verified by the tests in subclauses 8.2.2 to 8.2.7.

8.2.2 Number of alerts for one situation

8.2.2.1 Requirement

(MSC 252/18.2) *If practicable, there* shall *be not more than one alert for one situation that requires attention.*

NOTE 1 The same alert can be presented on more than one task station.

NOTE 2 One failure may result in additional different alerts from subsequent functions which have dependency on the failed function.

8.2.2.2 Methods of test and required results

Refer to the manufacturer's FMEA documentation to identify five failures applicable to the EUT. For each selected failure cause the EUT to fail as described. Confirm by observation that, where practicable, only one alert is presented for each resultant situation.

8.2.3 Alerts to be handled by the alert management

8.2.3.1 Requirement

(MSC 252/18.3) *The alert management* shall *as a minimum be able to handle all alerts required by performance standards adopted by the* IMO *for navigational equipment comprised by the INS or connected to the INS. The alert management* shall *have the capability to handle all other alerts of navigational equipment comprised by the INS or connected to the INS in identical manner and* shall *incorporate all alerts that are critical to the safety of navigation.*

NOTE 1 Above requirement includes a request for the INS to incorporate all alerts that are critical to safety of navigation. This is understood to include all alerts required by performance standards adopted by the IMO for navigational equipment and alerts from automatic control function(s) implemented by the manufacturer for which there is no IMO performance standard.

NOTE 2 Figure F.1 shows minimum configuration of navigation equipment to be handled by the INS, connected to the INS or being part of the EUT.

8.2.3.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the alert management of the EUT as a minimum is able to handle all alerts required by performance standards adopted by the IMO for navigational equipment comprised by the INS or connected to the INS (see Annex J).

Confirm by inspection of manufacturer's documentation that the alert management has the capability to handle all other alerts of navigational equipment comprised by the INS or connected to the INS in an identical manner.

If provided, confirm by inspection of manufacturer's documentation that the alert management has the capability to handle all alerts from automatic control functions – within the EUT or connectable to the EUT based on the installation manual (see 9.1) – for which there is no IMO performance standard.

8.2.4 Logical architecture of the alert management

8.2.4.1 Requirement

(MSC 252/18.4) *The logical architecture of the alert management and the handling concept for alerts* shall *provide the capability to minimize the number of alerts especially those on a high priority level (e.g. using system knowledge from redundancy concepts inside INS and evaluating inherent necessities for alerts against navigational situations, operational modes or activated navigational functions).*

The INS shall have capability to revaluate distributed alerts before its presentation. As a minimum the EUT shall provide this capability for primary navigational data for which multiple sensors/sources are available. The situation related revaluation and consideration of navigational modes or activated navigational functions shall be carried out to minimize the number and priority of alerts. Only the result of the revaluation shall be presented to the OOW. The result may either be no change to original alert or change to responsibility transferred.

8.2.4.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the logical architecture, system design and the alert related communication offers the capability for revaluation and minimization of alerts.

For testing the functionality of responsibility transfer, see 8.4.2.5.2, 8.4.3.4.2, 8.5.2, 8.6.1.9.2, 8.9.2.2.1 and 8.9.2.2.2.

8.2.5 Alert management HMI

8.2.5.1 Requirement

(MSC 252/18.5) *It* shall *be possible to provide the central alert management HMI at least on the navigating and manoeuvring workstation and allowing the handling by the bridge team.*

NOTE IMO MSC/Circ.982 defines navigating and manoeuvring workstation.

8.2.5.2 Methods of test and required results

Refer to the manufacturer's documentation. Identify task station(s) intended to be installed at the navigating and manoeuvring workstation and confirm by observation that the EUT always allows operation of the central alert management HMI at least in one task station at the navigating and manoeuvring workstation.

8.2.6 Audible announcements

8.2.6.1 Requirement

(MSC 252/18.6) *The audible announcement of alerts* shall *enhance the guidance of the bridge team to the task stations or displays which are directly assigned to the function generating the alert and presenting the cause of the announcement and related information for decision support, e.g., dangerous target alarms* shall *appear and have to be acknowledged at the workstation where the collision avoidance function is provided.*

8.2.6.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the audible announcement is released only at task stations where decision support for the presented alert is presented (see also 8.6.1.4.2).

8.2.7 Display at several locations

8.2.7.1 Requirement

(MSC 252/18.7) *As alerts can be displayed at several locations, the system* shall *be consistent as far as practicable with respect to how alerts are displayed, silenced and acknowledged at any one task station of the INS.*

8.2.7.2 Methods of test and required results

Refer to the manufacturer's documentation. Select at least 5 representative alerts that will be reported at different locations of the EUT. Activate those alerts and confirm by observation that their presentation is consistent as far as practicable with respect to how alerts are displayed, silenced and acknowledged on each of the locations of the EUT where the alerts are presented.

8.3 Priorities and categories

8.3.1 Priorities of alerts

8.3.1.1 Requirement

(MSC 252/19.1.1) *The alert management* shall *distinguish between the three priorities listed:*

- *Alarms*
- *Warnings and*
- *Cautions*

(MSC 252/19.1.2) *Alarms* shall *indicate situations or conditions requiring immediate attention, decision and if necessary action by the bridge team.*

(MSC 252/19.1.3) *Warnings* shall *indicate changed situations or conditions and* shall *be presented for precautionary reasons which are not immediately hazardous but which may become so, if no* forward-looking decision is made or *action is taken*.

(MSC 252/19.1.4) *Cautions* shall *indicate a condition which does not warrant an alarm or warning condition, but still requires attention and out of the ordinary consideration of the situation or of given information.*

8.3.1.2 Methods of test and required results

Refer to the manufacturer's documentation. For each of the alerts listed in Annex C simulate a failure situation that causes the alert and confirm by observation that it has the correct priority.

8.3.2 Criteria for classification of alerts

8.3.2.1 Requirement

(MSC 252/19.1.5) *Alerts additional to the alerts required by the* IMO shall *be assigned to a priority level using the criteria for classification.*

(MSC 252/19.2.1) *Criteria for classification* (i.e. prioritization) *of alarms:*

- *conditions requiring immediate attention, decision and if necessary action by the bridge team to avoid any kind of hazardous situation and to maintain the safe navigation of the ship*
- *or escalation required as alarm from a not acknowledged warning.*

(MSC 252/19.2.2) *Criteria for classification* (i.e. prioritization) *of warnings:*

- *conditions or situations which require immediate attention for precautionary reasons, to make the bridge team aware of conditions which are not immediately hazardous, but may become so.*

(MSC 252/19.2.3) *Criteria for classification* (i.e. prioritization) *of cautions:*

- *awareness of a condition which still requires attention out of the ordinary consideration of the situation or of given information.*

8.3.2.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that manufacturer defined alerts are in compliance with the criteria for classification of alerts.

8.3.3 Categories of alerts

8.3.3.1 Requirement

(MSC 252/19.3.1) *Alerts* shall *be separated for the alert handling in INS into two categories of alerts* – Category A alerts and Category B alerts.

(MSC 252/19.3.1.1) *Category A alerts are specified as alerts where graphical e.g. radar, ECDIS, information at the task station directly assigned to the function generating the alert is necessary, as decision support for the evaluation the alert related condition.*

Category A alerts shall *include alerts indicating:*

- *danger of collision*
- *danger of grounding.*

(MSC 252/19.3.1.2) *Category B alerts are specified as alerts where no additional information for decision support is necessary besides the information which can be presented at the central alert management HMI. Category B alerts are all alerts not falling under Category A.*

All alerts classified as cautions belong to Category B.

(MSC 252/19.4) *A classification in priorities and categories of alerts for INS and for alerts of the individual performance standards is attached as* Annex C*.*

8.3.3.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that alerts are categorized as A or B in compliance with the criteria for categorization.

8.4 State of alerts

8.4.1 General

8.4.1.1 Requirement

(MSC 252/20.1.1) *The presentation of alarms and warnings is defined in the performance standards for presentation of navigation-related information on shipborne navigational displays (Resolution MSC.191(79)).*

(MSC 252/20.1.2) *The state of an alert* (related information of an alert) shall *be unambiguous for the alert management, the INS and all associated operational and sensor/source displays*.

Announcement states and related condition are described in Table 4.

Table 4 – Announcement states and related conditions

Announcement state	Condition
active – unacknowledged	Alert condition still present, alert not acknowledged
active – silenced	Alert condition still present, alert silenced by the operator
active – acknowledged	Alert condition still present, alert acknowledged by the operator
active – responsibility transferred	Alert condition still present, the INS with additional system knowledge has taken over
rectified – unacknowledged	Alert condition rectified, alert still unacknowledged
active	Alert condition for caution present
normal	Alert condition not existing
NOTE 1 See 8.5.1 for reason for announcement state “Responsibility transferred”. NOTE 2 See state diagram in Figure J.5.	

Announcement states and their presentation are described in Table 5, Table 6, Table 7, Table M.1 and Table M.2. Text-based visual indication is mandatory. Optionally, icons can be presented together with the text, see Annex M.

Category A alerts cannot always be acknowledged in a task station. This condition is called as ‘acknowledge not allowed’. This condition shall be indicated. Optionally, icons can be used (see Tables M.1 and M.2).

Table 5 – Announcement state and presentation for Alarms

Announcement state	Visual indication	Audible indication
active – unacknowledged	Red flashing	3 short audible signals and shall be repeated every 7sec. (see 8.6.1.4.1) Speech output optional
active – silenced	Red flashing	Audible signal and speech output silent
active – acknowledged	Red steady, but distinguishable from other cases	Audible signal and speech output silent
active – responsibility transferred	Red steady , but distinguishable from other cases	Audible signal and speech output silent
rectified – unacknowledged	Red flashing, but distinguishable from other cases	Audible signal and speech output silent
normal	Not applicable	Not applicable
Remarks: • "rectified – unacknowledged" state is not applicable for navigational alarms such as CPA/TCPA. When CPA/TCPA alarm condition is rectified, the announcement state becomes "normal" immediately without acknowledgement. • If the user is required to read alarm text a marker symbol is required to flash rather than the text (IEC 60945:2002, 6.1.5). • When colour coding is used, it should be used in combination with other symbol attributes, such as size, shape and orientation (IMO MSC.191(79)/5.5.3). This can be used as guidance for distinguishable visual indications for each announcement state. • "distinguishable from other cases". Manufacturer can specify his own method or he can use icons available in Tables M.1 and M.2.		

Table 6 – Announcement state and presentation for Warnings

Announcement state	Visual indication	Audible indication
active – unacknowledged	Yellowish orange flashing	2 short audible signals and not to be repeated (see 7.6.1.4.1) Speech output optional and not to be repeated
active – silenced	Yellowish orange flashing	Audible signal and speech output silent
active – acknowledged	Yellowish orange steady, but distinguishable from other cases	Audible signal and speech output silent
active – responsibility transferred	Yellowish orange steady, but distinguishable from other cases	Audible signal and speech output silent
rectified – unacknowledged	Yellowish orange flashing, but distinguishable from other cases	Audible signal and speech output silent
normal	Not applicable	Not applicable
Remarks: • "rectified – unacknowledged" state is not applicable for navigational warnings. • "distinguishable from other cases". Manufacturer can specify his own method or he can use icons available in Tables M.1 and M.2.		

Table 7 – Announcement state and presentation for Cautions

Announcement state	Visual indication	Audible indication
active	Yellow	Audible signal and speech output silent
normal	Not applicable	Not applicable

8.4.1.2 Methods of test and required results

Confirm by observation that the presentation of alarms and warnings is in compliance with IEC 62288 as appropriate.

Methods of test and required results are described in 8.4.2, 8.4.3 and 8.4.4.

8.4.2 Alarms

8.4.2.1 Different announcement states

8.4.2.1.1 Requirement

(MSC 252/20.2.1) *The alert management* shall *distinguish between different announcement states of each individual alarm:*

- *unacknowledged alarm*
- *acknowledged alarm.*

(See Table 4, Table 5, Table M.1 and Table M.2.)

8.4.2.1.2 Methods of test and required results

Methods of test and required results are described in 8.4.2.2 and 8.4.2.5.

8.4.2.2 Unacknowledged alarm

8.4.2.2.1 Requirement

(MSC 252/20.2.2) *When an alarm condition is detected, it* shall *be indicated as unacknowledged alarm:*

a) initiate an audible signal, accompanied by the visual alarm announcement;

NOTE 1 IEC 60945:2002, 4.2.2.2 contains generic requirement for sound pressure level.

b) provide a message on HMI *of sufficient detail to enable the bridge team to identify and address the alarm condition;*

c) *may be accompanied by speech output presented at least in English.* There shall be only one speech output within the EUT at any given time. The visual announcement and speech output shall occur simultaneously. The audio signal shall be announced before the speech output.

NOTE 2 IEC 60945:2002, 4.2.1.6 contains generic requirements for voice announcements.

The speech output shall use plain language using marine terminology as defined in SMCP as appropriate. The volume shall be adjustable to extinction without affecting the sound pressure level of the audible signal. Failure of the speech output shall not degrade operation of visual indication or operation of audible signal.

(MSC 252/20.2.3) *An unacknowledged alarm* shall *be clearly distinguishable from those existing and already acknowledged. Unacknowledged alarms* shall *be indicated flashing and by an audible signal.*

(MSC 252/20.2.4) *The characteristics of the audible alarm signal, whether used singly or in combination with speech,* shall *be such that there is no possibility of mistaking it for the audible signal used for a warning.*

8.4.2.2.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 3 Category A and 3 Category B alarms where the INS does not change the alert state after evaluation (see 8.5.1). Confirm by observation that:

- each alarm is indicated as "active – unacknowledged" alarm in compliance with Table 5, Table M.1(if icon provided) and Table M.2 (if icon provided) together with associated descriptive text at least both on CAM HMI(s) and on HMI(s) directly assigned to the function generating the alarm;
- audible signal in compliance with Table 5 occurs for:
  - Category A alarm only at HMI of task stations directly assigned to the function generating the alarm;
  - Category B alarm both at CAM HMI(s) and at HMI(s) directly assigned to the function generating the alarm.

If speech output is provided, confirm by observation that:

- the audio signal as defined in Table 5 occurs before the speech output;
- the same speech is repeated as long as the alarm is unacknowledged;
- only one speech output is announced at any given time;
- speech output is at least in plain English language, using marine terminology conforming with the SMCP where appropriate;
- it is possible to adjust the speech volume to extinction without affecting the audible signal.

Follow manufacturer's instructions and cause failure of the speech output. Confirm by observation that visual indication and audible signal remain as defined in Table 5, Table M.1 and Table M.2.

8.4.2.3 Silencing of alarms

8.4.2.3.1 Requirement

(MSC 252/20.2.5) *It* shall *be possible to temporarily silence alarms* and speech output, if provided*. If an alarm is not acknowledged within 30 s the audible signal* and the speech output shall *start again in case the announcement state is still "active – unacknowledged" or as specified in the equipment performance standards.*

It shall be possible to temporarily silence all alerts independent of category within the INS (see 8.6.2.1). At least this function shall be available at CAM HMI.

If the source of the alert is external to the EUT then the relevant alert command shall be generated in the relevant interface (see 8.9.4 for detailed requirements and test methods).

A prolonged activation of temporary silence command shall not prevent reactivation of the audible signal and speech output of an alert after 30 s.

Activation of temporary silence shall not prevent audible signal and speech output of new alerts.

8.4.2.3.2 Methods of test and required results

Refer to the manufacturer's documentation to identify all methods of temporary silencing of all alerts. Use the same alarms as in 8.4.2.2.2 and activate them all in parallel. Confirm by observation for CAM-HMI and for all other available methods of temporary silence that:

- the audible signal and speech output for all alerts stops when the temporary silence is activated;
- the audible signal and the speech output start again after 30 s if the alarm condition is not rectified and the alarm is not acknowledged;
- a prolonged activation of temporary silence command for longer than 30 s does not prevent start of the audible signal and the speech output after 30 s from initial activation of the temporary silence;
- activation of temporary silence command does not prevent start of the audible signal and the speech output for new alerts.

Refer to the manufacturer's documentation to identify all methods of temporary silencing of subset of alerts at task station(s). If provided, use the same alarms as in 8.4.2.2.2 and activate them all in parallel. Confirm by observation for all available methods of temporary silence that:

- the audible signal and speech output for the alerts stops when the temporary silence is activated;
- the audible signal and the speech output start again after 30 s if the alarm condition is not rectified and the alarm is not acknowledged;
- a prolonged activation of temporary silence command for longer than 30 s does not prevent start of the audible signal and the speech output after 30 s from initial activation of the temporary silence;
- activation of temporary silence command does not prevent start of the audible signal and the speech output for new alerts.

Refer to interfaces in Annex F to select 2 interfaces. Generate 1 Category A and 3 Category B alarms where the INS does not change the alert state after evaluation (see 8.5.1). Confirm by observation that the temporary silence command on the EUT generates a silence command sentence on the interface.

8.4.2.4 Continuation of alarm

8.4.2.4.1 Requirement

(MSC 252/20.2.6) *The audible signal, if not temporarily silenced, and the visual signal for an unacknowledged alarm* shall *continue until the alarm is acknowledged, except specified otherwise in the equipment performance standards*, e.g. for CPA/TCPA alerts where the visual signal can be ceased when the alarm condition is rectified.

The BAM performance standards specify that the audible signal shall cease when the alarm condition is rectified (See MSC 302(87)/3.6 and 302(87)/7.3.8). Therefore the audible signal of each alarm within the INS shall cease when the corresponding alarm condition is rectified.

If a sensor/source or function external to the EUT that generated an alert is no longer in use but not in failure, then depending of the type of sensor/source it is assumed to:

- continue to report ALR-sentence with no active alerts (see Clause J.3 and Annex L); or
- continue to report heartbeat HBT-sentence and alert list ALC-sentence with no active alerts (see Clause J.4).

If a sensor/source or function within the EUT that generated an alert is no longer in use but not in failure, then the EUT in its related output interfaces (see Annex F) shall continue to

report heartbeat HBT-sentence and alert list ALC-sentence with no active alerts. For example, cross track distance alert in case of switching off track control, collision avoidance alerts when switching radar to stand-by.

8.4.2.4.2 Methods of test and required results

Use same alarms as in 8.4.2.2.2. Generate the alarms, do not acknowledge them and rectify the alarm condition. Confirm by observation that:

- the audible signal stops after the alarm condition is rectified;
- if provided, the speech announcement stops after the alarm condition is rectified;
- a flashing visual indication in compliance with Table 5 is available after the alarm condition is rectified.

Refer to the manufacturer's documentation. Generate 3 alarms for which an equipment performance standard allows removal of the alarm after the alarm condition is rectified, e.g. CPA/TCPA alert. Generate the alarms, do not acknowledge them and rectify the alarm condition. Confirm by observation that:

- the alarm including visual indication and audible signal disappears after the alarm condition is rectified;
- if provided, speech announcement stops after the alarm condition is rectified.

Refer to the manufacturer's documentation. If available, generate 3 alarms for which the alert generating function within the EUT can be switched off without interrupting the alert related communication. Do not acknowledge them and switch off the generating function. Confirm by observation that:

- the alarm including visual indication and audible signal disappears after the alarm generating function is switched off;
- the relevant output interfaces of the EUT continue to report HBT-sentence and report ALC-sentence with no active alerts;
- if provided, speech announcement stops after the alarm generating function is switched off.

Refer to interfaces in Annex F to select 2 interfaces. Generate 3 alarms for which the alert generating function external to the EUT can be switched off without interrupting the alert related communication. Confirm by observation that:

- the alarm including visual indication and audible signal disappears after reception of relevant ALR or ALC-sentence;
- if provided, speech announcement stops after reception of relevant ALR or ALC-sentence.

8.4.2.5 Acknowledged or responsibility transferred alarm

8.4.2.5.1 Requirement

(MSC 252/20.2.7) *An acknowledged alarm* and a responsibility transferred alarm shall *be indicated by a steady visual indication.*

8.4.2.5.2 Methods of test and required results

Use same alarms as in 8.4.2.2.2. Generate the alarms. Confirm by observation that:

- the audible signal and speech output stop after the acknowledgement, see Table 5;
- the visual indication changes to steady after the acknowledgement, see Table 5, Table M.1 and Table M.2.

NOTE Above are tests for indication. Note that acknowledgement of an alarm depends on location (CAM-HMI or HMI of task stations directly assigned to the function generating the alarm) and category of alarm. Perform these tests in such location where acknowledgement is possible.

Generate a condition that causes an alarm with state responsibility transferred. Confirm by observation that:

- the audible signal and speech output remain silent in responsibility transferred state, see Table 5;
- the visual indication is steady in responsibility transferred state, see Table 5, Table M.1 and Table M.2.

