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Interested committees:

Title: BS EN IEC 62065 Maritime navigation and radiocommunication equipment and systems

Track control systems - Operational and performance requirements, methods of testing

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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IEC 62065 ED3

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2023-08-04

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80/1056/RR

IEC TC 80 : MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS

SECRETARIAT:

United Kingdom

SECRETARY:

Mr Kim Fisher

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 18

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY

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TITLE:

Maritime navigation and radiocommunication equipment and systems – Track control systems – Operational and performance requirements, methods of testing and required test results

NOTE FROM TC/SC OFFICERS:

This revision has been prepared by WG 16. The test requirements of Clause 6 are still under review.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND
RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS –
TRACK CONTROL SYSTEMS –****Operational and performance requirements,
methods of testing and required test results**

FOREWORD

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International Standard IEC 62065 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This third edition cancels and replaces the second edition, which has been technically revised.

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

- alert management has been brought in line with MSC.302(87), IEC 62923-1 and IEC 62923-2, reducing the number of alerts for one situation and improving the information provided by alerts. An overview is provided in Annex F.
- the previous Annex F has been removed as outdated and not instrumental in the standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
80/XXXX/FDIS	80/XXXX/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

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

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – TRACK CONTROL SYSTEMS –

Operational and performance requirements, methods of testing and required test results

1 Scope

This International Standard specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards adopted by the IMO in resolution MSC.74(69) Annex 2 Recommendation on Performance Standards for Track Control Systems. In addition, it takes into account IMO resolution A.694(17) to which IEC 60945 is associated. It also takes into account IMO resolution MSC.302(87) on bridge alert management (BAM), to which IEC 61923-1 and IEC 62923-2 are associated.

When a requirement of this document is different from IEC 60945, the requirement in this document takes precedence.

All text of this document that is identical to that in IMO resolution MSC.74(69), Annex 2, is printed in italics and the resolution (abbreviated to – A2) and paragraph numbers are indicated in brackets i.e. (A2/3.3).

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

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

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

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

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

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

IEC 62923-1, *Maritime navigation and radiocommunication equipment and systems — Bridge alert management — Part 1: Operational and performance requirements, methods of testing and required test results*

IEC 62923-2, *Maritime navigation and radiocommunication equipment and systems — Bridge alert management — Part 2: Alert and cluster identifiers and other additional features*

IMO MSC.74(69) Annex 2, *Recommendation on Performance Standards for Track Control Systems*

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

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

active track

track activated for track control

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.2

alarm

high-priority alert

condition requiring immediate attention and action by the bridge team, to maintain the safe navigation and safe operation of the ship

[SOURCE: IMO Resolution MSC.302(87)]

3.1.3

alert

announcement of abnormal situations and conditions requiring attention

Note 1 to entry: *Alerts are divided in four priorities: emergency alarms, alarms, warnings and cautions. An alert provides information about a defined state change in connection with information about how to announce this event in a defined way to the system and the operator.*

[SOURCE: IMO Resolution MSC.302(87)]

3.1.4

along-track speed control

automatic control of the ship's speed during track control based on a pre-planned track

3.1.5

assisted turn

manoeuvre of a ship automatically controlled by a pre-set radius or rate of turn but not based on the ship's position to perform an approximation of a curved track

3.1.6

back-up navigator

any individual, generally an officer, who has been designated by the ships master to be on call if assistance is needed on the bridge

83 [SOURCE: IMO Resolution MSC.74(69), Annex 2]

84 **3.1.7**

85 **back-up navigator call**

86 signal automatically sent from the TCS to the BNWAS to call assistance to the bridge

87 **3.1.8**

88 **consistent common reference system**

89 CCRS

90 sub-system or function for acquisition, processing, storage, surveillance and distribution of data
91 and information providing identical and obligatory reference to sub-systems and subsequent
92 functions and to other connected equipment, if available

93 **3.1.9**

94 **course**

95 for marine navigation, horizontal direction in which a vessel is steered or intended to be steered,
96 expressed as angular distance from north, usually 000° at north, clockwise through 360°