8.4.2.6 Visual signal

8.4.2.6.1 Requirement

(MSC 252/20.2.8) *The visual signal for an acknowledged alarm* and responsibility transferred alarm shall *continue until the alarm condition is rectified.*

8.4.2.6.2 Methods of test and required results

Use same alarms as in 8.4.2.2.2. Generate the alarms and acknowledge them. Confirm by observation that the alarm including visual indication disappears after the alarm condition is rectified.

Generate a condition that causes an alarm with state responsibility transferred. Confirm by observation that the alarm including visual indication disappears after the condition is rectified.

8.4.3 Warnings

8.4.3.1 Different announcement states

8.4.3.1.1 Requirement

(MSC 252/20.3.1) *The alert management* shall *distinguish between different announcement states of each individual warning:*

- *unacknowledged warning*
- *acknowledged warning.*

(See Table 4, Table 6, Table M.1 and Table M.2).

8.4.3.1.2 Methods of test and required results

Methods of test and required results are described in 8.4.3.2 and 8.4.3.4.

8.4.3.2 Indication of unacknowledged warning

8.4.3.2.1 Requirement

(MSC 252/20.3.2) *When a warning condition is detected, it* shall *be indicated as unacknowledged warning:*

a) initiate an momentarily audible signal, accompanied by the visual warning announcement;

b) provide a message on HMI *of sufficient detail to enable the bridge team to identify and address the warning condition;*

c) *may be accompanied by speech output presented at least in English.* The visual announcement and speech output shall occur simultaneously. The audio signal shall be announced before the speech output.

NOTE IEC 60945:2002, 4.2.1.6 contains generic requirements for voice announcements.

The speech output shall use plain language using marine terminology as defined in SMCP, as appropriate. The volume shall be adjustable to extinction without affecting the sound pressure level of the audible signal. Failure of the speech output shall not degrade operation of visual indication or operation of audible signal.

(MSC 252/20.3.3) *An unacknowledged warning* shall *be clearly distinguishable from those existing and already acknowledged. Unacknowledged warnings* shall *be indicated by a flashing and by a* momentarily *audible signal.*

(MSC 252/20.3.4) *When a warning occurs a momentarily audible signal* shall *be given. The characteristics of the audible warning signal, whether used singly or in combination with speech,* shall *be such that there is no possibility of mistaking it for the audible signal used for an alarm.*

The speech output, if provided, shall not repeat for warnings.

8.4.3.2.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 3 Category A and 3 Category B warnings where the INS does not change the alert state after evaluation (see 8.5.1). Confirm by observation that:

- each warning is indicated as "active – unacknowledged" warning in compliance with Table 6, Table M.1 (if icon provided) and Table M.2 (if icon provided) together with associated descriptive text at least both on CAM HMI(s) and on HMI(s) directly assigned to the function generating the warning;
- audio signal in compliance with Table 6 occur for:
  - Category A warning only at HMI of task station directly assigned to the function generating the warning;
  - Category B warning both at CAM HMI(s) and at HMI(s) directly assigned to the function generating the warning.

If speech output is provided, confirm by observation that:

- the audio signal as defined in Table 6 occurs before the speech output;
- speech is not repeated;
- only one speech output is announced at any given time;
- speech output is at least in plain English language, using marine terminology conforming with the SMCP where appropriate;
- it is possible to adjust the speech volume to extinction without affecting the audible signal.

Follow manufacturer's instructions and cause failure of the speech output. Confirm by observation that visual indication and audible signal remain as defined in Table 6, Table M.1 and Table M.2.

8.4.3.3 Silencing of warnings

8.4.3.3.1 Requirement

It shall be possible to temporarily silence warnings and speech output, if provided (see also 8.4.2.3.1). If a warning is not acknowledged within 30 s the audible signal and the speech output shall start again in case the announcement state is still "active – unacknowledged" or as specified in the equipment performance standards.

It shall be possible to temporarily silence all alerts independent of category within the INS (see 8.6.2.1). At least this function shall be available at CAM HMI.

If the source of the alert is external to the EUT then relevant alert command shall be generated in the relevant interface (see 8.9.4 for detailed requirements and test methods).

A prolonged activation of a temporary silence command shall not prevent reactivation of the audible signal and speech output of an alert after 30 s.

Activation of temporary silence shall not prevent an audible signal and speech output of new alerts.

NOTE The audible indication of a warning is 2 short audible signals. The temporary silence of warning function is executed for any unacknowledged warning independent if the audible signal was active or not.

8.4.3.3.2 Methods of test and required results

Refer to the manufacturer's documentation to identify all methods of temporary silencing of all alerts. Use the same warnings as in 8.4.3.2.2 and activate them all in parallel. Confirm by observation for CAM-HMI and for all other available methods of temporary silence that:

- the audible signal and speech output for all alerts stops when the temporary silence is activated;
- the audible signal and the speech output start again after 30 s if the warning condition is not rectified and the warning is not acknowledged;
- a prolonged activation of temporary silence command for longer than 30 s does not prevent the start of the audible signal and the speech output after 30 s from initial activation of the temporary silence;
- the activation of a temporary silence command does not prevent the start of the audible signal and the speech output for new alerts.

Refer to the manufacturer's documentation to identify all methods of temporary silencing of the subset of alerts at task station(s). If provided, use the same warnings as in 8.4.3.2.2 and activate them all in parallel. Confirm by observation for all available methods of temporary silence that:

- the audible signal and speech output for the alerts stops when the temporary silence is activated;
- the audible signal and the speech output start again after 30 s if the warning condition is not rectified and the warning is not acknowledged;
- a prolonged activation of temporary silence command for longer than 30 s does not prevent the start of the audible signal and the speech output after 30 s from the initial activation of the temporary silence;
- the activation of a temporary silence command does not prevent the start of the audible signal and the speech output for new alerts.

Refer to interfaces in Annex F to select 2 interfaces. Generate 1 Category A and 3 Category B warnings where the INS does not change the alert state after evaluation (see 8.5.1). Confirm by observation that the temporary silence command on the EUT generates a silence command sentence on the interface.

8.4.3.4 Continuation of warning

8.4.3.4.1 Requirement

(MSC 252/20.3.5) *The visualization for an unacknowledged warning* shall *continue until the warning is acknowledged, except specified otherwise in the equipment performance standards.*

If a sensor/source or function external to the EUT that generated an alert is no longer in use but not in failure, then depending of the type of sensor/source it is assumed to:

- continue to report ALR-sentence with no active alerts (see Clause J.3 and Annex L); or
- continue to report heartbeat HBT-sentence and alert list ALC-sentence with no active alerts (see Clause J.4).

If a sensor/source or function within the EUT that generated an alert is no longer in use but not in failure, then the EUT in its related output interfaces (see Annex F) shall continue to report heartbeat HBT-sentence and alert list ALC-sentence with no active alerts. For example off heading alert in case heading control is switched off.

8.4.3.4.2 Methods of test and required results

Use same warnings as in 8.4.3.2.2. Generate the warnings, do not acknowledge them and rectify the warning condition. Confirm by observation that a flashing visual indication in compliance with Table 6 is available after the warning condition is rectified.

Refer to the manufacturer's documentation. If available, generate 3 warnings for which an equipment performance standard allows removal of the warning after the warning condition is rectified. Generate the warnings, do not acknowledge them and rectify the warning condition. Confirm by observation that the warning including visual indication disappears after the warning condition is rectified.

Refer to the manufacturer's documentation. If available, generate 3 warnings for which the alert generating function within the EUT can be switched off without interrupting the alert related communication. Do not acknowledge them and switch off the generating function. Confirm by observation that:

- the warning including visual indication disappears after the warning generating function is switched off;
- the relevant output interfaces of the EUT continue to report HBT-sentence and report ALC-sentence with no active alerts.

Refer to interfaces in Annex F to select 2 interfaces. Generate 3 warnings for which the alert generating function external to the EUT can be switched off without interrupting the alert related communication. Confirm by observation that the warning including visual indication disappears after reception of the relevant ALR or ALC-sentence.

8.4.3.5 Acknowledged or responsibility transferred warning

8.4.3.5.1 Requirement

(MSC 252/20.3.6) *An acknowledged warning* and a responsibility transferred warning shall *be indicated by a steady visual indication.*

8.4.3.5.2 Methods of test and required results

Use same warnings as in 8.4.3.2.2. Generate the warnings. Confirm by observation that the visual indication changes to steady after the acknowledgement, see Table 6, Table M.1 and Table M.2.

Generate a condition that causes a warning with state responsibility transferred. Confirm by observation that the visual indication is steady in responsibility transferred state, see Table 6, Table M.1 and Table M.2.

8.4.3.6 Visual signal

8.4.3.6.1 Requirement

(MSC 252/20.3.7) *The visual signal for an acknowledged warning* and for a responsibility transferred warning shall *continue until the warning condition is rectified.*

8.4.3.6.2 Methods of test and required results

Use same warnings as in 8.4.3.2.2. Generate the warnings and acknowledge them. Confirm by observation that the warning including visual indication disappears after the alert condition is rectified.

Generate a condition that causes a warning with state responsibility transferred. Confirm by observation that the warning including visual indication disappears after the condition is rectified.

8.4.4 Cautions

8.4.4.1 Indication

8.4.4.1.1 Requirement

(MSC 252/20.4.1) *A caution* shall *be indicated by a steady visual indication. No acknowledgement* shall *be necessary for a caution.*

A caution shall be silent and is not allowed to be accompanied by audible signal or speech output.

(MSC 252/20.4.3) *A message* shall *be provided* on HMI *of sufficient detail to enable the bridge team to identify and address the caution condition.*

8.4.4.1.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 3 cautions. Confirm by observation that:

- each caution is indicated as "active" caution in compliance with Table 7, Table M.1(if icon provided) and Table M.2 (if icon provided) together with associated descriptive text at least both on CAM HMI(s) and on HMI(s) directly assigned to the function generating the caution;
- audio signal is silent for cautions.

If speech output is provided, confirm by observation that the speech output is silent for cautions.

8.4.4.2 Removal of caution

8.4.4.2.1 Requirement

(MSC 252/20.4.2) *A caution* shall *be automatically removed after the condition is rectified*.

8.4.4.2.2 Methods of test and required results

Use same cautions as in 8.4.4.1.2. Generate the cautions. Confirm by observation that the caution including its visual indication disappears after the alert condition is rectified.

8.4.5 Alert escalation

8.4.5.1 Transfer to BNWAS

8.4.5.1.1 Requirement

(MSC 252/20.5.1) *After a time defined by the user unless otherwise specified by the* IMO*, an unacknowledged alarm* shall *be transferred to the bridge navigational watch alarm system (BNWAS), if available. The unacknowledged alarm* shall *remain visible and audible.*

Silencing of an alarm extends the transfer timeout by 30 s. This extension of transfer timeout is only done once.

In this context, “rectified – unacknowledged” alarms are not considered to be unacknowledged alarms because they are silent.

NOTE 1 Refer to Annex C for alarms to be transferred.

NOTE 2 For track control related alerts the time is defined as 30 s (see IMO MSC.74(69) annex 2, paragraphs 5.1.6 and 5.3.4).

NOTE 3 BNWAS has its own definition for how an unacknowledged alarm is transferred to it (see IEC 62616:2010, 3.1.4). The relevant INS sentence is defined in Clause J.2.

8.4.5.1.2 Methods of test and required results

Confirm by inspection of manufacturer’s documentation that the EUT provides at least one of the standardized methods specified in IEC 62616.

Confirm by observation that the EUT transfers the event of an unacknowledged alarm

- for track control related alarms after 30 s, if track control is part of the EUT,
- for any other unacknowledged alarm after a time defined by the user.

8.4.5.2 Change of priority

8.4.5.2.1 Requirement

(MSC 252/20.5.2) *An unacknowledged warning* shall *be changed to alarm priority, as required by specific requirements for the individual equipment or after 60 s unless otherwise set by the user.*

(MSC 252/20.5.3) *The alert escalation* shall *be in compliant with the alert escalation requirements of the individual performance standards.*

NOTE 1 MSC.302/7.6.2 requires that an unacknowledged warning be:

- repeated as a warning after a limited time period not exceeding 5 min; or
- changed to alarm priority after a limited time period not exceeding 5 min; or
- changed to alarm priority after a user selectable time of not more than 5 min, if provided; or
- changed to alarm priority, as required by specific requirements for the individual equipment and system.

If the individual equipment standard does not specify mandatory rules for alert escalation then, based on the manufacturer's design, a warning shall either be

- repeated as a warning after 60 s, or
- changed to alarm after 60 s, or
- changed to alarm after an user selectable time period of maximum 5 min.

NOTE 2 Track control (see IMO MSC.74(69) annex 2) specifies escalation sequence of “early course change indication” and “actual course change indication”. Annex C classes both “early course change indication” and “actual course change indication” as warnings.

8.4.5.2.2 Methods of test and required results

Confirm by inspection of manufacturer’s documentation that the default value for alert escalation is either 60 s or a value specified for individual equipment.

If provided, confirm by observation that the user selectable time period for alert escalation is less than 5 min.

Confirm by inspection of manufacturer's documentation that the manufacturer provides information about

- which warnings are repeated as warning after 60 s,
- which warnings are handled as required by individual performance standards, and
- which warnings are changed to alarms either after 60 s or after a user selectable time period.

Refer to the manufacturer's documentation to identify 2 cases, if available, in which a warning is repeated as warning. Confirm by observation that time between repetition is 60 s.

Refer to the manufacturer's documentation to identify 2 cases, if available, in which a warning is changed to alarm. Confirm by observation that the time between change of priority is either 60 s or selectable up to 5 min by the user.

Refer to the manufacturer's documentation to identify 2 cases, if available, in which individual performance standards specify the rule for alert escalation. Confirm by observation that the rule specified for the individual performance standards is used.

8.5 Consistent presentation of alerts within the INS

8.5.1 Requirement

(MSC 252/21.1.1) *To ensure a consistent presentation of alerts and the presentation of a reduced number of high priority alerts within the INS:*

1. *the alerts released by navigational functions, sensors, sources* shall *be presented as far as practicable, after evaluation with the system knowledge of the INS, to reduce the number of high priority alerts;*

   NOTE Responsibility transferred is the process used to inform functions, sensors and/or sources that after evaluation the INS with its system knowledge has taken the responsibility in order to reduce the number of high priority alerts.

2. *the priority of the alert is to be defined in compliance with the relevant paragraphs of this performance standards;*

3. *the priority of any alert* shall *be assigned and presented consistently for all parts of the INS;*

4. *the alert releasing sensor/source or function (system)* shall *provide the alert related information of the alert message* on HMI *for explanation and decision support, including information for user support in respect to the alert messages, as far as possible;*

5. *if additional information regarding decision support and user guidance is available with the system knowledge of the INS, this information* shall *be made available for the user;*

6. *HMI's presenting alert information* shall *have the capability to present the alert information, provided by the alert releasing sensor/source or function (system) and the information added with system knowledge of the INS.*

8.5.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 1 alarm and 1 warning of Category A and 1 alarm and 1 warning of Category B. Confirm by observation that the:

- priority of the alert generated by the EUT is categorised according to criteria for classification of alerts as stated in 8.3.2;

- alert is presented consistently and in compliance with Table 5, Table 6, Table M.1 and Table M.2 together with associated descriptive text on HMI in all parts within the EUT;
- EUT provides additional guidance for decision to the operator utilising its advanced knowledge of the overall system configuration and available data, if applicable;
- HMIs presenting alert information within an EUT present the alert and guidance for decision information provided by the alert releasing sensor/source or function (system) together with the additional information added for guidance for decision by EUT utilising its advanced knowledge of the whole system if applicable.

Confirm by inspection of the manufacturer's documentation that an EUT can utilise its advanced knowledge of the overall system configuration and available data to reduce the number of high priority alerts within the EUT.

NOTE 1 After evaluation, the INS with its system knowledge may have executed responsibility transfer and generated a new alert of lower priority.

Refer to the manufacturer's documentation to select 3 Category A and 3 Category B alarms where the INS does change the alert state after evaluation. Generate those alerts and confirm by observation that:

- the new alert is indicated as "active – unacknowledged" warning or as "active" caution in compliance with Table 6, Table 7, Table M.1 and Table M.2 together with associated descriptive text on HMI;
- the original alarm is, at least on demand, indicated as "active – responsibility transferred" alarm in compliance with Table 5, Table M.1 and Table M.2;
- the alert communication in the interface of the EUT (see Annex F) was executed as specified for alert communication (see Annex K).

Refer to the manufacturer's documentation to select 3 Category A and 3 Category B warnings where the INS changes the alert state after evaluation. Generate those alerts and confirm by observation that:

- the new alert is indicated as "active" caution in compliance with Table 7, Table M.1 and Table M.2 together with associated descriptive text on HMI;
- the original warning is, at least on demand, indicated as "active – responsibility transferred" warning in compliance with Table 6, Table M.1 and Table M.2;
- the alert communication in the interface of the EUT (see Annex F) was executed as specified for alert communication (see Annex K).

Refer to the manufacturer's FMEA documentation to select a sensor failure for a sensor not selected for use and for which there is a second active redundant sensor available, e.g. heading sensors.

- Simulate this failure of one sensor and confirm by observation that a caution is presented consistently and in compliance with Table 7 (see 8.4.1.1) together with associated descriptive text on HMI in all parts within the EUT,
- Simulate failure of both sensors and confirm by observation that an alert is presented consistently and in compliance with Table C.1 and Table C.2 of Annex C together with associated descriptive text on the HMI in all parts within the EUT.

NOTE 2 The focus of these tests is to be put on the alert presentation of the specifically generated alert. Generating those specific alerts by failure simulation may cause additional alerts and functional aspects which are not part of these specific tests.

NOTE 3 These tests may be performed by releasing one alert at a time or all alerts simultaneously.

8.6 Central alert management HMI

8.6.1 General requirements

8.6.1.1 Display of alerts

(MSC 252/22.1) *All alerts* shall *be displayed on the central alert management HMI.*

See 7.6.1.9.1

8.6.1.2 Aggregated alerts

8.6.1.2.1 Requirement

(MSC 252/22.2) *The central alert management HMI* shall *offer the possibility to display Category A alerts as "aggregated alerts", i.e., a single visual indication indicates the existence of many alerts on the task station presenting the function, e.g. one alert* shall *indicate the existence of multiple dangerous target alerts existing at the task station for collision avoidance.*

NOTE 1 Availability of aggregated alert version is mandatory for dangerous target alerts. Optionally, it is allowed to offer also individual alert presentation.

NOTE 2 Aggregation of alerts is not limited to Category A. BAM (see IMO MSC.302(87)) specify rules for aggregation of alerts which are not required by the IMO.

8.6.1.2.2 Methods of test and required results

Generate at least 2 targets which trigger the CPA/TCPA alarm. Confirm by observation that the CPA/TCPA alarm can be presented as an aggregated alert.

Refer to the manufacturer's documentation. If there are other aggregated alerts than the CPA/TCPA alarm, generate at least one scenario of aggregated alert other than CPA/TCPA and confirm by observation that the central alert management HMI is able to present the alert as an aggregated alert.

8.6.1.3 Announcement and indication of alerts

8.6.1.3.1 Requirement

(MSC 252/22.3) *The central alert management HMI* shall *provide the means to announce and indicate alerts to draw the attention of the bridge team.*

8.6.1.3.2 Methods of test and required results

Methods of test and required results are described in 8.6.1.4.2 and 8.6.1.9.2.

8.6.1.4 Audible announcement at CAM HMI and at individual equipment

8.6.1.4.1 Requirement

(MSC 252/22.4) *The central alert management HMI* shall *have the capability to substitute the audible alert announcement of the individual equipment* within the EUT*, except for Category A alerts.*

(MSC 252/21.2) *The audible announcement of Category A alerts* shall *occur at the task stations or displays which are directly assigned to the function generating the alert.*

NOTE Requirements of MSC.302(87) BAM shall take precedence over the requirements of MSC.252(83) INS, see MSC.302(87)/3.6.

(MSC.302/8.2) Audible annunciation of Category A shall only occur at the task station, system or sensor directly assigned to the function generating the alert.

(MSC.302/8.3) The audible annunciation of Category B alerts shall be duplicated at the CAM HMI.

8.6.1.4.2 Methods of test and required results

Methods of test and required results are described in 8.4.2.2.2 and 8.4.3.2.2.

8.6.1.5 Identification of alerts

8.6.1.5.1 Requirement

(MSC 252/22.5) *The central alert management HMI* shall *allow to identify alerts, and enable the immediate identification of the alert releasing function or sensor/source.*

8.6.1.5.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 5 alerts from different functions or sensor/sources. Confirm by observation that the central alert management HMI allows the immediate identification of the alert releasing function or sensor/source.