97 Note 1 to entry: 360° is indicated as 000°.

98 **3.1.10**

99 **course difference limit**

100 maximum difference between track course and heading before a warning is activated

101 **3.1.11**

102 **cross-track distance**

103 *perpendicular distance of the ship from the track*

104 [SOURCE: IMO Resolution MSC.74(69), Annex 2]

105 **3.1.12**

106 **cross-track limit**

107 *maximum cross-track distance before an alarm is activated*

108 [SOURCE: IMO Resolution MSC.74(69), Annex 2]

109 **3.1.13**

110 **curved track**

111 *non-straight track between two straight legs*

112 [SOURCE: IMO Resolution MSC.74(69), Annex 2]

113 **3.1.14**

114 **fall-back arrangements**

115 automatic reaction of the TCS by using data, function or hardware of degraded quality in relation
116 to the failed one

117 EXAMPLE Dead reckoning for position information, heading control in case of a failure of track control.

118 **3.1.15**

119 **FROM-waypoint**

120 *last passed waypoint*

121 [SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.16**great circle**

intersection of the earth surface and a plane containing the points A, B and the centre of the sphere

3.1.17**heading**

direction in which the bow of a ship is pointing expressed as an angular displacement from north

[SOURCE: IMO Resolution MSC.191(79)]

3.1.18**heading control**

control of the ship's heading

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.19**heading monitor function**

monitoring of the actual heading sensor by an independent second source

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.20**leg**

straight line between two waypoints and/or curved track(s)

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.21**main conning position**

place on the bridge with a commanding view providing the necessary information and equipment for the conning officer to carry out his functions

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.22**minimum manoeuvring speed for track control**

lowest fore/aft speed through the water at which the track control system is capable of maintaining its performance within the specified accuracy limits

Note 1 to entry: The value depends on the ship's design and loading and on the present environmental conditions.

3.1.23**NEXT-waypoint**

waypoint following the TO-waypoint

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.24**override facility**

control to perform the override function

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.25**override function***intentional fast change-over from automatic to temporary manual control*

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.26**position monitor function***monitoring of the actual position sensor by an independent second source*

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.27**primary position-fixing system**

electronic position-fixing system (EPFS) used for track control

3.1.28**radius of turn****ROT***radius of a curved track*

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.29**rate of turn***change of heading per time unit*

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.30**rhumb line**

line on the surface of the earth making the same angle with each meridian crossed

3.1.31**ship manoeuvring characteristics**

range-of-manoeuve possible for the ship

Note 1 to entry: Examples of the range-of-manoevres are: maximum rate of turn, minimum radius of turn, maximum turn acceleration and deceleration.

3.1.32**single operator action***procedure achieved by no more than one hard-key or soft-key action, excluding any necessary cursor movements, or voice actuation using programmed codes*

[SOURCE: IMO Resolution MSC.252(83)]

3.1.33**speed**

absolute value of velocity

Note 1 to entry: May either be the ship's speed through the water, or the speed made good over the ground.

3.1.34**surge**

alongship component of ship motion

3.1.35**sway**

athwartships component of ship motion (positive to starboard)

3.1.36**temporary track**

track that originates at the current position of the ship and joins the pre-planned track

Note 1 to entry: The temporary track may include temporary waypoints which can be identified as different from the waypoints of the pre-planned track.

3.1.37**TO-waypoint**

waypoint which the ship is approaching

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.38**track**

path to be followed over ground

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.39**track control****TC**

control of the ship's movement along a track, where corrections made by the controller to compensate for wind, drift and other influences, are based on the cross-track distance and not only on the bearing to the TO-waypoint

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.40**track course**

direction from one waypoint to the next, a constant course on a rhumb line track and a varying course on a great circle track

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.41**warning**

condition requiring immediate attention, but no immediate action by the bridge team

Note 1 to entry: Warnings are resented for precautionary reasons to make the bridge team aware of changed conditions which are not immediately hazardous, but may become so if no action is taken.