8.6.1.6 Alerts of different priorities

8.6.1.6.1 Requirement

(MSC 252/22.6) *The central alert management HMI* shall *be designed that alert messages of the different priorities are clearly distinguishable from each other.*

8.6.1.6.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate an alert of each priority and confirm by observation that those alerts are presented in a manner to be clearly distinguishable from each other (see Table 5, Table 6, Table 7, Table M.1 and Table M.2).

8.6.1.7 Aids for decision making

8.6.1.7.1 Requirement

(MSC 252/22.7) *The alert messages* shall *be completed with aids for decision making, as far as practicable. An explanation or justification of an alert* shall *be available on request.*

NOTE 1 ALF-sentence is available to provide "Alert description text".

NOTE 2 The alert generating function, sensor or source is assumed to provide "Alert description text", as far as practicable.

NOTE 3 The CAM-HMI is assumed to have available capability to show the content of the "Alert description text", if provided by the function, sensor or source.

8.6.1.7.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate an alert for which "Alert description text" is provided. Confirm by observation that on request it is displayed on the centralized alert management HMI.

Refer to the manufacturer's documentation. Generate an alert for which "Alert description text" is not provided. Confirm by observation that on request the centralized alert management HMI informs that there are no aids for decision making available.

8.6.1.8 Immediate acknowledgement

8.6.1.8.1 Requirement

(MSC 252/22.8) *The central alert management HMI* shall *enable an immediate acknowledgement of the alarms and warnings by a single operator action, except for Category A.*

If appropriate graphical information is available in conjunction with CAM-HMI in a task station, then such Category A alerts can be acknowledged at that CAM-HMI immediately by single operator action.

A single operator action shall acknowledge one single individual alert.

8.6.1.8.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 3 Category B alarms and 3 Category B warnings. Confirm by observation that each individual alert can be acknowledged at CAM HMI by a single operator action.

Refer to the manufacturer's documentation. Generate 3 Category A alarms and 3 Category A warnings. Confirm by observation that the individual alert cannot be acknowledged at CAM-HMI unless appropriate graphical information is available in conjunction with the CAM-HMI.

8.6.1.9 Display of alerts

8.6.1.9.1 Requirement

(MSC 252/22.9) *The central alert management HMI* shall *be able to display at least 20 recent alerts at the same time.*

Alerts with an announcement state "active-responsibility transferred" shall at least be presented on request.

(MSC 252/22.10) *If the central alert management HMI is such that it can not contain all active* and rectified-unacknowledged alert *messages requiring the bridge team's attention, then there* shall *be a clear and unambiguous indication that there are additional active* or rectified-unacknowledged alert *messages requiring attention*.

(MSC 252/22.11) *It* shall *be possible to display the additional active* alert *messages by a single operator action.*

At least next 20 active or rectified – unacknowledged alert messages shall be available for display by single operator action.

(MSC 252/22.12) *It* shall *be possible to return to the display containing the highest priority alerts by a single operator action.*

(MSC.302/9.16) *As default alerts* shall *be presented grouped in order of priority. Within the priorities the alerts* shall *be displayed in order in which they occur (sequence).*

Priority order for alerts is:

- unacknowledged alarms in order of which they occur (sequence);
- unacknowledged warnings in the order of which they occur (sequence);
- rectified – unacknowledged alarms in the order of which they occur (sequence);
- rectified – unacknowledged warnings in the order of which they occur (sequence);

- acknowledged alarms in the order of which they occur (sequence);
- acknowledged warnings in the order which they occur (sequence);
- cautions in the order of which they occur (sequence).

8.6.1.9.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate 20 alerts and confirm by observation that all 20 alerts can be presented simultaneously on the CAM-HMI at least on request.

Refer to the manufacturer's documentation. Generate a condition that causes an alert with state responsibility transferred. Confirm by observation that at least on request it is presented on the CAM-HMI.

Refer to the manufacturer's documentation to identify how many alerts can be displayed simultaneously. Generate more alerts than can be displayed simultaneously at the display of CAM-HMI. Confirm by observation that a clear and unambiguous indication is provided to indicate that there are additional active or rectified-unacknowledged alerts requiring attention. Confirm by observation that it is possible to display additional alerts by single operator action. Generate even more alerts. Confirm by observation that it is possible to display the next 20 alerts by single operator actions.

Confirm by observation that it is possible to return to the display containing the highest priority alerts by a single operator action.

8.6.2 Silencing of audible alerts

8.6.2.1 Requirement

(MSC 252/22.13.1) *It* shall *be possible to temporarily silence all audible alerts* and speech output, if provided, *at the central alert management HMI.*

(MSC 252/22.13.2) *The audible signal* shall *be reactivated, if the alert has not been acknowledged within the specified times in paragraph 20* (see 8.4.2.3 and 8.4.3.3) *for alarms and warnings.*

8.6.2.2 Methods of test and required results

See 8.4.2.5.2.

8.6.3 Category A and B alert history list

8.6.3.1 History list

8.6.3.1.1 Requirement

(MSC 252/22.14.1) *An operator accessible alert history list* shall *be provided by the central alert management HMI.*

The alert history list shall contain both Category A and Category B alerts.

8.6.3.1.2 Methods of test and required results

Confirm by observation that an operator accessible history list is available at CAM-HMI.

8.6.3.2 Retention of alert

8.6.3.2.1 Requirement

(MSC 252/22.14.2) *When a Category* A and *B alert is no longer active the message* shall *be kept with its entire content in an alert history list, with the date and time the alert was raised, acknowledged and rectified.*

8.6.3.2.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate a Category B alert, silence it, acknowledge it, rectify its alert condition and confirm by observations that all actions with text, time and state information are still listed within the alert history list. Repeat above for a Category A alert.

8.6.3.3 Order of messages

8.6.3.3.1 Requirement

(MSC 252/22.14.3) *The messages of the alert history list* shall *be displayed in chronological order.*

8.6.3.3.2 Methods of test and required results

Refer to the manufacturer's documentation. Generate minimum 2 Category A and B alerts, silence them, acknowledge them, rectify their alert condition and confirm by observation that all actions with text, time and state information are displayed within the alert history list in chronological order.

8.6.3.4 Access to list

8.6.3.4.1 Requirement

(MSC 252/22.14.4) *Access to the alert history list and return to the active alert display* shall *be possible by a simple operator action.*

8.6.3.4.2 Methods of test and required results

Switch between the alert history list and the active alert display and confirm by observation that this can be carried out by a simple operator action.

8.6.3.5 Indication of access

8.6.3.5.1 Requirement

(MSC 252/22.14.5) *The system* shall *provide a clear and unambiguous indication when the alert history list is being accessed and displayed.*

8.6.3.5.2 Methods of test and required results

Activate the presentation of the alert history list and confirm by observation that it is clearly indicated that the history list presentation mode is active.

8.6.3.6 New alert condition

8.6.3.6.1 Requirement

(MSC 252/22.14.6) *The system* shall *revert automatically to the active alert display when it detects a new alert condition.*

NOTE Requirements of MSC.302(87) BAM take precedence over the requirements of MSC.252(83) INS, see MSC.302(87)/3.6.

(MSC.302/9.15) *When information other than the list of active alerts (e.g., the alert history list, configurations) is presented, then it* shall *still be possible to see the appearance of new alerts.*

8.6.3.6.2 Methods of test and required results

Select the presentation of the alert history list. Generate a new active alert. Confirm by observation that it is possible to see the appearance of a new alert.

8.6.3.7 Search of alerts

8.6.3.7.1 Requirement

(MSC 252/22.14.7) *The central alert management HMI* shall *support the search and identification of alerts in the alert history list.*

8.6.3.7.2 Methods of test and required results

Confirm by observation that the central alert management HMI supports the search and identification of alerts in the alert history list.

8.6.3.8 Retention of content

8.6.3.8.1 Requirement

(MSC 252/22.14.8) *It* shall *be possible to keep the content of the alert history list at least for 24 h.*

8.6.3.8.2 Methods of test and required results

Generate alerts and confirm by observation that the entry in the history list is kept for a minimum of 24 h.

8.7 Acknowledgement location

8.7.1 Requirement

(MSC 252/23.1.1) *The acknowledgement of alarms and warnings* shall *only be possible at a HMI (task station) where an appropriate situation assessment and decision support can be carried out.*

Category A of an alert indicates need for appropriate situation assessment and decision support (see 8.3.3.1).

8.7.2 Methods of test and required results

Confirm by inspection of manufacturer’s documentation that it identifies all alarms and warnings which require acknowledgement at a specific task station and that these alarms and warnings include all Category A alerts as defined in Annex C.

Confirm by analytical evaluation that these alarms and warnings include all those where situation assessment and decision support at a specific task station is required.

Confirm by observation, using a subset of these alerts, that the alerts can only be acknowledged at the relevant task station.

8.8 Self-monitoring of alert management

8.8.1 Monitoring of system communication

8.8.1.1 Requirement

(MSC 252/24.1) *The system communication between the alert management and the systems and sources/sensors initiating the alerts* shall *be monitored.*

8.8.1.2 Methods of test and required results

Refer to manufacturer's documentation about system communication for alert management. If available, identify 3 cases where it is possible to disturb alert management related system communication. Confirm by observation that EUT generates a warning to identify the loss of the system communication between the alert management and the systems and sources/sensors.

Refer to manufacturer's documentation about system communication for alert management. If available, fail communication with external equipment which takes part in alert related communication and confirm by observation that the EUT generates a warning to identify the loss of system communication between the alert management and the systems and sources/sensors.

8.8.2 Testing of alerts

8.8.2.1 Requirement

(MSC 252/24.2) *Provisions* shall *be made for functional testing of alerts, including the system communication between the alert management and the systems and sources/sensors initiating the alerts.*

Each task station within the EUT shall have a user operable facility for generating a test alert (e.g. Category B, priority warning, alert identifier 999, alert description "Test alert only", rectified automatically after 60 s).

8.8.2.2 Methods of test and required results

Confirm by observation the provision within the EUT using the following procedure.

- Generate test alerts from each task station within the EUT.
- Confirm by observation that the alerts are presented on the CAM-HMI and acknowledge them one by one. Confirm by observation that all test alerts are acknowledged.
- Confirm by observation that either the test alerts are removed automatically (e.g. by rectified alert condition) or that it is possible to remove the test alerts manually.

8.8.3 Failures

8.8.3.1 Requirement

(MSC 252/24.3) *The alert management* shall *have the capability to provide alerts for failure and loss of functions (systems), sources and sensors as far as those failures are monitored and indicated within INS. These* shall *be indicated at the central alert management HMI.*

8.8.3.2 Methods of test and required results

Refer to the manufacturer's documentation to identify INS functions, sources and sensors which lead to the generation of an alert when they fail or are lost. Confirm by observation that the alerts are presented at centralized alert management HMI when failures occur.

8.9 Interface requirements for alert related communication

8.9.1 Communication concept

8.9.1.1 Requirement

(MSC 252/25.1) *Connected sources, sensors and systems taking part in the alert related communication* shall *follow a standardized communication concept. Internal alert related communication within an individual source, sensor and equipment may use an alternative communication concept.*

The IEC 61162 series interfaces which are provided are to be defined by manufacturer's documentations. See 9.1.1.

INS shall provide its alerts in compliance with the IEC 61162 series using ALF, ALC, ⟦AC1⟩ ACN ⟨AC1⟧ and optional ARC sentences. See Annex J and Annex K.

The EUT shall provide legacy alert communication to sensors using ALR and ACK sentences as defined in the IEC 61162-1. See Annex L.

8.9.1.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the EUT provides alert communication in compliance with the IEC 61162 series as listed in Annex J. Internal alert related communication within an individual source, sensor and equipment may use an alternative communication concept.

Confirm by inspection of manufacturer's documentation that the EUT provides legacy alert communication to sensors in compliance with ALR and ACK sentences.

8.9.2 Alert priorities, states, etc.

8.9.2.1 Requirement

(MSC 252/25.2) *The communication protocol* shall *allow the implementation of the functions described in these standards. In particular, this includes:*

(MSC 252/25.2.1) *Transmission of all relevant alert priorities, states, associated quality information, additional alert message information for, e.g., explanation of alert, decision support.*

NOTE 1 IMO MSC 302(87) BAM include one additional priority called Emergency alarm and one additional category called C. Both are used with other than navigation equipment. This INS standard contains no requirements for implementation of these additional items.

NOTE 2 Time field available in alert related sentences is optional and this INS standard contains no requirement to implement it.

8.9.2.2 Methods of test and required results

8.9.2.2.1 EUT as receiver of alerts

Connect equipment or interface simulation to EUT.

Refer to the manufacturer's documentation. Generate the following alerts and confirm by observation that alerts are presented on centralized alert management HMI according to their state.

List of alerts to be tested:

- alarm Category A (active – unacknowledged)
- alarm Category A (active – silenced)
- alarm Category A (active – responsibility transferred), if supported by the EUT
- alarm Category A (active – acknowledged)
- alarm Category A (rectified – unacknowledged)
- alarm Category A (normal), alert disappears
- alarm Category B (active – unacknowledged)
- alarm Category B (active – silenced)
- alarm Category B (active – responsibility transferred)
- alarm Category B (active – acknowledged)
- alarm Category B (rectified – unacknowledged)
- alarm Category B (normal), alert disappears
- warning Category A (active – unacknowledged)
- warning Category A (active – silenced)
- warning Category A (active –acknowledged)
- warning Category A (active – responsibility transferred)
- warning Category A (rectified – unacknowledged)
- warning Category A (normal), alert disappears
- warning Category B (active – unacknowledged)
- warning Category B (active – silenced)
- warning Category B (active –acknowledged)
- warning Category B (active – responsibility transferred)
- warning Category B (rectified – unacknowledged)
- warning Category B (normal), alert disappears
- caution (active)
- caution (normal), alert disappear

Confirm by observation that standardized alert identifiers (see Clause J.5) are used where appropriate.

Confirm by observation that the content alert text-field of the ALF sentence is available on demand.

8.9.2.2.2 EUT as source of alerts

If provided, generate the following alerts within EUT and confirm by observation that correctly coded alert reporting sentence is available in the output interface

List of alerts to be tested:

- alarm Category A (active – unacknowledged)
- alarm Category A (active – silenced)
- alarm Category A (active – responsibility transferred), if supported by the EUT
- alarm Category A (active – acknowledged)
- alarm Category A (rectified – unacknowledged)
- alarm Category A (normal), alert disappears

- alarm Category B (active – unacknowledged)
- alarm Category B (active – silenced)
- alarm Category B (active – responsibility transferred)
- alarm Category B (active – acknowledged)
- alarm Category B (rectified – unacknowledged)
- alarm Category B (normal), alert disappears
- warning Category A (active – unacknowledged)
- warning Category A (active – silenced)
- warning Category A (active – acknowledged)
- warning Category A (active – responsibility transferred)
- warning Category A (rectified – unacknowledged)
- warning Category A (normal), alert disappears
- warning Category B (active – unacknowledged)
- warning Category B active – silenced)
- warning Category B (active –acknowledged)
- warning Category B (active – responsibility transferred)
- warning Category B (rectified – unacknowledged)
- warning Category B (normal), alert disappears
- caution (active)
- caution (normal), alert disappears

Confirm by observation that standardized alert identifiers (see Clause J.5) are used where appropriate.

8.9.3 Alert source identity

8.9.3.1 Requirement

(MSC 252/25.2.2) *Transmission of alert source identity* shall be implemented *so that originator component and/or function can be determined, as well as it being possible to differentiate between alerts originating from the same device but at different time and also between alerts indicating different conditions from the same device at the same time.*

NOTE 1 The time can either be the time of reception of the alert related sentence by the central alert management or the time reported by the alert source.

NOTE 2 Inside the EUT the time is part of the CCRS, but there is no requirement for external sensors or sources to synchronize their time with the time of the INS. Therefore if the EUT implements use of time-field of alert related sentences the EUT is assumed to use this time information for display only purposes and the EUT is assumed to use internal time for recording and arranging the order of alert events.

The default time of an alert is the reception time by the INS. If the source of the alert is synchronized with the time of the INS, then it is allowed to use the reported time of the source instead of the reception time by the INS.

8.9.3.2 Methods of test and required results

8.9.3.2.1 EUT as receiver of alerts

Connect equipment or interface simulation to EUT.

Generate alerts and confirm by observation that the CAM-HMI:

- distinguishes between different sources of alerts;
- distinguishes between alerts defined by same alert identifier from same source but with different alert instances;
- distinguishes between alerts defined by different alert identifiers from same source at same time.

Generate alerts and confirm by observation that the history list of CAM-HMI distinguishes between alerts defined by same alert identifier from same source but at a different time.

8.9.3.2.2 EUT as source of alerts

Generate sufficient alerts within the EUT and confirm by observation that the alert reporting sentence at the output interface:

- reports the INS as the source;
- distinguishes between alerts defined by the same alert identifier from the same source but with different alert instances;
- distinguishes between alerts defined by different alert identifiers from the same source at the same time.

8.9.4 Acknowledge and silence

8.9.4.1 Requirement

(MSC 252/25.2.3) *Transmission of acknowledgement and silence signals between the device where the alert was silenced or acknowledged and the device where it originates and where it may also have to be silenced/acknowledged* shall be implemented.

8.9.4.2 Methods of test and required results

8.9.4.2.1 EUT as receiver of alerts

Connect equipment or interface simulation to EUT.

Generate alerts and confirm by observation that:

- an acknowledgement of Category B alert on EUT generates an acknowledgement command sentence on the interface;
- an acknowledgement of Category A alert on the task station of the EUT, in which the acknowledge is possible, generates an acknowledgement command sentence on the interface;
- an attempt to acknowledge a Category A alert on the task station of the EUT, in which the acknowledge is not possible, does not generate any alert command sentence on the interface;
- a silence operation on EUT generates a silence command sentence on the interface.

8.9.4.2.2 EUT as source of alerts

If provided, generate the following alerts within the EUT, use a simulator to generate acknowledge and silence commands, and confirm by observation that:

- an acknowledgement of Category B alert acknowledges the alert in EUT;
- an attempt to acknowledge a Category A alert does not change the state of alert in the EUT. If provided, the EUT generates an alert command refused sentence to the interface;
- a silence operation command causes temporary silence.

8.9.5 Fault tolerance of alert communication

8.9.5.1 Requirement

(MSC 252/25.2.4) *Transmission mechanisms* shall be implemented *that avoid that signals in one or the other directions are lost (by fully reliable transmissions or by suitable retransmissions).*

(MSC 252/25.2.5) *Mechanisms that allow consistent reconnection of a component of the INS system to the system after disconnect at any time and in any alert condition* shall be implemented*.*

(MSC 252/25.2.6) *In general, mechanisms* shall be implemented *that allows consistency in the complete INS with regards to alert management.*

8.9.5.2 Methods of test and required results

8.9.5.2.1 EUT as receiver of alerts

Connect equipment or interface simulation to the EUT.

- Generate 10 alerts.
- Confirm by observation that the alerts are presented on CAM-HMI.
- Disconnect the interface.
- Silence or acknowledge 2 alerts and rectify 2 alerts on external equipment or simulation.
- Reconnect the interface.
- Confirm by observation that the 8 remaining alerts are correctly presented on CAM-HMI within 70 s.

8.9.5.2.2 EUT as source of alerts

Connect equipment or interface simulation to the EUT.

Confirm by observation the following procedure.

- Generate 10 alerts within the EUT.
- Confirm by observation that 10 alerts are reported on the interface using ALF and ALC (see Annex J).
- Silence or acknowledge 2 alerts and rectify 2 alerts within the EUT.
- Use simulator to request repeat of alert information using ⟦AC1⟩ ACN ⟨AC1⟧ (see Annex J).
- Confirm by observation that the 8 remaining alerts are correctly repeated on the interface using ALF.

8.10 Integration of systems in alert management

8.10.1 Overall alert management

8.10.1.1 Requirement

(MSC 252/26.1.1) *All systems, sources and sensors incorporated, connected in the INS* shall *be part of the alert management.*

8.10.1.2 Methods of test and required results

Tests are already covered with performed tests in 8.2 to 8.8.

8.10.2 Inclusion of other equipment

8.10.2.1 Requirement

(MSC 252/26.1.2) *The following equipment and systems, if installed, and not incorporated in the INS* shall *be also included in the alert management as far as possible:*

- *heading information system*
- *heading/track control system*
- *electronic position-fixing systems*
- *speed and distance measuring equipment*
- *radar with target tracking functions*
- *ECDIS*
- *AIS*
- *echo sounding equipment*
- *GMDSS equipment*
- *relevant machinery alarms for early warning.*

8.10.2.2 Methods of test and required results

Confirm by inspection of the manufacturer's documentation that the EUT provides alert management for each interface listed in 8.10.2.1.

Connect equipment or interface simulation to EUT. Select 5 interfaces from the interface list in 8.10.2.1. For each interface:

- generate an alert in connected equipment or interface simulator;
- confirm by observation that the alert is presented in the CAM-HMI;
- acknowledge the alert within the EUT;
- confirm by observation that the alert acknowledge command is generated on the interface.

8.10.3 Connection of other equipment

8.10.3.1 Requirement

(MSC 252/26.1.3) *The following equipment and systems, if installed,* shall *be connected to the alert management:*

- *bridge navigational watch alarm.*

8.10.3.2 Methods of test and required results

See 8.4.5.1.2.

9 Module D – Documentation requirements

9.1 Manuals

9.1.1 Requirement

(MSC.252(83)/27.1) *Operating manuals* shall *include:*

- *an overall functional description of the INS*
- *the redundancy concept and the availability of functions*

- *a description of possible failures and their effects on the system (e.g. by using part of the failure analysis)*
- *guidance for the adjustment of the limits for alerts*
- *the implications of using different reference locations*
- *details of each data convention and common references: attitude axis, rotation, reference location of CCRP*
- *details of the integrity monitoring provided by external sensors or subsystems and their required settings*
- *details of the mechanism for marking valid, doubtful and invalid data*
- *for an INS providing automatic control functions (e.g. for heading, track or speed) details of the external override and/or bypassing devices used in the reversionary mode.*
- *Information about the criteria for automatic selection of sensors and sources (see 5.7)*

(MSC.252(83)/27.2) *The installation manuals* shall *include adequate information to allow the INS to be installed so that it can meet all requirements adopted by the* IMO.

(MSC.252(83)/27.3) *The installation manuals* shall *include the following:*

- *details of sources, components and the interconnections forming the INS*
- *details of the interfaces and connections for data import and export and the interconnection diagrams and interfacing details for external parts of the INS and for devices, sensors to be connected including those sensors/sources to meet the back-up requirements of* 7.6.2.1
- *instructions for the installation and connection of facilities for alert acknowledgement and cancellation including the back-up officer alarm in case of an INS providing automatic control functions (e.g. for heading, track or speed)*
- *the details of the power supply arrangements*
- *recommendations on the physical layout of equipment and necessary space for maintenance*
- *for an INS providing automatic control functions (e.g. for heading, track or speed) details of the installation and connection of external override and/or bypassing devices used in the reversionary mode and if rudder angle, heading, propulsion data – e.g. power, propeller pitch, are not be presented on a display of the INS workstation, the necessary details.*

9.1.2 Methods of tests and required results

Confirm by inspection of manufacturer's documentation that the Operating manuals and the installation manuals include the required information.

9.2 Information regarding the system configuration

9.2.1 Requirement

(MSC.252(83)/28.1) *Manufacturer or system integrator of INS* shall *declare the following information relating to the system configuration, if applicable:*

- *basic system configuration*
- *interconnecting block diagram (Hardware)*
- *sources identification*
- *override*
- *priority of control (task stations)*

- *data flow schematic diagram and its interpretation*
- *default conditions*
- *back-up arrangement*
- *redundancy arrangement*
- *explanation of scope to fulfil requirements of SOLAS regulation V/19 with particular INS (for one equipment concept)*

other useful materials for inspector (such evidence of fulfilled requirements as other means).

NOTE Examples of other useful material for inspection are:

- plausible ranges of input data (see 6.3.2.2);
- management of latency and maximum allowed latency (see 6.3.3.2);
- methods available for integrity check (see 6.5.2);
- description of HMI philosophy (e.g. style book) (see 7.5.1.2).

9.2.2 Methods of tests and required results

Confirm by inspection of manufacturer's documentation that the required information has been provided.

9.3 Failure analysis

9.3.1 Requirement

(MSC.252(83)/29.1.1) *A failure analysis, at INS functional level,* shall *be performed and documented for the INS. The failure analysis* shall *verify that the INS is designed on "fail-to-safe" principle and that failure of one part of the integrated system should not affect the functionality of other parts, except for those functions directly dependent on the defective part.*

NOTE IEC 60812 (FMEA) describes how failure analysis can be performed.

9.3.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the required information has been provided.

9.4 Onboard familiarization material

9.4.1 Requirement

(MSC.252(83)/30) *Material enabling onboard familiarization training* shall *be provided for the INS. The onboard familiarization material* shall *explain all configuration, functions, limitations, controls, displays, alerts and indications of the INS. Guidance and recommendations to the equipment manufacturers for the provision of onboard familiarization material are given in* Annex B.

9.4.2 Methods of test and required results

Confirm by inspection of manufacturer's documentation that the provided material is capable of providing:

- information about all configurations;
- information about all functions;
- information about all limitations;
- information about all controls;

- information about all displays;
- information about all alerts;
- information about all indications;
- explanation of key configurations;
- explanation of key functions;
- explanation of key limitations;
- explanation of key controls;
- explanation of key displays;
- explanation of key alerts;
- explanation of key indications.

NOTE “key” above means most important, most used, main, etc.

Annex A
(informative)

Modular structure for IMO performance standards

(Appendices 3 and 4 of IMO Resolution MSC.252(83))

A.1 Modular structure for radar performance standards

Table A.1 presents the modular structure for radar performance standards (according to Resolution MSC.192(79).

Table A.1 – Modular structure for radar performance standards

Module	*Paragraph of MSC.192(79)*	*Subclause of IEC 62388:2007*	*Contents*
A			*Sensor and Technical Requirements*
A1			*Sensor and Signals*
	5.1	5.1	*Frequency*
	5.3.3.1-3	5.5.1, 5.5.4, 5.5.7	*Signal processing*
	5.3.4	5.6	*SARTs and radar beacons*
	5.6	5.10	*Roll and pitch (Detection)*
A2			*Target detection, discrimination and accuracy*
	5.2	5.8.5	*Range and bearing accuracy*
	5.3	–	*Detection*
	5.3.1.1	5.9.2	*Detection in clear conditions*
	5.3.1.2	5.7.3	*Detection at close ranges*
	5.3.1.3.1-4	5.9.3	*Detection in clutter conditions*
	5.4	5.7.3	*Minimum range*
	5.5	5.8,3, 5.8.4	*Range and bearing discrimination*
A3			*Design and Installation*
	5.8	5.11	*Radar availability delay*
	5.9.1	7.1.2, 7.1.3	*CCRP and off-set compensation*
	7.1.1 part	14.1.1	*Design for maximum availability*
	7.1.2	14.1.1	*Record operational hours*
	7.3	14.2.2	*Transmitter mute over preset sector*
	7.4	5.10.4, 14.3, 14.6.2	*Antenna*
	7.5	17.3	*Radar system installation*
B			*Operational Requirements*
B1			*Display and operation*
	2 Application	1.3	*Table 1: Screen size*
	5.3.2	5.4	*Gain and anti-clutter functions*
	5.7	5.3	*(Means for) Radar performance optimization and tuning*
	5.9.2-5.9.4	7.2.2, 7.1.1, 9.4.2, 8.1.1	*Radar measurements – CCRP*
	5.10	8.2	*Display range scales*
	5.11	8.9.2	*Fixed rings*

Module	Paragraph of MSC.192(79)	Subclause of IEC 62388:2007	Contents
	5.12	8.3.2	*Variable range markers*
	5.13	8.8.2	*Bearing scale*
	5.14	7.2.3	*Heading line*
	5.15	8.4.2, 8.4.3	*EBLs*
	5.16	8.7	*Parallel Index lines*
	5.17	8.6.2	*Remote measurement of range and bearing*
	5.18	8.5.2	*User cursor*
	5.19	9.2	*Azimuth stabilization*
	5.20	9.3.2	*Display mode of the radar picture*
	5.21	9.4.2	*Off-centring*
	5.22	9.5	*Ground and sea stabilization*
	5.23	10.2	*Target trails and past positions*
	5.35	14.4.3	*Integrating multiple radars*
	7.6.2	17.1.1	*Target simulation for training*
B2			*Target information (tracking and AIS)*
	2 Application	1.3	*Table 1: Screen size*
	5.24	10.3.2, 10.3.5	*Presentation*
	5.25	10.3, 10.4	*Target (radar) tracking and acquisition*
	5.26	10.5	*AIS reported targets*
	5.27	10.3.2, 10.5.5	*AIS graphical presentation*
	5.28	10.6	*AIS and radar target data*
	5.29	10.7	*Operational alarms*
	5.30	10.8	*AIS and radar target association*
	5.31	10.9	*Trial manoeuvre*
B3			*Chart and route overlay*
	5.32	8.10	*Display of maps, navigation lines and routes*
	5.33	11.1	*Display of charts*
B4			*Failure, back-up and fallback arrangements*
	5.34.1	15.1.3	*Picture freeze alarm*
	5.34.2	15.1.4	*Signal or sensor failure*
	7.1 part	14.1.1	*Design to facilitate simple fault diagnosis*
	9	15.2	*Backup and failure arrangement*
B5			*Ergonomic Criteria*
	5.34 para 1	15.1.1	*Presentation of alarms*
	6.1	12.1.1	*Operational controls*
	6.2	6.2, 6.8.2, 6.11.1, 11.1.2	*Display presentation*
	7.2	14.1.2	*Display device requirements*
	7.6.1	17.1.1	*(General:) Design for simple use by trained person*
C			*Interfacing*
	8.1	13.2.1	*Input data*
	8.2	13.2.2	*Input data integrity and latency*
	8.3	13.3	*Output data*

Module	*Paragraph of MSC.192(79)*	*Subclause of IEC 62388:2007*	*Contents*
D			*Documentation*
	5.3.1.3.5	5.9.4	*Degradation in performance*
	5.3.3.4	5.5.9	*Basic aspects of signal processing*
	6.3	17.2	*Instructions and documentation*
	7.1.3	14.1.1	*Routine servicing and restricted life components*

A.2 Modular structure for track control performance standards

Table A.2 presents the modular structure for track control performance standards (Resolution MSC.74(69), Annex 2).

Table A.2 – Modular structure for track control performance standards

Module	*Paragraph of MSC.74(69) Annex 2*	*Sub-clause of IEC 62065:2002*	*Contents*
B			*Operational Requirements*
B1			*Functionality*
	5	4.1	*Operational requirements*
B2			*Operation*
	6	4.2	*Ergonomic criteria*
B3			*Connection to sensors*
	7.1	4.4.1	*Sensors*
B4			*Failure, back-up and fallback arrangements*
	8	4.5	*Fallback arrangements*
C			*Interfacing*
	7.2	4.4.2	*Status Information*
	7.3	4.4.3	*Standards*

Annex B
(informative)

Guidance to equipment manufacturers for the provision of on-board familiarization material

(Appendix 2 of IMO Resolution MSC.252(83))

B.1 General

1.1 It is a requirement of the International Safety Management Code (ISM) that personnel working on assignments related to safety and the protection of the environment need to be given proper familiarization with their duties.

1.2 To assist with this process it is required that the INS equipment manufacturer or system integrator provides suitable training material that may be used by the ship operator as a basis for onboard familiarization of users.

1.3 The material is intended to be used by bridge officers who have had generic training in the use of INS through attending shore-based instruction based on the Organization's Model Course 1.32 "Operational use of Integrated Bridge Systems including Integrated Navigation Systems".

1.4 The intention of the familiarization material is that it should give a rapid means of understanding the configuration of the INS and its method of operation. General concepts concerning the use of INS are not required to be part of the material, as these would unnecessarily increase the duration of the familiarization training.

1.5 The material should be organized such that it represents the actual equipment and configuration that is fitted to the ship.

B.2 On-board familiarization training for INS

2.1 The aim of familiarization training is to explain the configuration, functions, limitations, controls, displays, alerts and indications of the specifically installed INS.

2.2 It should allow an OOW, unfamiliar with the ship's equipment but trained in the generic use of INS, to become rapidly acquainted with the installed system.

2.3 Emphasis should be given on producing effective familiarization training that can be completed in the shortest possible time. This will help maximize the probability that the process will be properly completed.

2.4 For a typical system it may be expected that it will take no longer than 30 minutes for a qualified user to undertake INS familiarization training. This time does not include the time taken to become familiar with major interconnected functionality, such as radar and ECDIS.

2.5 Familiarization can take a number of forms. The following are illustrative examples but other effective methods of training are acceptable:

- *computer-based training on the ship. Such training may also be appropriate to be used remotely (e.g., on a notebook computer of a new user, prior to joining the ship)*
- *a training mode on the fitted INS*
- *a training video (on tape, disk or solid state memory), supported by a self-training manual*
- *a stand-alone self-training manual.*

2.6 The topics that need to be covered are listed in section 3 below.

2.7 The functions of the INS should be broken down into logical top-down descriptions.

2.8 The familiarization material does not replace the User Instruction Manual. Appropriate references can be made to it from within the material. This may be beneficial when describing more detailed operations or to reference large diagrams.

2.9 For lesser used, non-critical functions it is only necessary to reference the relevant section in the User Instruction Manual, rather than them having to be included in their entirety in the familiarization material. Ideally, material is provided for such functions but with instructions to enable the user to skip these sections, as appropriate, until a more convenient opportunity.

2.10 Familiarization is best given within the context of the ship's normal bridge operating procedures. These procedures are normally contained within the Ship Operating Manual or equivalent document.

B.3 Familiarization training framework

B.3.1 General description

3.1.1 This should start with a top-level functionality description including the identification of the types of automatic control that are provided (if any).

3.1.2 A description should be given of the connected equipment that forms the INS, to a level that a normal user would require for operation (not maintenance). This description could be in the form of a block diagram.

3.1.3 The general philosophy of operation should be explained, including a description of the human machine interfaces. If automatic modes of operation are provided a general description of these is also required.

3.1.4 The physical location of all workstations and other displays and controls should be identified.

3.1.5 A description of the CCRS and identification of the CCRS (s) should be given. If more than one point is defined, the intended use of all individual reference points should be given, together with an explanation of how a point is selected and indicated.

3.1.6 For all navigation parameters the manual and/or automatic backup and fall-back sequences when sensors become inoperable should be explained.

3.1.7 Instructions on setting basic display controls such as brightness, contrast, colour and day/night colour schemes should be given.

B.3.2 Detailed operation (normal conditions)

3.2.1 The functions described should include all systems and subsystems that are part of the INS and any ship's functionality that can be controlled through the INS, such as the:

- *navigation subsystems*
- *steering controls*
- *propulsion controls*

3.2.2 Depending on the type of INS fitted, the following specific information should be given:

- *detailed operation of the automatic controls that are included, such as track controller functions*
- *the method(s) used to switch between operating modes and how to revert to manual operation*
- *the method of accessing the main/top-level display of all workstations and other INS equipment, including instructions to rapidly revert to such a display from whatever configuration has been set previously*
- *description of the displayed information on non-controllable displays, (if included within the installed configuration), e.g., a basic conning display*
- *the route planning and checking functions that are available*
- *the route monitoring functions that are available*
- *the operation of the Bridge navigational watch alarm facility, if fitted.*

3.2.3 Where appropriate, for each function, the following information should be included:

- *function name*
- *function description*
- *description of menu structure and displayed information*
- *description of operator controls*
- *required manually input information, if any*
- *description of how to configure task stations and user-modifiable displays and other data to user preferences. The method to rapidly revert to 'sensible' defaults must be given, even if it is considered that user configurations are not essential functions that need to be included as part of the familiarization material*
- *description of alerts and indicators, including mode indication. Procedural action on receiving alarms and warnings is covered in section 3.3*
- *the access of latency, integrity and accuracy data.*

3.3 Detailed operation (abnormal and emergency conditions)

3.3.1 The following information should be included:

- *details of conditions in which any automatic mode should not be used or should be used with certain restrictions or cautions;*
- *identification of major failure alarms and warnings;*
- *procedures involving the INS to follow on encountering alarms and warnings, other major failures, incidents or accidents, including:*

  (i) reversion to a mode with lesser automation or to manual operation

  (ii) emergency disabling of functions that are causing or worsening the emergency.

Annex C
(normative)

Classification of alerts

(Appendix 5 of IMO Resolution MSC.252(83))

For the purpose of transferring requirements for alarms and indications of existing individual performance standards into 3 priority classes of alerts within the INS performance standard, the alarms of the individual performance standards are subdivided into two classes of alarms being alarms and warnings in the INS performance standard (see Tables C.1 and C.2).

This classification of alerts applies to all alerts presented on the bridge.

Table C.1 – Classification of INS alerts as specified in these performance standards

Source	Cause	Alarm	Warning	Caution	Category A	Category B
INS	*System function lost,* see 3.1.79	*x*				*x*
	Integrity verification not possible or failed (6.5)		*x*			*x*
	*Invalid information for functions in use (*IMO MSC.252(83)*5.3.1.2*), see 6.3.1.1.		*x*			*x*
	*Invalid information for functions not in use (*IMO MSC.252(83)*5.3.1.2)*, see 6.3.1.1.			*x*		*x*
	*Different thresholds entered (*IMO MSC.252(83)*5.4.3.3)*, see 6.5.1.			*x*		*x*
	*Loss of system communication (*IMO MSC.252(83)*12.6.2)* , see 7.7.7.		*x*			*x*

Sensor failures in Table C.2 are applicable for failures of CCRS output data.

Table C.2 – Classification for INS for alerts specified in the individual equipment performance standards

Source	Cause	Alarm	Warning	Caution	Category A	Category B
Heading control systems	*Failure or reduction in power supply*	*x*				*x*
	Off heading alarm		*x*		*x*	
	Heading monitor (deviation from second heading source)		*x*			*x*
Track Control systems	*Early course change indication (track control via waypoints)*		*x*		*x*	
	Actual course change indication		*x*		*x*	
	Wheel over line (actual course change indication not acknowledged) *1) alarm* *2) back-up navigator alarm*	*x*			*x*	

Source	Cause	Alarm	Warning	Caution	Category A	Category B
	Failure or reduction in power supply including any failure of track control which stops track control		*X*			*X*
	Position monitor		*X*		*X*	
	Heading monitor		*X*		*X*	
	Sensor failure (heading, position, speed) *1) alarm* *2) back-up navigator alarm*	*X*				*X*
	Cross-track alarm	*X*			*X*	
	Course difference (heading deviates from track course)		*X*		*X*	
	Low speed alarm		*X*			*X*
ECDIS	*Positioning system failure*		*X*			*X*
	Crossing safety contour	*X*			*X*	
	Deviation from planned route – off-track alarm	*X*			*X*	
	Area with special conditions – cross the boundary		*A*	*A*	*X*	
	Approach to critical point		*X*		*X*	
	Different geodetic datum		*X*			*X*
	System malfunction		*X*			*X*
	(system malfunction of backup device)		*X*			*X*
RADAR/ AIS	*Target capacity*		*X*		*X*	
	CPA/TCPA alarm	*X*			*X*	
	Acquisition/activation zone		*X*		*X*	
	Lost target alarm		*X*		*X*	
	Failure of any signal or sensor in use		*X*			*X*
GNSS	*HDOP exceeded*			*X*		*X*
	No calculation of position		*X*			*X*
	Loss of position		*X*			*X*
	Loss of differential signal		*X*			*X*
	Differential corrections not applied		*X*			*X*
	Differential integrity status		*X*			*X*
Echo sounder	*Depth below keel alarm*	*X*			*X*	
	Failure or reduction in power supply		*X*			*X*
Gyro compass	*System fault*		*X*			*X*
Bridge watch alarm	*Malfunction*		*X*			*X*
	Power supply failure		*X*			*X*

A: selected by the user. In case a Caution is selected the Category is B.

Annex D
(normative)

Default display configurations

(Appendix 6 of IMO Resolution MSC.252(83))

As required in 7.4.2.1*, the INS* shall *offer as basic operational settings the following default display configurations for the tasks route monitoring and collision avoidance* (see Tables D.1 and D.2).

Table D.1 – Task "Route monitoring"

Function	Setting
Display category	*ECDIS Standard display*
Selected sea area	*Around own ship with appropriate off-set*
Range	*3 NM*
Orientation	*True motion, north-up*
Manual updates	*If applied*
Operator's notes	*If applied*
position sensor	*GNSS (system position provided by INS)*
Past track	*On*
Selected route	*Last selected route, including route parameters*
Look-ahead time	*6 min*

Table D.2 – Task "Collision avoidance"

Function	Setting
Band	*X-band, if selectable*
Gain	*Automatically optimized*, if provided
Anti-clutter functions	*Automatically optimized*
Tuning	*Automatically optimized*
Range	*6 NM*
Fixed rings	*Off*
VRMs	*One VRM on*
EBLs	*One EBL on*
Parallel index lines	*Off or last setting, if applied*
Display mode of the radar picture	*True motion, north-up*
Off-centring	*Appropriate look-ahead*
Target trails	*On*
Past positions	*Off*
Radar target tracking	*Continued*
Vector mode	*Relative*
Vector time	*6 min*
Automatic radar target acquisition	*Off*
Graphical AIS reported target display	*On*
Radar and AIS Target fusion	Association *On*

Function	Setting
Operational alarms (except collision warnings) see MSC.192(79)/5.2.9	*Off*
Collision warning	*On (limits CPA 2 NM; TCPA 12 min)*
Display of maps, navigation lines and routes	*Last setting*
Display of charts	*Off*

Annex E
(informative)

Data flow diagram/consistent common reference system (CCRS)

This information is intended to clarify the minimum requirements for data flow through the parts of the INS carrying out sensor data pre-processing, integrity monitoring, consistent common reference and system data distribution. The management of known data and parameters are included.

The data flow diagram includes processes to determine the validity and plausibility of all input data, to determine their integrity and to provide system data for distribution. For essential information the sensor data pre-processing ensures that the same type of data is from the same source, and it ensures consistency of any distributed or displayed information.

The following numbers relate to those within the circles in Figure E.1.

1) The INS receives sensor data from various sources.
   - The raw data from a sensor may or may not be marked with a validity flag.
   - The raw data from a sensor may or may not be marked with an integrity status flag and complemented with expected error data (e.g. from RAIM or equivalent monitoring function).
2) The data received from sensors may be related to an individual given point of measurement (e.g. antenna position, place of installation) and may be related to the individual time within each sensor. In such cases, data synchronisation, spatial correction and selection may be necessary as additional preconditioning.
3) Known data and parameter (e.g. knowledge of measurement of the ship's hull, reference dimensioning of antenna positions, threshold values to be used for integrity monitoring, maximum ROT of the vessel, ...) may be centrally managed for common use in sensor data pre-processing functions and may be distributed as a subset of system data.
4) Data from consistent common reference may be used for integrity monitoring to fill possible gaps in availability of data originally received from sensors and to provide appropriate consistent common reference and checked status.

Optional:

5) A fast access data channel may be applicable to those functions within an INS and/or to that external equipment where data without any time lag are required. In such cases, dedicated sources may be connected in parallel to sensor data pre-processing and to a fast access data channel. With simultaneous consideration of the following preconditions a fast access data channel can be used:
   - an error correction function is supplied externally and
   - a spatial correction for that type of data is not required and
   - the integrity monitoring for data used in the fast access data channel is provided simultaneously by the integrity monitoring function within the INS and
   - the data selection complies with the requirements of the CCRS and
   - the fast access data channel is fed through system data distribution and
   - data transferred through the fast access data channel are complemented with the integrity status and the expected error as a result from integrity monitoring within the INS.

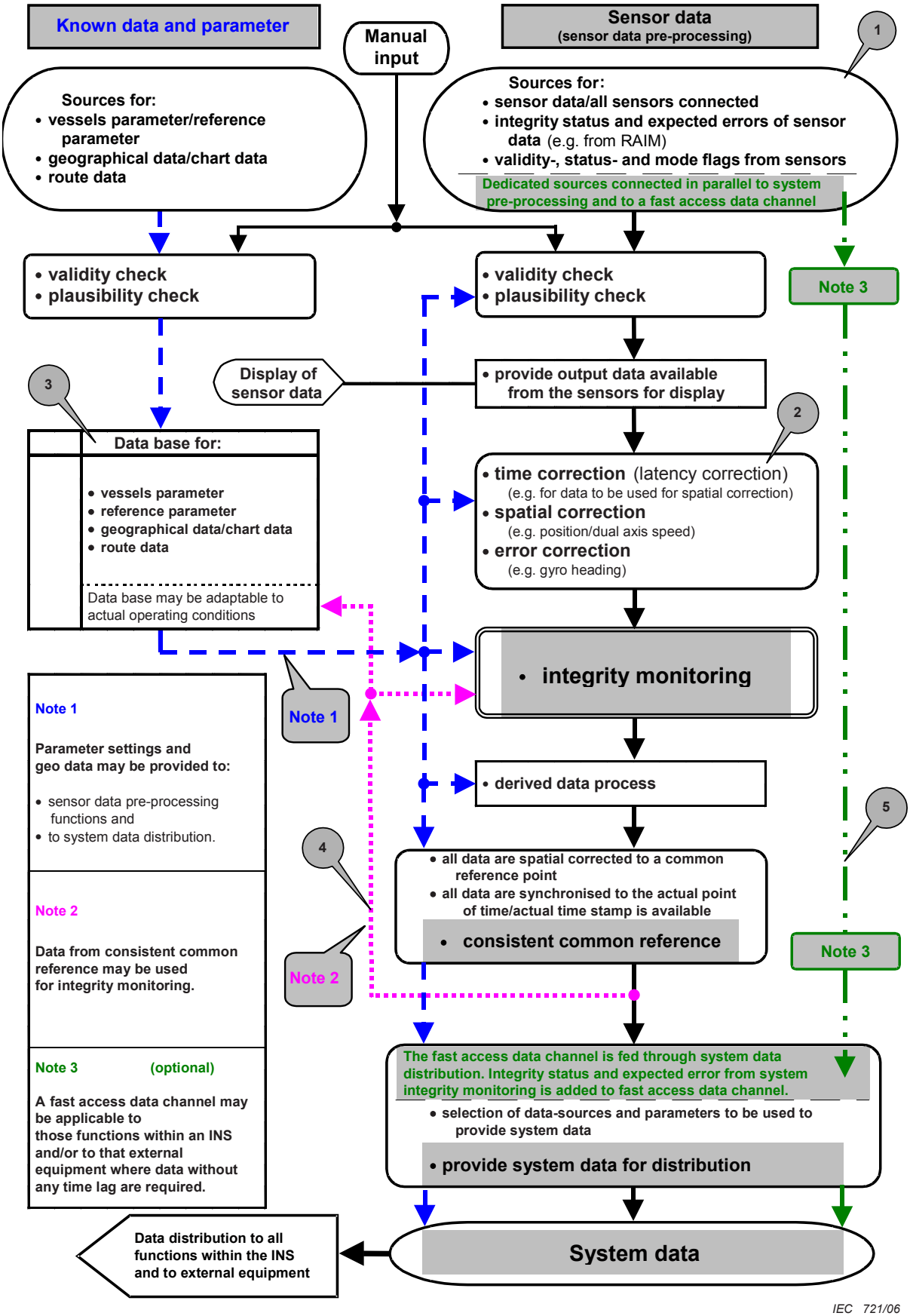


Figure E.1 – Data flow diagram/consistent common reference system (CCRS)

Annex F
(normative)

IEC 61162 interfaces

The INS shall be capable of at least transmitting and receiving data using the IEC 61162 series sentences specified in the Tables F.1 and F.2. The manufacturer shall specify which IEC 61162 series each physical interfaces supports. IEC 61162-2 compliant interfaces to heading sensor and AIS shall be provided.

Figure F.1 shows the required logical interfaces. If more than one logical interface is implemented on a single physical interface then all aspects of each logical interface, including alert communication, heartbeat, etc., shall be distinguishable from those of other logical interfaces implemented on the same physical interface.

If any equipment, sensor or source in Figure F.1 is included into the EUT then there is no requirement to provide an external interface for it.

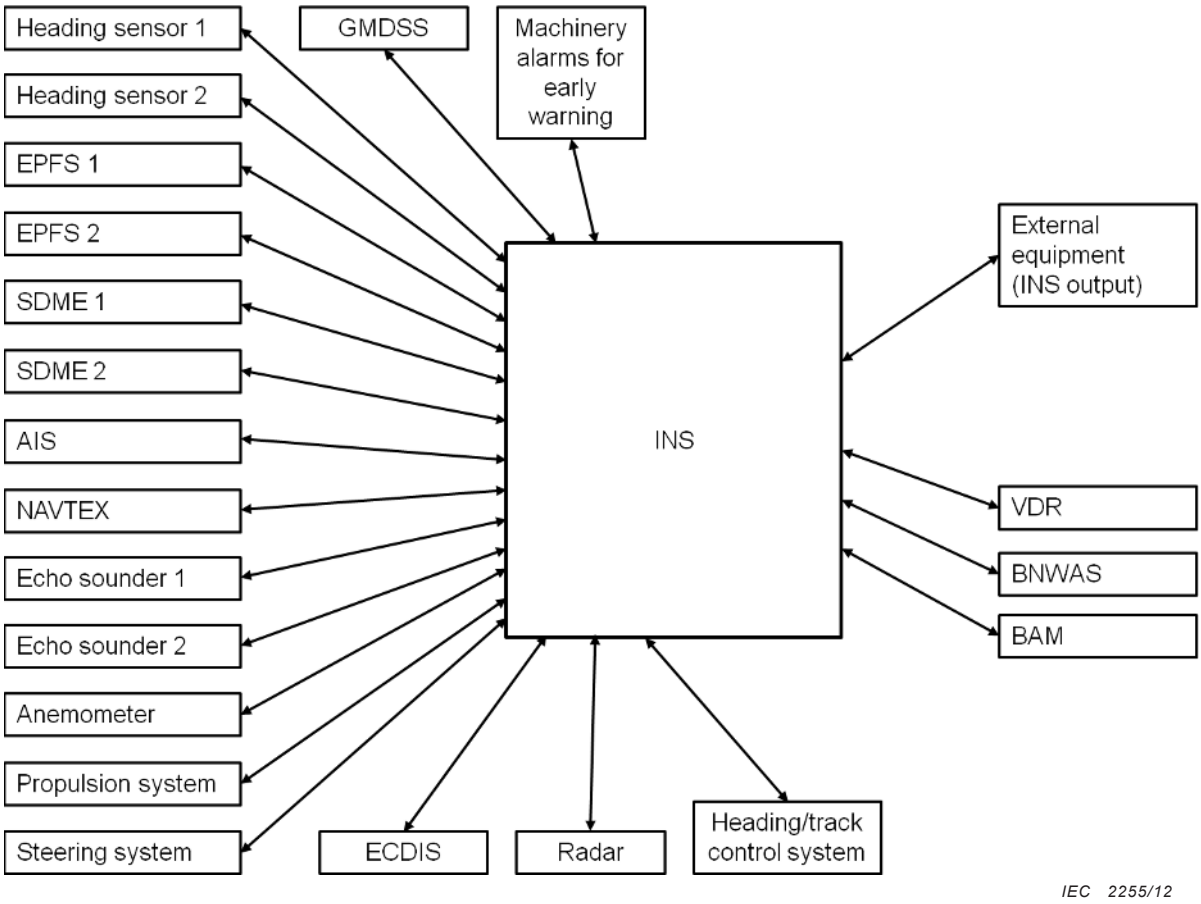


Figure F.1 – INS logical interfaces

Table F.1 – IEC 61162-1 sentences transmitted by the INS

Mnemonic	Interface (see Figure F.1)	Name	Comment
ACK	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, BNWAS, Radar, Machinery alarms for early warning	Acknowledge alarm	Acknowledge alarm command from INS to legacy simple sensor
⟨AC1⟩ ACN ⟨AC1⟩[a]	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning	Alert command	Alert command e.g. acknowledge
ALC[a]	VDR, BAM	Cyclic alert list	List of current alert
ALF[a]	VDR, BAM	Alert sentence	Details of a new alert
ALR	BNWAS	Set alarm state	Alert transfer to BNWAS
ARC[a]	BAM	Alert command refused	Alert command not accepted
DPT	VDR	Depth	Part of CCRS data
DTM	VDR	Datum reference	Part of CCRS data
EVE	BNWAS	Operator activity	Optional interface to reset dormant period of the BNWAS
GLL	Heading/Track control system, External equipment (INS output), VDR	Geographic position – latitude/longitude	Position of CCRP
HBT	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning, External equipment (INS output), VDR, BAM	Heartbeat	Support reliable alert related communication
NSR[b]	Heading/Track control system, External equipment (INS output), VDR	Navigational status report	Integrity and plausibility of the CCRS data
POS	External equipment (INS output), VDR	Device position and ship dimensions	Location of CCRP on the ship
THS	Heading/Track control system, External equipment (INS output), VDR	Heading true	Part of CCRS data
VBW	Heading/Track control system, External equipment (INS output), VDR	Speed through water report	STW of CCRS data
VDR	Heading/Track control system, External equipment (INS output), VDR	Set and drift	Set and drift of CCRS data

Mnemonic	Interface (see Figure F.1)	Name	Comment
VTG	Heading/Track control system, External equipment (INS output), VDR	Speed and course over ground	SOG and COG of CCRS data
ZDA	Heading/Track control system, External equipment (INS output), BAM	Time and date	

[a] See Annex K.

[b] See Annex I.

CCRS data and other data modified by the INS shall be transmitted using the talker identifier "IN"; data that is retransmitted by the INS without modification shall be transmitted using the talker identifier of the original source.

Table F.2 – IEC 61162-1 sentences received by the INS

Mnemonic	Interface (see Figure F.1)	Name	Comment
⟨AC1⟩ ACN ⟨AC1⟩[a]	BAM	Alert command	Alert command e.g. acknowledge
ALC[a]	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning	Cyclic alert list	List of current alert
ALF	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning	Alert sentence	Details of a new alert
ALR	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning	Set alarm state	Current alarm state of legacy simple sensor connected to the INS
ARC[a]	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning	Alert command refused	Alert command not accepted
DPT	Echo sounder 1, Echo sounder 2	Depth	
DTM	EPFS 1, EPFS 2	Datum reference	
ETL	Propulsion system, Steering system	Engine telegram	Part of propulsion system and data for manual/automatic control of ship's movement

Mnemonic	Interface (see Figure F.1)	Name	Comment
GLL GGA GNS RMC	EPFS 1, EPFS 2	Geographic position – latitude/longitude	
HBT	Heading sensor 1, Heading sensor 2, EPFS 1, EPFS 2, SDME 1, SDME 2, AIS, NAVTEX, Echo sounder 1, Echo sounder 2, Anemometer, Propulsion system, Steering system, Heading/Track control system, ECDIS, GMDSS, Radar, BNWAS, Machinery alarms for early warning, External equipment (radar output), VDR, BAM	Heartbeat	Support reliable alert related communication
HDT	Heading sensor 1, Heading sensor 2	Gyro compass	
HTD	Heading/Track control system, Steering system	Heading/track control	With and without track control included in the INS: Source of active mode of steering control and manual/automatic control of ship's movement
MWV MWD	Anemometer	Anemometer	
NRX	NAVTEX	NAVTEX	Source of safety related messages
PRC RPM	Propulsion system	Propeller(s)	Part of propulsion system
ROR RSA	Propulsion system	Rudder angle(s)	
ROT	Heading sensor 1, Heading sensor 2	Rate of turn	
THS	Heading sensor 1, Heading sensor 2	Heading source	
TRC TRD	Propulsion system	Thruster(s)	Part of propulsion system
VDM VDO	AIS	AIS transponder	Source of AIS targets and safety related AIS message
VBW VLW	SDME 1, SDME 2	Speed log	
VTG	EPFS 1, EPFS 2	Speed and course from EPFS	
ZDA	EPFS 1, EPFS 2	Time and date	

[a] Annex K.

Annex G
(informative)

Guidance for testing

G.1 Methods of test derived from ISO 9241-12

This guidance is derived from ISO 9241-12:1998 (see Bibliography). It is intended to provide guidance to accredited testing laboratories for the development of test plans and test procedures that evaluate a minimum degree of compliance with the requirements specified. They do not identify specific processes, approaches or facilities.

G.2 Observation

Observation refers to simple examination of the presentation of information to confirm that a particular observable condition has been met. Observations may be made by any person with the necessary skill to understand the presentation of information to determine if a statement concerning an observable property has been correctly applied. It is used when suitably trained individuals with a broad range of education and/or experience can be confidently expected to reach the same conclusion about a property of presented information or the performance of display equipment.

The phrase "confirm by observation" is used in the method of test. Conformance is determined by comparing the observed property to the requirement. Some observations may be made directly from the presentation. Other observations may require simulation of input from sensors or other sources. Typical confirmations by observation include:

- existence of functions or features;
- use of symbols or a defined range of words;
- a system output in response to a defined input.

G.3 Inspection of documented evidence

Inspection of documented evidence refers to examination of relevant documents to confirm that a particular presentation or display requirement has been met. Documented evidence may include manuals, system requirements, design justification, industry conventions, etc. Inspections may be made by a suitably qualified person who has the necessary education, skill and/or experience to apply the documentation to the system's presentation or display equipment. It is used when performance of a system's presentation or display equipment is not directly observable or measurable. It may also be used when observation would be excessively repetitious, time consuming, or expensive. The phrase "confirm by inspection of documented evidence" is used in the method of test. Conformance is determined by comparing the documented property to the requirement. Typical confirmations by inspection of documented evidence include:

- conformance to a standard or other documented evidence;
- existence of optional features or functions;
- design and/or operation of algorithms.

NOTE Test protocols from other official tests / type approvals can also be considered within this method of test.

G.4 Measurement

In this standard, measurement refers to measuring or calculating a value or variable for comparison to a specified value to determine that a particular requirement has been met.

Measurements may require the use of test facilities and equipment. Measurements may be made by any person with the necessary skill to measure and/or calculate the value and compare it against a requirement, standard or other documented evidence. Compliance is determined by comparing the measured or calculated value or variable to the requirement.

G.5 Analytical evaluation

The test method “analytical evaluation” refers to detailed examination of the presentation of information to confirm that a particular condition has been met. The phrase "confirm by analytical evaluation" is used. Analytical evaluations may be made by a relevant expert with the necessary education, skills and/or experience to make an informed and reliable judgement concerning the presentation of information, its appropriateness and usability. It is used for the evaluation of properties which can be judged only in the context of other information or knowledge which requires the tester presentation. Compliance is determined by comparing the observed property to the requirement.

Annex H
(normative)

Verification of CCRP calculations

H.1 Scenario for verification of CCRP calculations

This Annex describes the test scenario and results for calculations of CCRP, EBL, VRM, range and bearing to AIS and radar tracked target and course and speed (see 6.4.2.2).

The offsets for the sensor locations and CCRP are set to

- CCRP set 320 m forward of the ship's aft most point and 15 m starboard of centre-line,
- 1st EPFS antenna set 20 m forward of ship's aft most point and 15 m port of centre line,
- SMDE set 20 m forward of ship's aft most point and 15 m port of centre line,
- radar 20 m forward of ship's aft most point and 15 m port of centre line.

H.2 Stationary scenario

Set the 1st EPFS position to 00°00,000'N, 000°00,000'W.

Simulate an AIS target and a radar tracked target at the position 00°01,000'N, 000°01,000'E. Select centred true EBL/VRM. For each measurement set cross-point of EBL/VRM to target.

Simulate a stationary scenario (speed 0 kn) starting with 0° heading. Increase heading in steps of 45° until the heading has reached 0° again. For each step confirm by observation that CCRP, EBL, VRM and calculated range and bearing data for the AIS target and the radar tracked target is according to the values given in Table H.1.

Table H.1 – Required results

Heading	CCRP		VRM to target	EBL to target
	latitude	**longitude**	**range**	**bearing** (T)
0°	00°00,162N	000°00,016E	1,29 NM	49,6°
45°	00°00,103N	000°00,126E	1,25 NM	44,3°
90°	00°00,016S	000°00,162E	1,32 NM	39,5°
135°	00°00,126S	000°00,103E	1,44 NM	38,5°
180°	00°00,162S	000°00,016W	1,54 NM	41,2°
225°	00°00,103S	000°00,126W	1,58 NM	45,6°
270°	00°00,016N	000°00,162W	1,52 NM	49,7°
315°	00°00,126N	000°00,103W	1,41 NM	51,6°
NOTE The least significant digit of the given values is rounded-to-nearest.				

Set the 1st EPFS position to 00°00,000'N, 180°00,000'W.

Simulate an AIS target and a radar tracked target at the position 00°01,000'N, 179°59,000'W. Select centred true EBL/VRM. For each measurement set cross-point of EBL/VRM to target.

Simulate a stationary scenario (speed 0 kn) starting with 0° heading. Increase heading in steps of 45° until the heading has reached 0° again. For each step confirm by observation

that CCRP, EBL, VRM and calculated range and bearing data for the AIS target and the radar tracked target is according to the values given in Table H.2.

Table H.2 – Required results

Heading	CCRP		VRM to target	EBL to target
	latitude	longitude	range	bearing (T)
0°	00°00,162N	179°59,984W	1,29 NM	49,6°
45°	00°00,103N	179°59,874W	1,25 NM	44,3°
90°	00°00,016S	179°19,838W	1,32 NM	39,5°
135°	00°00,126S	179°59,897W	1,44 NM	38,5°
180°	00°00,162S	179°59,984E	1,54 NM	41,2°
225°	00°00,103S	179°59,874E	1,58 NM	45,6°
270°	00°00,016N	179°59,838E	1,52 NM	49,7°
315°	00°00,126N	179°59,897E	1,41 NM	51,6°
NOTE The least significant digit of the given values is rounded-to-nearest.				

H.3 Dynamic scenario

Simulate a scenario with own ship rotating with a constant rate of turn (10°/min) with 1st EPFS antenna position as centre of rotation. After reaching a steady situation confirm by observation that the course over ground and speed (speed over ground and speed through water) at CCRP is according to the values given in Table H.3.

Table H.3 – Required results for dynamic scenario

ROT	CCRP course	CCRP speed		
	COG and CTW offset to HDG	SOG and STW absolute value	transversal	longitudinal
10°/min to Stbd	95,7°	1,7 kn	1,7 kn stbd	0,2 kn aft

The resolution required for this test is given in Table H.4.

Table H.4 – Required resolution for test

Data	Resolution
CCRP (lat/lon)	0,001’
Range	0,01 NM
Bearing	0,1°
Speed	0,1 kn

Annex I
(normative)

Sentence for integrity and plausibility

NOTE Refer to IEC 61162-1 for a possible later version of this sentence.

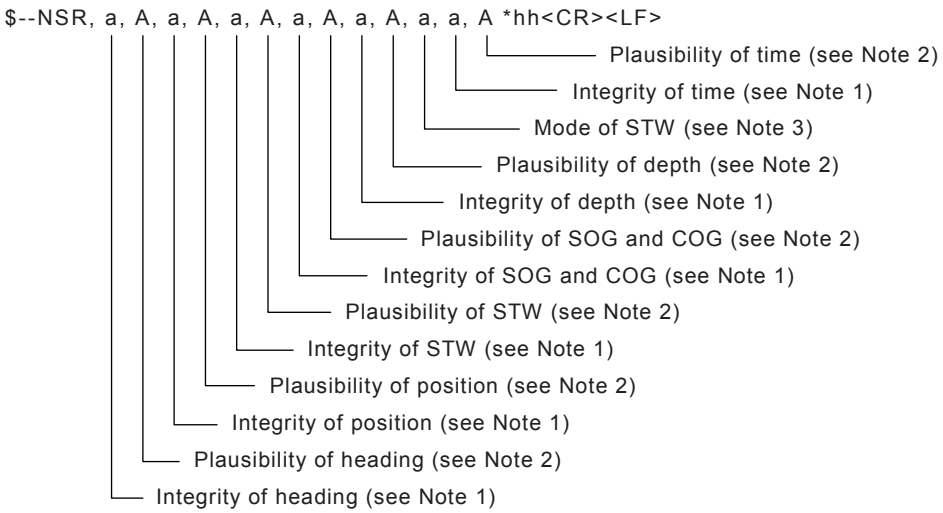
NSR – Navigation status report

This sentence is used to handle integrity and plausibility of data for a consistent common reference system (CCRS) associated with an Integrated Navigation System (INS).

Null fields are not allowed for this sentence.

The NSR sentence shall be sent periodically at intervals of not greater than 30 s. For all state changes the NSR sentence is transmitted prior to relevant sentence (e.g. GLL, THS etc.).

For the INS the talker id is “IN”.



NOTE 1 Integrity status:

P = Passed, integrity verification passed

F = Failed, integrity verification not passed

D = Doubtful, integrity verification not possible

N = Not available, reporting device does not support integrity check

NOTE 2 Plausibility status:

A = Yes (Plausible)

V = No (Not plausible)

N = Not available, reporting device does not support plausibility check

NOTE 3 Mode of STW

W = measured water reference

E = Estimated/calculated from non-water referenced sources

M = Manual input

N = Not available

Annex J
(normative)

INS alert related communication

J.1 Overview

This annex describes methods of alert related communication for various purposes with the INS. Depending of the purpose different methods are used.

The intention is that future edition of standards for equipment communication with the INS will adopt the use of advanced sentences described in Clause J.4 instead of simple sentences described in Clause J.3.

J.2 Use of ALR for BNWAS

This INS standard requires that an unacknowledged alarm shall be transferred after a timeout to BNWAS. The BNWAS standard IEC 62616 defines alternative methods to receive such information: either by using ALR-sentence, by contact closure or by other equivalent method. The EUT shall provide at least one alternative. If sending of ALR sentence method is used to actuate the “Emergency Call” system of the BNWAS (see IEC 62616) then the sentence below shall be used:

$INALR,,260,A,V,Emergency Call*1C<CR><LF>

and to remove this “Emergency Call”:

$INALR,,260,A,A,Emergency Call*0B<CR><LF>

NOTE The requirement is to transfer an unacknowledged alarm, which means that unacknowledged alerts of lower priority such as warning or caution do not cause activation of the BNWAS Emergency call.

J.3 Use of ALR and ACK for legacy simple sensors

J.3.1 General

Alert related communication between the INS and a legacy simple sensor is accepted when all of the following conditions are satisfied:

- interface to legacy simple sensor is based on serial line i.e. IEC 61162-1 or IEC 61162-2. The INS allows the use of a serial to network gateway function (SNGF) within the EUT, capable of assigning source identifiers according to IEC 61162-450;
- legacy simple sensor does not generate any alert classified by the INS as alarm priority (see Annex C), i.e. the simple sensor is only a source of audible and visual announcement;
- legacy simple sensor does not generate any alert classified by the INS as Category A (see Annex C), i.e. the simple sensor is only a source of Category B alerts;
- the interface to the legacy simple sensor is implemented in compliance with Annex L.

The rules for the use of ALR and ACK by the INS are as follows.

- As ALR sentence does not contain priority, every ALR from legacy simple sensor shall be treated as a warning (see Annex C).
- As ALR sentence does not contain category, every ALR from legacy simple sensor shall be treated as of Category B (see Annex C).

- Optionally the incoming ALR sentences can be transformed into an ALF message data structure of INS compliant sensors, as described in Table J.1. The outgoing ACK sentences can be generated by transforming the INS compliant data structure ⟦AC1⟩ ACN ⟨AC1⟧ for INS compliant sensors, as described in Table J.2.

  NOTE It is not required to use IEC 61162 data protocol for INS internal communication. For INS internal alert communication a proprietary format can be used. Using the ALR/ALF and ⟦AC1⟩ ACN ⟨AC1⟧/ACK conversion table the legacy simple sensor alerts can be handled within INS like INS compliant sensors that use ALF/⟦AC1⟩ ACN ⟨AC1⟧ messages.
- Failure and error handling of the alert interface shall be handled as defined in Annex L.
- The INS shall remove the alert from the Central Alert Management HMI as soon it is
  – acknowledged by the operator using the Central Alert Management HMI, and
  – reported as removed from the source by the ALR sentence.
- The first 16 characters of the alarm's description text of the ALR sentence shall be used by the INS as alert title. Full content of the alarm's description text of the ALR shall be used by the INS as additional alert description.
- The unique alarm number at alarm source of the ALR sentence shall be used by the INS as alert identifier. This alert identifier is not required to be compliant with the alert identifiers listed in Clause J.5.

The rules for the use of ALR and ACK by the legacy simple sensor are that the legacy simple sensor shall repeat sending of ALR for each available alert. A cycle time up to 60 s is acceptable.

J.3.2 ALR /ALF and ⟦AC1⟩ ACN ⟨AC1⟧/ACK data structure conversion

The ALR/ALF data structure conversion in given in Table J.1 and the ⟦AC1⟩ ACN ⟨AC1⟧/ACK data structure conversion is given in Table J.2.

Table J.1 – Conversion from ALR to ALF

ALR	Conversion/value	ALF data structure
–	1	Total number of ALF sentences for this message
–	1	Sentence number, 1 to *n*
–	1	Sequential message identifier
Time of alert condition change, UTC	hhmmss.ss As received	Timestamp of last change
–	B (shall always be B otherwise it is no longer a simple sensor and ALF/ ⟦AC1⟩ ACN ⟨AC1⟧ shall be used)	Alert category
–	W(arning) (shall always be a warning otherwise it is no longer a simple sensor and ALF/ ⟦AC1⟩ ACN ⟨AC1⟧ shall be used)	Alert priority
Alarm condition, Alarm's acknowledge state	A,V →V (active – unacknowledged) A,A →O (active – responsibility transferred) V,V →U (rectified – unacknowledged) V,A → N (normal)	Alert states
–	N/A	Manufacturer mnemonic code
Unique alarm number (identifier) at alarm source	As received	Alert Identifier
	1	Alert Instance

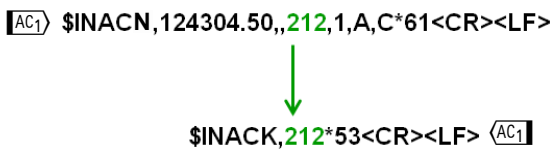
ALR	Conversion/value	ALF data structure
	Defined by INS upon reception of new ALR (1…99)	Revision counter
Alarm's description text	One of the alternatives below: • configurable text in case the Alarm's description text field is empty • ALR text when present to fill both alert title and additional alert description	Alert title and additional alert description

EXAMPLE:

Table J.2 – Conversion from [AC1⟩ ACN ⟨AC1] to ACK

[AC1⟩ ACN ⟨AC1] data structure	Conversion/value	ACK
Time	– (ignored)	–
Manufacturer mnemonic code	– (ignored)	–
Alert identifier	Identical to received alert identifier from corresponding ALR	Unique alarm number (identifier) at alarm source
Alert instance	– (ignored)	–
Alert command	– (ignored, the message itself is the acknowledgement and should be sent immediately after receiving an ALR)	–
Sentence status flag	– (ignored)	–

EXAMPLE:



J.3.3 Legacy sensors communication showing priority reduction

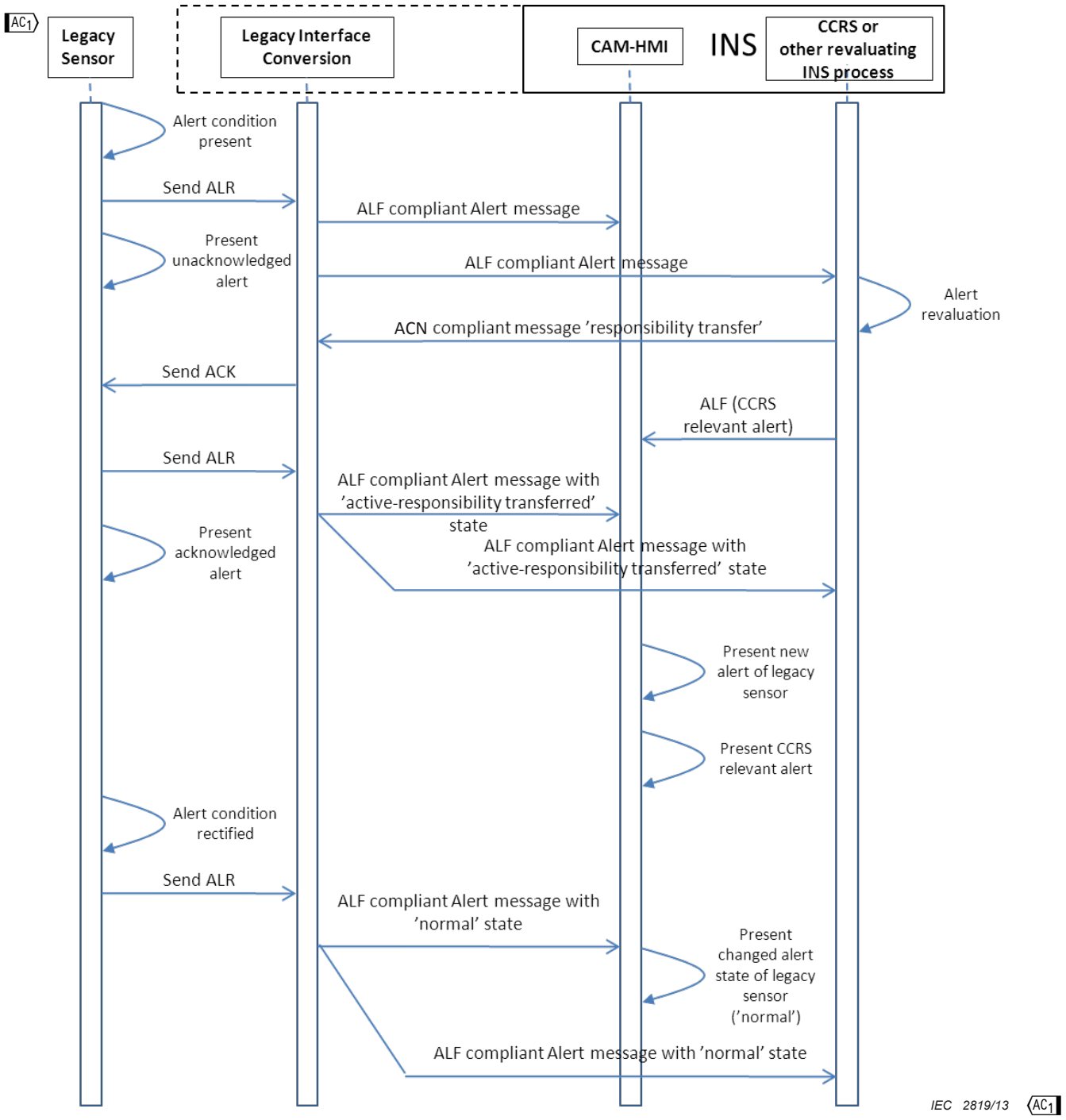


Figure J.1 – Legacy sensor communication showing priority reduction

Figure J.1 provides a pictorial description of the interactions between the legacy sensor and the INS. The Figure shows two use cases, one for CAM-HMI and another for CCRS. The event described is when an alert generated at the legacy sensor is known by the INS and can be re-evaluated by the INS. The result is that the INS transfers responsibility for that alert. Note that the references to the ALF and AC1 ACN AC1 sentences are not intended to imply that the use of the sentences within the INS is mandatory, only that equivalent processing is required to take place.

J.3.4 Legacy sensors communication in case priority reduction is not possible

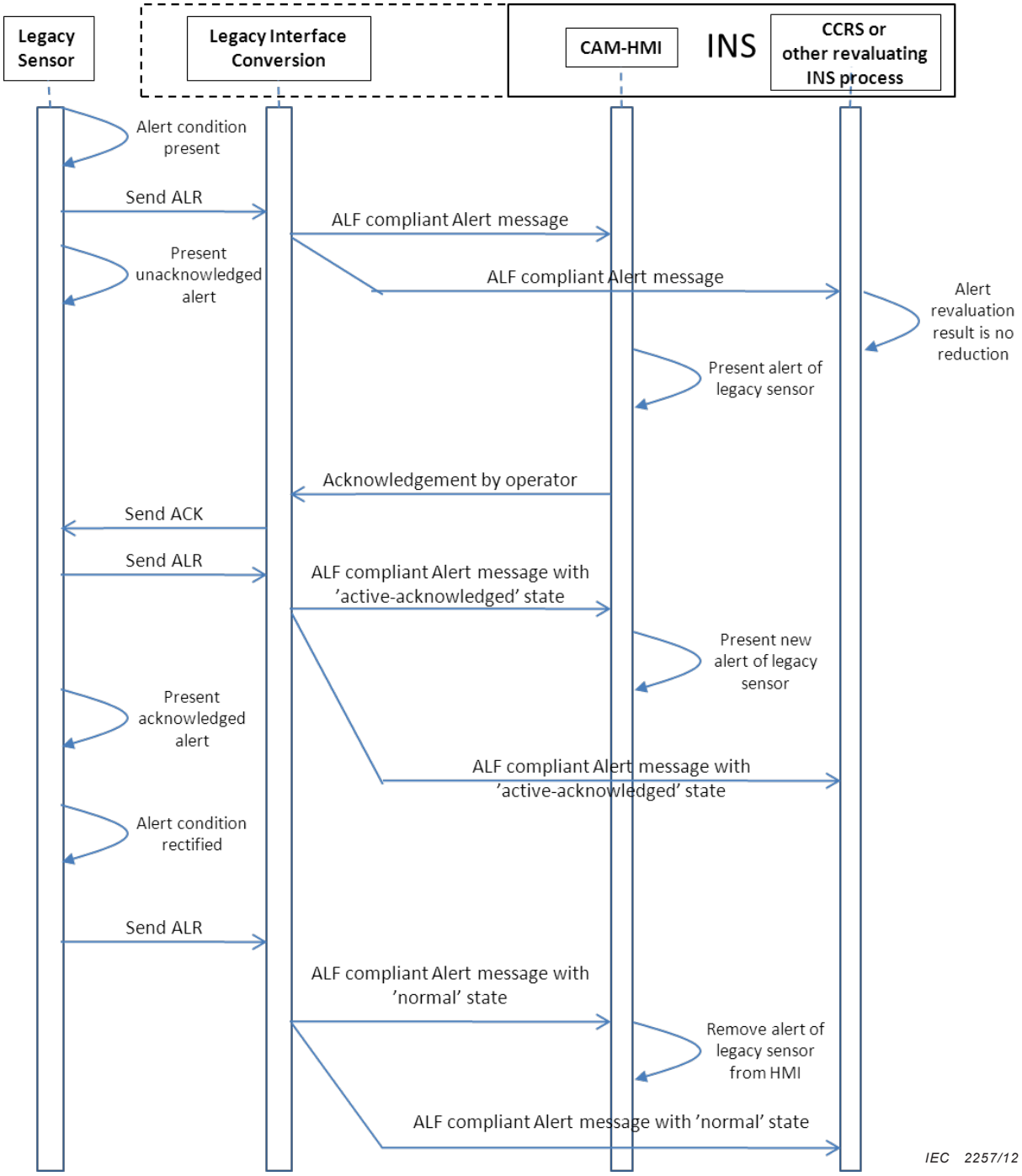


Figure J.2 – Legacy sensor communication in case priority reduction is not possible

Figure J.2 provides a pictorial description of the interactions between the legacy sensor and the INS. The Figure shows two use cases, one for CAM-HMI and another for CCRS. The event described is when an alert generated at the legacy sensor is not known by the INS. Note that the references to the ALF and ⟦AC1⟩ ACN ⟨AC1⟧ sentences are not intended to imply that the use of the sentences within the INS is mandatory, only that equivalent processing is required to take place.

J.4 Use of HBT, ALF, ALC, ⟦AC1⟩ ACN ⟨AC1⟧ and ACR

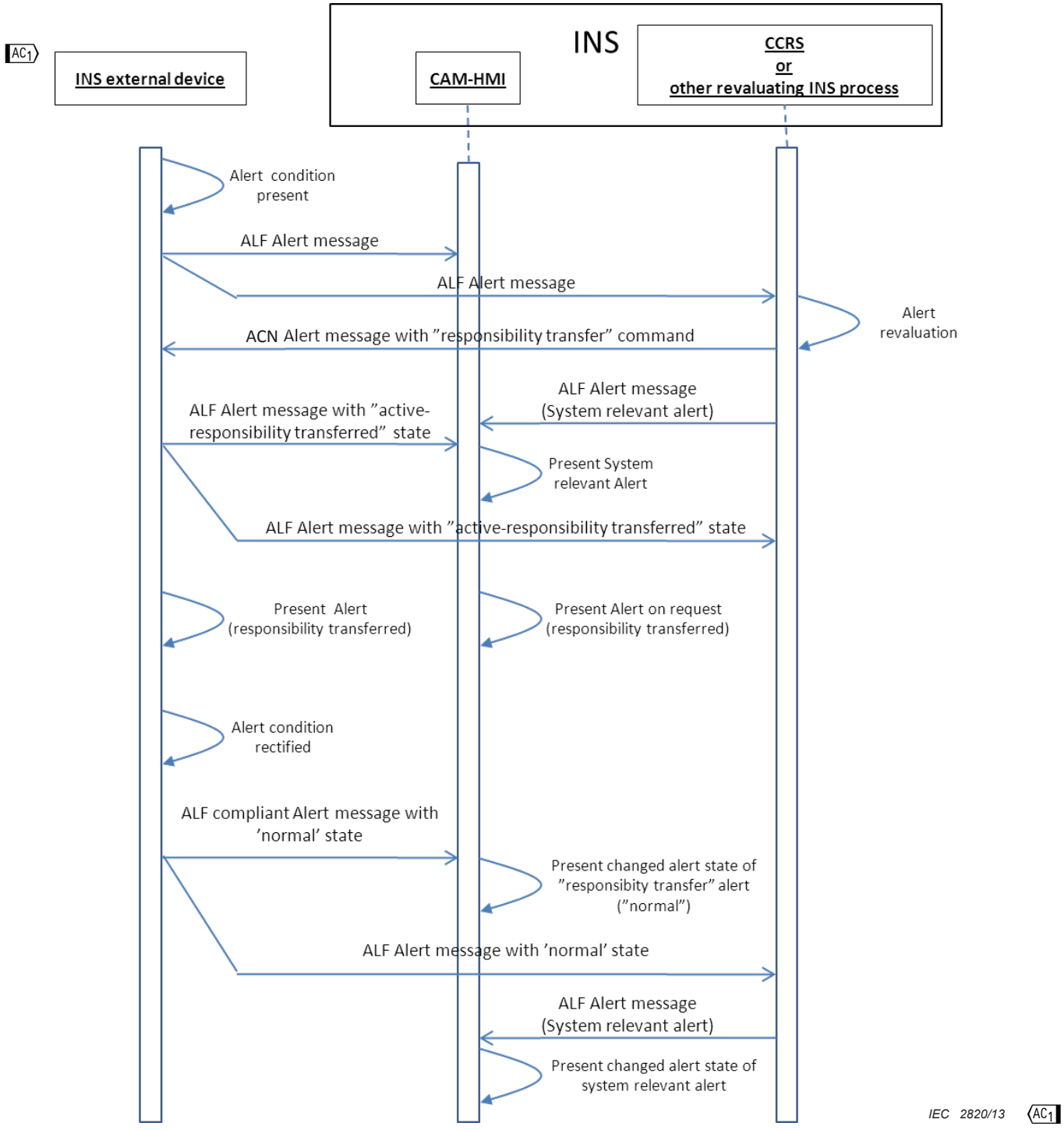
J.4.1 General

The HBT, ALF, ALC, ⟦AC1⟩ ACN ⟨AC1⟧ and ARC sentences are recommended alert communication sentences to be used with the INS. The HBT is available in IEC 61162-1. The ALF, ALC, ⟦AC1⟩ ACN ⟨AC1⟧ and ARC are defined in Annex K.

The HBT sentence is used to supervise operation of interfaces in both directions. The receiver shall generate an appropriate alert in the case of a HBT sentence malfunction.

J.4.2 Alert communication showing priority reduction

Figure J.3 shows two use cases, one for CAM-HMI and another for CCRS.



NOTE This Figure does not show the acknowledgement of the system relevant alert by the operator.

Figure J.3 – Alerts' communication showing priority reduction

J.4.3 Alert communication in case priority reduction is not possible

Figure J.4 shows two use cases, one for CAM-HMI and another for CCRS.

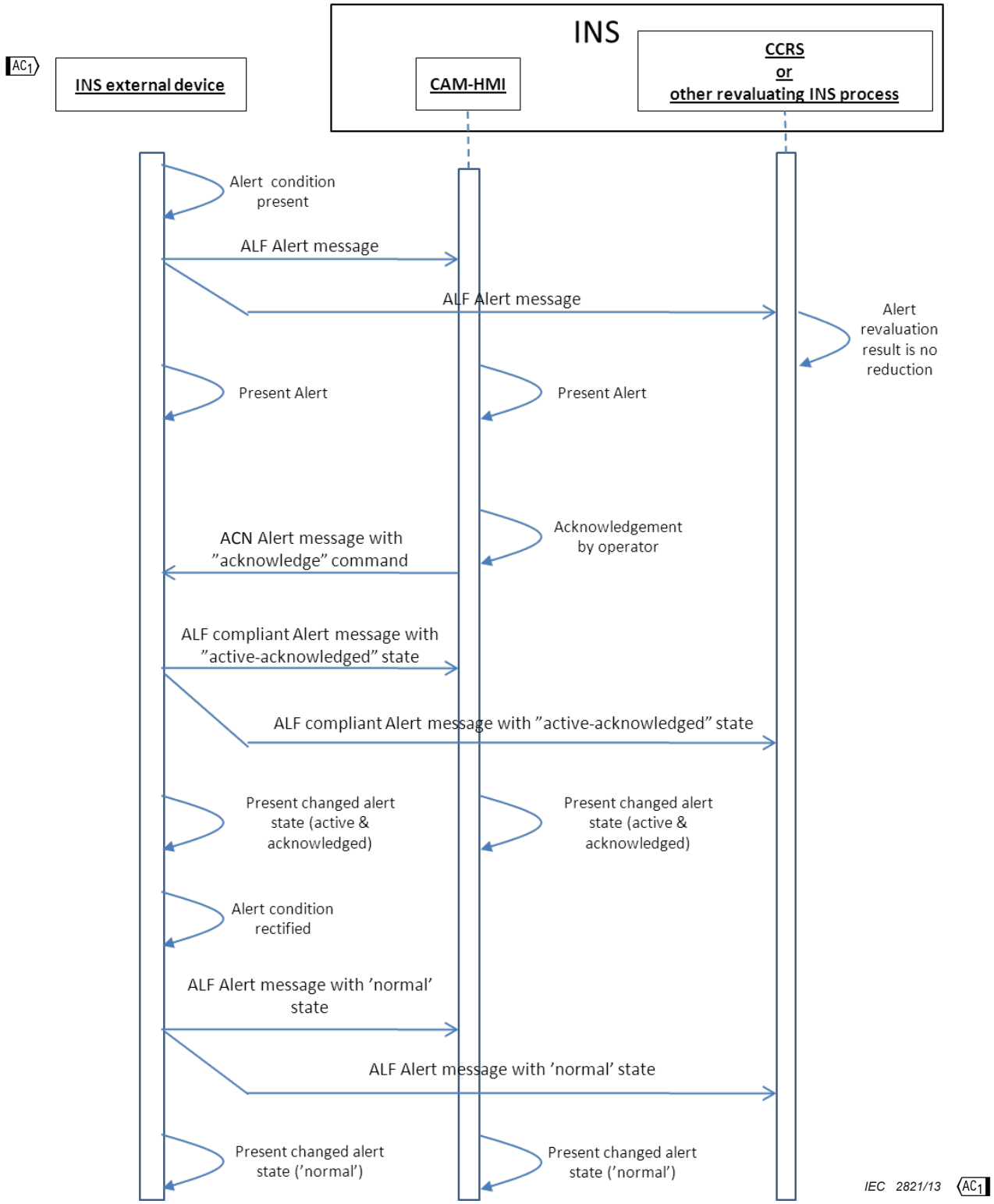


Figure J.4 – Alerts with communication in case priority reduction is not possible

J.4.4 Use of ALF

J.4.4.1 On network IEC 61162-450

When ALF is sent on this type of network, the TAG-Block in front of the sentence shall include the source identifier of the alert releasing instance (parameter code “s:” within the TAG-Block). If an optional second ALF sentence is transmitted then both the first and the second ALF sentence shall include grouping (parameter code “g:” within the TAG-Block).

J.4.4.2 On network IEC 61162-3

When the content of the ALF is sent on this type of network the parameter group Alert PGN #126983 is intended to be used to report an alert condition and alert state of a device. The Alert PGN #126983 is broadcast each time the alert information within the PGN changes or upon request using the Request Group Function PGN #126208.

To transmit additional alert description text, the Alert Text PGN #126985 is transmitted. Optionally additional alert description text can be requested using the Request Group Function PGN #126208.

J.4.5 Use of ALC

J.4.5.1 On network IEC 61162-450

When ALC is sent on this type of network, the TAG-Block is mandatory and shall include the source id of the ALC releasing device/instance as source (parameter code “s:”) and shall include grouping (parameter code “g:”) if a cyclic alert list contains more than one ALC sentence.

J.4.5.2 On network IEC 61162-3

When the content of the ALC is sent on this type of network the Alert List PGN #127001 is intended to provide condensed identifying data for all active alerts. This PGN provides the means to determine if an alert (Alert PGN #126983) was missed. Missed alerts may be requested using the Request Group Function PGN #126208. The Alert List PGN #127001 is transmitted cyclically every 5 s and on event (whenever there is a state change to any active alert or an occurrence of a new alert).

The Alert List PGN #127001 transmission shall never stop. When there are no active alerts, the Alert List PGN #127001 will contain “0” for the number of alert entries.

J.4.6 Use of ⟦AC1⟩ ACN ⟨AC1⟧

J.4.6.1 On network IEC 61162-450

When ⟦AC1⟩ ACN ⟨AC1⟧ is sent on this type of network, the TAG-Block is mandatory. In that case, it shall include as source the source ID of the command releasing instance (parameter code “s:”) and as destination the source ID of the command’s target (parameter code “d:”).

J.4.6.2 On network IEC 61162-3

When the content of the ⟦AC1⟩ ACN ⟨AC1⟧ is sent on this type of network the Alert Response PGN #126984 is used to acknowledge and temporarily silence an alert. The responsibility transfer function is PGN #127002.

J.4.7 Use of ARC

J.4.7.1 Declaration of use

The use of this sentence is optional. The manufacturer shall declare whether or not the function Alert Command Refuse is supported.

NOTE This sentence is provided to minimize the delay between an operator action and the resultant notification to the operator that the action has been refused by the INS. Equipment which does not implement the ARC sentence may experience increased delays in this notification.

J.4.7.2 On network IEC 61162-450

When ARC is sent on this type of network, the TAG-Block is mandatory. In that case, it shall include as source the source ID of the ARC releasing instance (parameter code “s:”) and as destination the source ID of the original command (parameter code “d:”).

J.4.7.3 On network IEC 61162-3

When the content of the ARC is sent on this type of network the Acknowledge Group Function PGN #126208 can be used to report that the alert acknowledgment or responsibility transfer function has not been accepted.

J.5 INS standardized alert identifiers

The standardized alert identifiers in Table J.3 shall be used by the INS for alerts defined in Annex C.

Table J.3 – Unique alert identifier at alert source

Source	Cause	Unique alert identifier at alert source
INS	System function lost	110
	Integrity verification not possible (6.5)	111
	Invalid information for functions in use (6.3.1.2)	112
	Invalid information for functions not in use (6.3.1.2)	113
	Different thresholds entered (6.4.3)	114
	Loss of system communication (8.8.1.2)	115
Heading control systems	Failure or reduction in power supply	140
	Off heading alarm	141
	Heading monitor (deviation from second heading source)	142
Track control systems	Early course change indication (track control via waypoints)	150
	Actual course change indication	151
	Wheel over line alarm (actual course change indication not acknowledged)	152
	Failure or reduction in power supply	153
	Position monitor	154
	Heading monitor	155
	Sensor failure (heading, position, speed)	156
	Cross-track alarm	157
	Course difference (heading deviates from track course)	158
	Low speed alarm	159
ECDIS	Positioning system failure	170
	Crossing safety contour	171
	Deviation from planned route – off-track alarm	172
	Area with special conditions – cross the boundary	173
	Approach to critical point	174
	Different geodetic datum	175
	System malfunction	176

Source	Cause	Unique alert identifier at alert source
	(System malfunction of backup device)	177
RADAR/ AIS	Target capacity	190
	CPA/TCPA	191
	Acquisition/activation (New target)	192
	Lost target alarm	193
	Failure of any signal or sensor in use	194
GNSS	HDOP exceeded	210
	No calculation of position	211
	Loss of position	212
	Loss of differential signal	213
	Differential corrections not applied	214
	Differential integrity status	215
Echo sounder	Depth below keel alarm	230
	Failure or reduction in power supply	231
Gyro compass	System fault	240
Bridge watch alarm	Malfunction	250
	Power supply failure	251

J.6 Alert state transition diagram

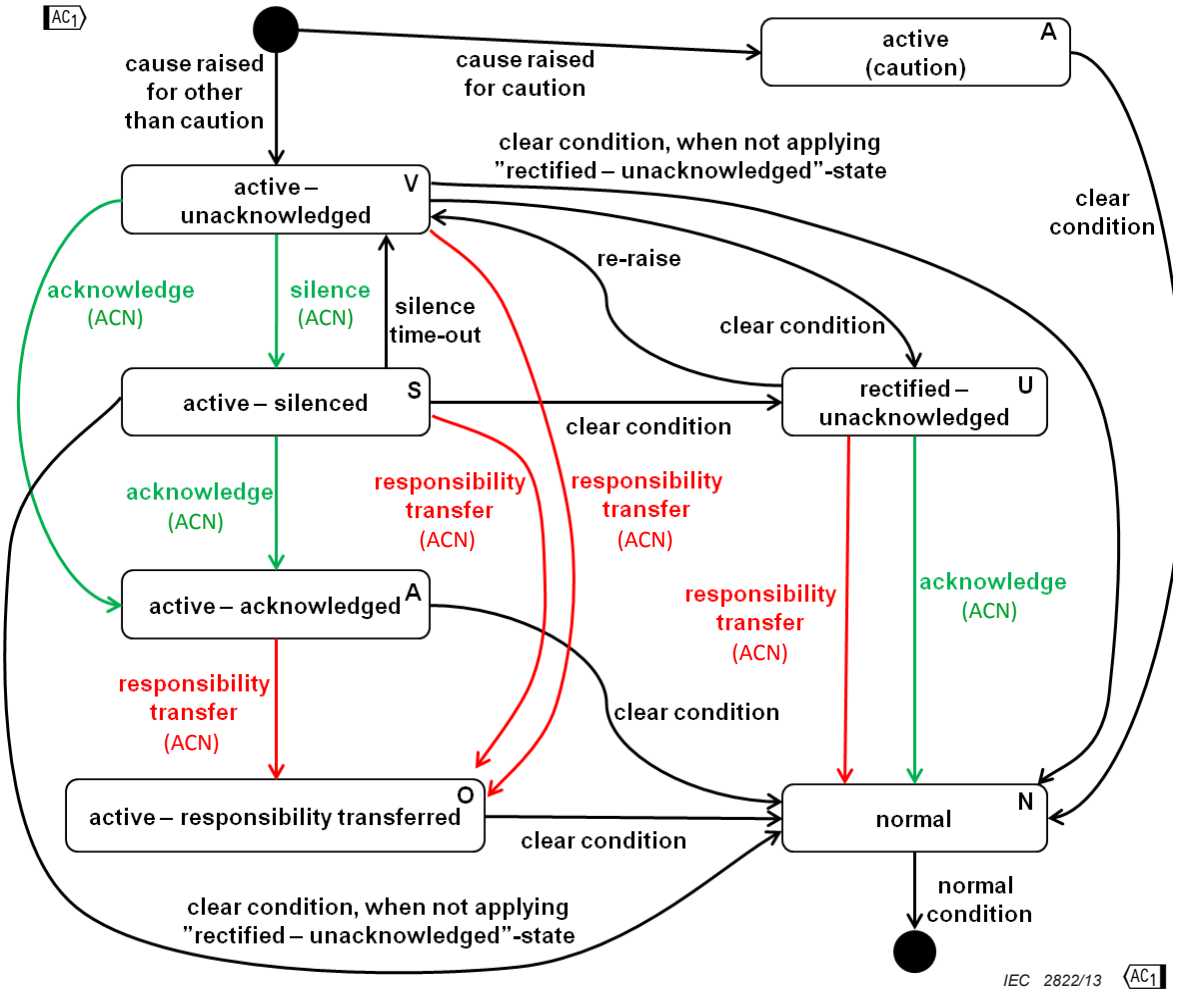


Figure J.5 – Alert state diagram

Figure J.5 reflects the view from the alert providing function. The alert states described are the following.

- active – unacknowledged: V
- active – silenced: S
- active – acknowledged or active: A
- active – responsibility transferred: O
- rectified – unacknowledged: U
- normal state: N

NOTE 1 The state “rectified – silenced” is covered by “rectified – unacknowledged”. This implies that “rectified–unacknowledged” will not generate any sound (because the alert’s cause is not present any longer). The reason for the alert state being represented by one data field and not two or more like in ALA or ALR is that, using one data field prevents misinterpretations and undefined/unwanted combinations of different states (e.g. rectified – silence which is equal in presentation with “rectified – unacknowledged”).

NOTE 2 The state “active” is used by alert priority Caution (C) and the state “active – acknowledged” is used by alert priorities Emergency Alarm (E), Alarm (A) and Warning (W). The alert priority Caution (C) can use only alert states “active” and “normal.

In addition to transitions available in Figure J.5 a transition from every state to “normal” state is possible under the following condition: intended switching off of a monitoring function, generating an alert e.g. switching steering mode from “Heading Control” to “Manual” mode in case of an “Off Heading” alert is present.

The INS, as receiver of an alert, requires time for alert revaluation to judge if the INS can reduce the number of high priority alerts as required by IMO. Therefore there shall be a delay of between 3 s to 5 s from the first transmission of the ALF sentence to the presentation (i.e. visual indication or audible signal) of alerts with state “active – unacknowledged” at the source of the alerts. Use of this delay avoids unwanted alert signals at the source.

Annex K
(normative)

Sentences for advanced alert related communication

NOTE Refer to IEC 61162-1 for possible later versions of these sentences.

K.1 General

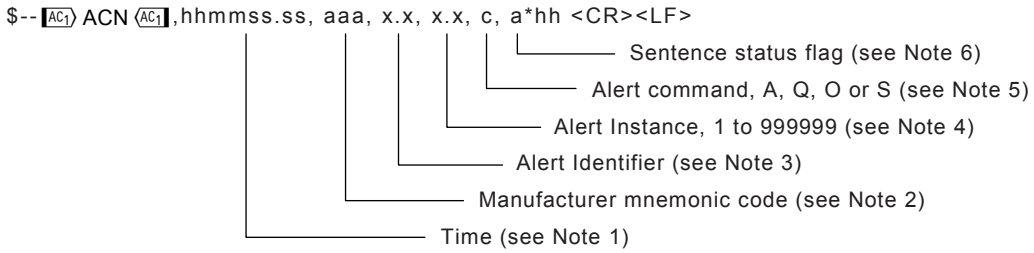
This annex describes details of new sentences used for advanced alert related communication for various purposes with the INS.

⟦AC1⟩ K.2 ACN – Alert command ⟨AC1⟧

This sentence is used for acknowledge, silence, responsibility transfer and to request repeat of alert details in case the reception process has detected, based on ALC, that ALF has been missed.

Responsibility transferred is used for a special conditional state of an alert. In this state the source of an alert indicates the alert visually as an acknowledged alert (i.e. no flashing indication nor audible signal). In this state the source of an alert re-raises an unacknowledged alert, if the source of the alert is unable to receive heartbeat (HBT) sentences from the sender of the sentence.

This sentence cannot be queried.



NOTE 1 Release time of the alert command. (e.g. for VDR purposes), optional can be a null field. Sender is allowed to use all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary. The receiver is allowed to ignore the content of this field. If the receiver does not ignore this field it should support all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary.

NOTE 2 Used for proprietary alerts defined by the manufacturer. For standardized alerts this should be a null field. For list of standardized alerts, see Annex J.

NOTE 3 The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum 7-digit integer. It identifies the type of the alert e.g. a “lost target” alert. For standardized alerts see list of Alert identifiers in Annex J. Number range 10000-9999999 is reserved for proprietary alerts. Alert Identifier examples:

“001”, “2456789”, “245”

NOTE 4 The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum 6-digit integer from 1 to 999999. The number of alert instance can be freely defined by the manufacturer as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from ‘active-unacknowledged’ state until ‘normal’ state is reached). It can also be a null field, when there is only one alert of that type.

NOTE 5 This should not be null field

acknowledge:	A
request / repeat information:	Q
responsibility transfer:	O
silence:	S

NOTE 6 This field should be “C” and should not be null field. This field indicates a command. A sentence without “C” is not a command.

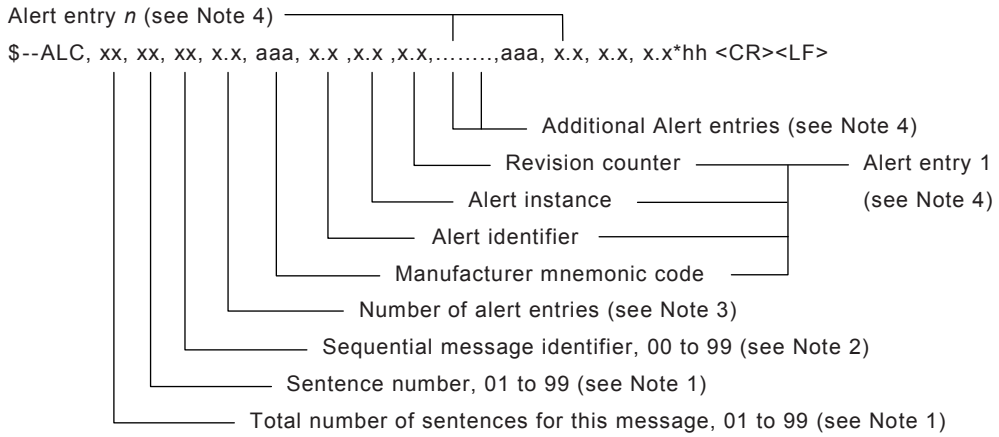
K.3 ALC – Cyclic alert list

The purpose of this sentence is to satisfy the needs for a safe and consistent data distribution with a minimum of data traffic. Each change on an alert’s data leads to an incremented Revision counter. So an alert processing device only needs to check the alert entries in the ALC messages to ensure that no ALF message has been lost. In the case where an ALF message has been lost, the missing message can be requested by sending a request alert command (see Clause K.2).

The ALC sentence provides condensed ALF sentence information. It contains the identifying data for each present alert of one certain source/device so that the receiver can understand which ALF has been missed (and retransmission of ALF can be requested by using the ⟦AC1⟩ ACN ⟨AC1⟧ sentence). It shall be published cyclically at least every 30 s by each alert generating device.

The cyclic alert list transmission shall never stop. When all alerts are in normal state the cyclic alert list is empty, i.e. the number of alert entries is 0.

The length of this sentence varies with the number of alerts (number of list entries) that are being generated. In cases where the needed number of entries exceeds the permitted sentence length the number of sentences is increased.



NOTE 1 The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These cannot be null fields.

NOTE 2 The sequential message identifier relates all sentences that belong to a group of multiple sentences (i.e. message). Multiple sentences (see Note 1) with the same sequential message identifier, make up one message.

NOTE 3 Contains the number of alert entries transported within this sentence.

NOTE 4 Alert entry 0 – *n*: Each alert entry consists of four fields:

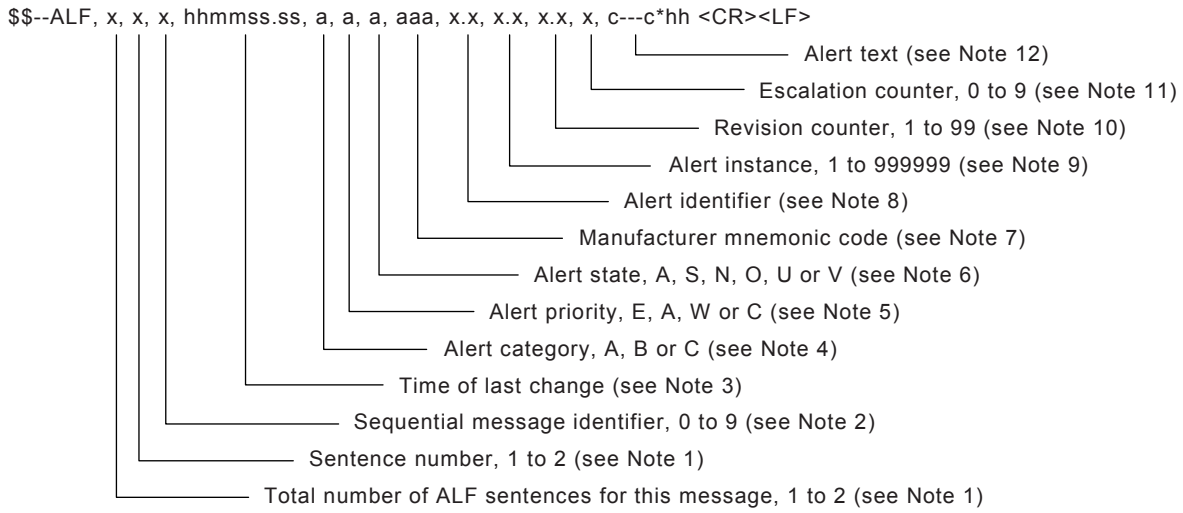
- Manufacturer Identifier (see ALF Manufacturer Identifier);
- Alert Identifier (see ALF Alert Identifier);
- Alert instance (see ALF Alert instance);
- Revision Counter (see ALF Revision Counter).

Each entry identifies a certain alert with a certain state. It is not allowed that an alert entry is split between two ALC sentences.

K.4 ALF – Alert sentence

This sentence is used to report an alert condition and the alert state of a device. An ALF message shall be published for an alert each time the alert information in this sentence changes and on alert request (see Clause K.2).

To transmit additional alert description text (see Note 12), optionally a second ALF sentence may be transmitted.



NOTE 1 The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These cannot be null fields. When the sentence number is 2, the following Alert category, Alert priority and Alert state can be null fields.

NOTE 2 The sequential message identifier relates all sentences that belong to a group of multiple sentences (i.e. message). Multiple sentences (see Note 1) with the same sequential message identifier, make up one message.

NOTE 3 Time should represent the last time the data within the alert message has changed. For example changing the alert text by in-/decrementing a contained counter or count down should cause a revision of alert message and a new time. Time is an optional field. The time-field is additional information about when this happened and not used for decision making. There is no mandatory requirement for time synchronization between the equipment. It should be either a null field (if not used) or UTC (if used). Sender is allowed to use all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary. The receiver is allowed to ignore the content of this field. If the receiver does not ignore this field, it should support all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary.

NOTE 4 The alert category is in compliance with the category definition as described in INS Performance Standard (MSC.252(83)) and Bridge Alert Management Performance Standard (MSC.302(87)):

A, Category A: Alerts, where information at the operator unit is directly assigned to the function generating the alert is necessary, as decision support for the evaluation of the alert-related condition, e.g. graphical information of danger of collision or graphical information of danger of grounding.

B, Category B: Alerts where no additional information for decision support is necessary besides the information which can be presented using the alert source and the text description of the alert.

C, Category C: Alerts that cannot be acknowledged on the bridge but for which information is required about the status and treatment of the alerts, e.g. certain alerts from the engine.

NOTE 5 Alert priority:

Emergency Alarm:	E, for use with Bridge Alert Management, (see IMO MSC.302(87))
Alarm:	A
Warning:	W
Caution:	C

NOTE 6 The alert state transition is defined in Annex J.

active – unacknowledged:	V
active – silenced:	S
active – acknowledged or active:	A

active – responsibility transferred: O

rectified – unacknowledged: U

normal: N

NOTE 7 Used for proprietary alerts defined by the manufacturer. For standardized alerts this should be a null field. For list of standardized alerts, see Annex J.

NOTE 8 The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum a 7-digit integer. It identifies the type of the alert, e.g. a “lost target” alert. For standardized alerts, see the list of Alert identifiers in Annex J. Number range 10000-9999999 is reserved for proprietary alerts. Alert Identifier examples:

“001”, “2456789”, “245”.

NOTE 9 The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum a 6-digit integer from 1 to 999999. The number of alert instance can be freely defined by the manufacturer as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from ‘active-unacknowledged’ state until ‘normal’ state is reached). It can be also a null field, when there is only one alert of that type.

NOTE 10 The revision counter is the main method to follow an up-to-date status. The revision counter is also unique for each instance of alert. The revision counter starts with 1 and the step for an increment is 1. The count resets to 1 after 99 is used. The revision counter increments on each change of content of any field of the alert.

NOTE 11 The escalation counter is presenting the number of alert escalations after time expiration during the state active-unacknowledged. The escalation counter starts with 0 and the step for increment is 1. The count resets to 1 after 9 is used. The alert escalation can be the escalation from warning into warning (activation of audible signal only), the escalation from warning to alarm, or the escalation from alarm to alarm with the activation of back-up navigator alarm.

NOTE 12 This field is used for the Alert title which is mandatory and for an additional alert description which is optional.

- The first ALF sentence transmits the Alert title. An Alert title is maximum 16 characters short form of the alert text.
- The optional second ALF sentence transmits the additional alert description. Additional alert description is the long description of the alert. The additional alert description contains more information for decision making (i.e. alert description text).
- The second ALF sentence uses null fields for Time of last change, Alert category, Alert priority, and Alert state to allow longer text. The actual number of valid characters should be such that the total number of characters in a sentence does not exceed the “82”-character limit.
- Some equipment standards specify alert text longer than 16 characters (for example the AIS standard has defined some alerts to be coded with ALR-sentence and with text longer than 16 characters). In such cases, the first ALF sentence is used for the first 16 characters of the alert text as alert title and the second ALF-sentence to carry the full alert text.

EXAMPLES:

$IIALF,1,1,0,124304.50,A,W,A,,192,1,1,0,LOST TARGET*14<CR><LF>

$IIALF,2,1,1,081950.10,B,A,S,XYZ,0512,1,2,0,HEADING LOST*2D<CR><LF>

$IIALF,2,2,1,,,,,XYZ,0512,1,2,0,NO SYSTEM HEADING AVAILABLE*0D<CR><LF>

K.5 ARC – Alert command refused

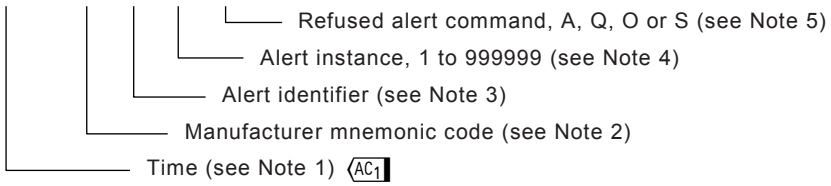
This sentence is used for:

- Category A or C alerts (see IMO MSC.302(87)), for which it is illegal to accept acknowledge or responsibility transfer, e.g. not enough information for decision support available or the source of acknowledgement is not acceptable,

  Note that in a properly working system such attempts should not happen.

- Category B (see IMO MSC.302(87)), if the source of acknowledge is not acceptable.

AC1 $--ARC, hhmmss.ss, aaa, x.x, x.x, c*hh <CR><LF>



NOTE 1 Release time of the Alert Command Refused, e.g. for VDR purposes, optional, can be a null field. The sender is allowed to use all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary. The receiver is allowed to ignore the content of this field. If the receiver does not ignore this field it should support all alternatives defined in IEC 61162-1:2010, Table 5, Field type summary.

NOTE 2 Used for proprietary alerts, defined by the manufacturer. For standardized alerts this should be a null field. For the list of standardized alerts, see Annex J.

NOTE 3 The alert identifier is unique within a single alert source. The alert identifier is a variable length integer field of maximum a 7-digit integer. It identifies the type of the alert, e.g. a “lost target” alert. For standardized alerts, see the list of Alert identifiers in Annex J. Number range 10000-9999999 is reserved for proprietary alerts. Alert Identifier examples:

“001”, “2456789”, “245”.

NOTE 4 The alert instance identifies the current instance of an alert to distinguish alerts of the same type (Alert identifier) and from the same source (e.g. dangerous target). Alert instance is maximum a 6-digit integer from 1 to 999999. The number of alert instance can be freely defined by the manufacturer, as long as it is unique for one type of alert (alert identifier). It is not permitted to modify the alert instance within a life cycle of a distributed alert (from ‘active-unacknowledged’ state until ‘normal’ state is reached). It can also be a null field, when there is only one alert of that type.

AC1 NOTE 5 Refused Alert Command: Indicates refused “Alert command” of a corresponding ACN sentence. This should not be a null field. AC1

acknowledge:	A
request / repeat information:	Q
responsibility transfer:	O
silence:	S

Annex L
(normative)

Alert communication with ALR and ACK

L.1 Alert information distribution

L.1.1 Overview

This annex describes alert communication for legacy simple sensors. For new designs, it is recommended to use sentences ALF, ALC, ⟦AC1⟩ ACN ⟨AC1⟧ and ARC.

L.1.2 Main device states

Figure L.1 shows the two main states N and A that the sensor device can be in with respect to alerts.

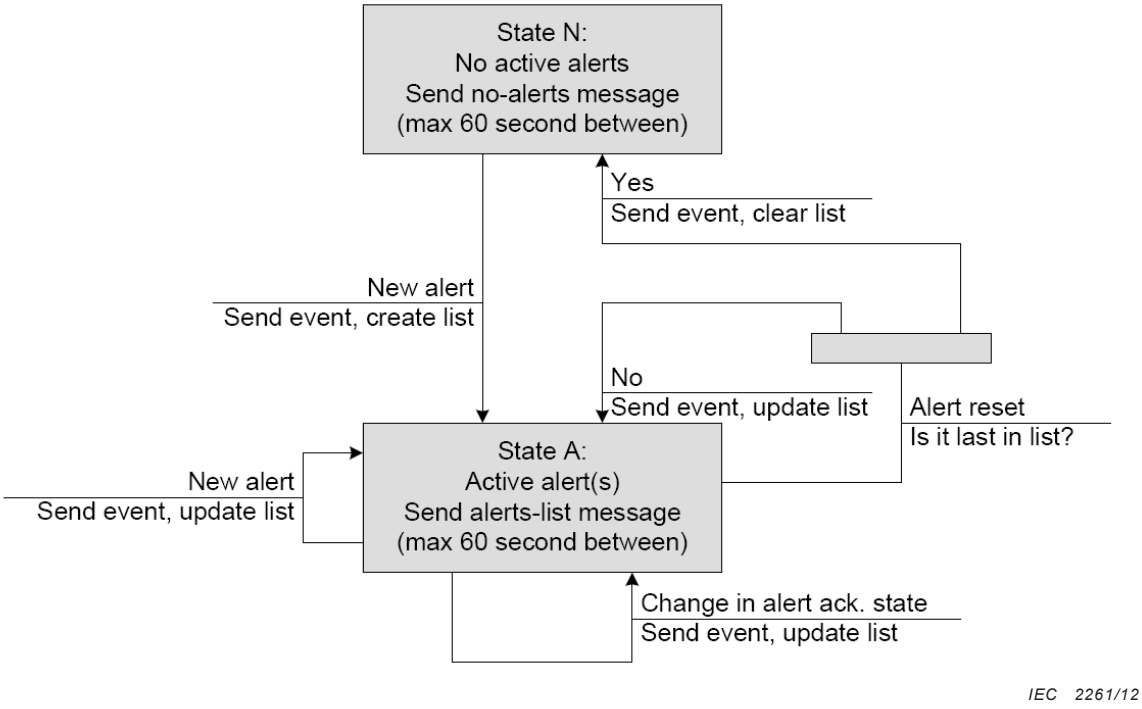


Figure L.1 – State diagram

The sensor device has two main states:

- State N: No active alerts. The device should send a “no-alerts” message (see L.1.3) with a period not exceeding 60 s unless otherwise specified in individual equipment standards.
- State A: The device has one or more active alerts, of which zero or more may be acknowledged and the rest (possibly zero) are unacknowledged. In this state, the device shall send all active alerts with a period not exceeding 60 s unless otherwise specified in individual equipment standards. When multiple alerts are active in the device, it is recommended to transmit all active alerts as “a list” of alerts (alert-list message).

In addition to the periodic transmissions as mentioned above, the device shall immediately send an alert message (ALR), when (values for alert condition and acknowledge state in parenthesis):

- a new alert is raised in the device – (A,V);

- an existing alert is acknowledged in the device (either on the device itself or by remote acknowledgement) – (A,A);
- an existing alert condition becomes non-active (V,V or V,A)).

The alert message may include the time stamp when the alert last changed status (normally current time) and include the alert number, explanatory text as well as appropriate alert and acknowledgement flags. It may optionally be followed by a TXT message to give additional contextual information. The TXT message should be contiguous with its associated ALR. An example is included below.

$--ALR,123456,906,A,V,Sensor fault*hh<CR><LF>

$--TXT,02,01,06,Selftest error 17*hh<CR><LF>

$--TXT,02,02,06,See service manual*hh<CR><LF>

NOTE This specification does not put any restrictions on the transitions that are reported through an event message. Receivers are prepared to receive and process all possible combinations and sequences of alert state events.

L.1.3 No-alerts message

The no-alerts message is intended to inform that the device has no active alerts. It shall be repeated with a period not exceeding 60 s unless otherwise specified in individual equipment standards. This message may be used to clear the receiver's alert list.

This message is sent as an ALR message, but without time stamp, and shall include a 'V' flag in both the alert condition and acknowledgement field. The no-alerts (list empty) message is included below.

$--ALR,,,V,V,*hh<CR><LF>

L.1.4 Alerts-list message

The alert/alert-list message is intended to periodically refresh the alert list so that the listener can verify that it has the correct internal list of active alerts. This will in turn help to remedy problems that may occur due to lost telegrams at earlier stage, synchronization of recently added receivers, etc.

The alert/alert-list message shall be repeated with a period not to exceed 60 s unless otherwise specified in individual equipment standards, if any alerts are active.

The alert/alert-list message consists of the same message(s) sent when the corresponding event occurred, but all active alerts shall be reported, and preferably with no delay between messages. An example with two messages in the list is included below:

$--ALR,123456,123,A,A,Battery power in use*hh<CR><LF>

$--ALR,130507,456,A,V,Self test failure*hh<CR><LF>

NOTE For alerts that are active longer than 24 h, the receiver will need to keep track of the original event time.

L.2 Alert acknowledgement

L.2.1 General principles

If the alert handling device has a bi-directional data link to the sensor device, it is possible to send remote acknowledgements to alerts (ACK sentence) based on user action, e.g., through

an acknowledgement button. This means that the resolution of potentially lost acknowledgement or alert status messages can be left to the user. The user should note that the acknowledgement was not effected and, if necessary, repeat the acknowledgement at the local or remote station.

L.2.2 Alert acknowledgement

If alert acknowledgement is implemented, exactly one acknowledgement message shall be sent each time the operator initiates an acknowledgement.

$--ACK,xxx*hh<CR><LF>

L.2.3 Alarm acknowledge capability

In some cases, the sensor device needs to know if the alert handling device is still able to communicate with it. This may, for example, be used to implement silent alerts on the sensor device.

In this case, it is necessary to send an empty alarm acknowledge message from the external alert handling device to the sensor device at regular intervals. The message should be sent at an interval not to exceed 60 s unless otherwise specified in individual equipment standards.

$--ACK,*hh<CR><LF>

The alert handling device shall not send any messages, including heartbeat, if the empty acknowledgement message from the sensor device has not been received in a period of maximum 130 s, unless otherwise specified in individual equipment standards.

Annex M
(normative)

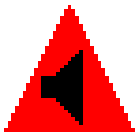
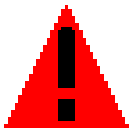
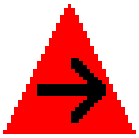
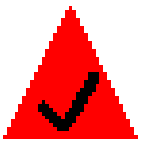
Icons for alert management

NOTE Refer to IEC 62288 for a possible later version of these icons.

The use of icons for alert management is optional, but if an icon is used then it is mandatory to use the icons provided in Tables M.1 and M.2.

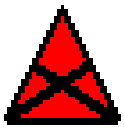
Tables M.1 and M.2 specify icons for daylight use. For other viewing conditions such as night and dusk the “Icon description” in Tables M.1 and M.2 are in force, but the examples of icon graphics should be modified as appropriate.

Table M.1 – Alert management icons – Basic

Icon number	Icon name	Icon description (normative)	Icon graphic(s) (example)
1	Active – unacknowledged alarm	A flashing red triangle. A symbol of loudspeaker in the middle of the triangle. To be presented together with the alert text.	
2	Active – silenced alarm	A flashing red triangle. A symbol as in icon number 1 with a prominent diagonal line above it. To be presented together with the alert text.	
3	Active – acknowledged alarm	A red triangle. An exclamation mark in the middle of the triangle. To be presented together with the alert text.	
4	Active – responsibility transferred alarm	A red triangle. An arrow pointing towards the right in the middle of the triangle. To be presented together with the alert text.	
5	Rectified – unacknowledged alarm	A flashing red triangle. A tick mark in the middle of the triangle To be presented together with the alert text.	
6	Active – unacknowledged warning	A flashing yellowish orange circle. A symbol of loudspeaker in the middle of the circle. To be presented together with the alert text.	
7	Active – silenced warning	A flashing yellowish orange circle. A symbol as in icon number 6 with a prominent diagonal line above it. To be presented together with the alert text.	
8	Active – acknowledged warning	A yellowish orange circle. An exclamation mark in the middle of the circle. To be presented together with the alert text.	

Icon number	Icon name	Icon description (normative)	Icon graphic(s) (example)
9	Active – responsibility transferred warning	A yellowish orange circle. An arrow pointing towards the right in the middle of the circle. To be presented together with the alert text.	
10	Rectified – unacknowledged warning	A flashing yellowish orange circle. A tick mark in the middle of the circle. To be presented together with the alert text	
11	Caution	A yellow square. An exclamation mark in the middle of the square. To be presented together with the alert text.	

Table M.2 – Alert management icons – Additional qualifiers

Icon number	Icon name	Icon description (normative)	Icon graphic(s) (example)
12	Aggregation	A plus sign. To be presented together with icons number 1 to 11	
13	Acknowledge not allowed for alarm (see Note)	A red triangle with a cross in the middle. To be presented together with icons number 1, 2 and 5.	
14	Acknowledge not allowed for warning (see Note)	A yellowish orange circle with a cross in the middle. To be presented together with icons number 6, 7 and 10.	
NOTE The “acknowledge not allowed” icon is used when a Category A alert cannot be acknowledged in a task station.			

NOTE For printing purposes of this standard the icon symbols in Tables M.1 and M.2 use red, yellowish orange, yellow and black. Mandatory is the use of red, yellowish orange and yellow (see column icon description in Tables M.1 and M.2). Black is used as an example, and it can be replaced by any suitable colour appropriate for the ambient viewing condition.

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IMO SN.1/Circ.265, *Guidelines on the application of SOLAS regulation V/15 to INS, IBS and bridge design*

IMO SN.1/Circ.288, *Guidelines for bridge equipment and systems, their arrangement and integration (BES)*

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