[SOURCE: IMO Resolution MSC.302(87)]

3.1.42**waypoint**

geographic position together with its associated data

3.1.43**wheel-over-line**

line where the ship has to initiate a curved track to eliminate the effect of any offset with respect to the new course, taking into consideration the distance required for the ship to build up the necessary rate of turn and the prevailing weather, speed and loading conditions

[SOURCE: IMO Resolution MSC.74(69), Annex 2]

3.1.44**wheel-over-time**

point in time when the track control system initiates the course change

3.1.45**yaw**

rate of turn (positive to starboard)

3.2 Abbreviated terms

~A	Not applicable for category A systems
ACCA	Actual course change alarm
ACCW	Actual course change warning
BAM	Bridge alert management
BNC	Back-up navigator call
BNWAS	Bridge navigational watch alarm system
CAM	Central alert management
CAM-HMI	Central alert management-human machine interface
CCRP	Consistent common reference point
CRS	Course
COG	Course over ground
DGPS	Differential GPS
DR	Dead reckoning
ECCA	Early course change alarm
ECCW	Early course change warning
ECDIS	Electronic chart display and information system
ENC	Electronic navigational chart
EOTW	End of track warning
EOTA	End of track alarm
EPFS	Electronic position fixing system
EUT	Equipment under test
GC	Great circle
GPS	Global positioning system
HC	Heading control
HCS	Heading control system
HDG	Heading
INS	Integrated navigation system
OOW	officer of the watch
RL	Rhumb line
SDME	Speed and distance measuring equipment
SWH	Significant wave height
TCS	Track control system
WOL	Wheel-over-line
WOT	Wheel-over-time
XTD	Cross-track distance
XTL	Cross-track limit

4 Application of this document

The application of this document is as follows.

- d) (A2/1) *Track control systems in conjunction with their sources of position, heading and speed information are intended to keep a ship automatically on a pre-planned track over ground under various conditions and within the limits related to the ship's manoeuvrability. A track control system may additionally include or be combined with*
- heading control;
 - along-track speed control (see Annex B).
- e) Planning the track by waypoints may be performed
- as part of the track control system, or
 - by importing waypoint or track data.
- f) The track control system ensures the integrity of the geodetic datum, the ship manoeuvring characteristics and the curved tracks of the imported data.
- g) This document applies for track control systems which can exchange data with a heading sensor, speed sensor, EPFS and/or heading control system but excludes waypoint data exchange.
- h) Track control does not necessarily require that ENC or other geographic data such as shallow area information be taken into consideration by the track control system.
- i) (A2/2.1) *These IMO Performance Standards are applicable for track control systems working*
- at ship's speed from minimum manoeuvring speed up to 30 kn; and
 - at ship's maximum rate of turn not greater than 10°/s.
- j) These performance standards do not apply to High Speed Craft as defined by SOLAS chapter 10.
- k) (A2/2.2) *Track control systems fitted on ships shall meet all requirements of the IMO Performance Standards (MSC.74(69) Annex 2 Recommendation on Performance Standards for Track Control Systems) relating to straight tracks as described in this document. Systems fitted on ships requiring curved track control shall additionally meet all the requirements relating to curved tracks, described as category C in this document.*
- l) This document applies to three categories of track control systems:
- Category A: Single leg track control or multiple leg track control without assisted turns between legs;
 - Category B: Multiple leg track control with assisted turns between legs;
 - Category C: Full track control on legs and turns.
- m) In this document, the ship models are for ships that use a conventional propeller propulsion system in conjunction with a single rudder or multiple parallel operated rudders (see Annex I).

NOTE A track control system may provide rudder order to the steering gear independently of a heading control system.

5 Requirements

5.1 General

The track control system shall comply with the applicable requirements of IEC 60945 and IEC 62288.

5.1 Operational requirements

5.1.1 Functionality

5.1.1.1 Track control mode

(See 6.4.3.2)

(A2/5.1.1) *A track control system shall be able to steer the ship from its position*

.1 to a single waypoint; or

.2 along a track containing a sequence of waypoints

using rhumb line or great circle sailing.

5.1.1.2 Starting requirements

(See 6.4.2.1, 6.4.2.2, 6.4.2.3, 6.4.2.4, 6.4.3.1)

(A2/5.1.2) *The system shall allow the officer of the watch (user) to start or restart track control only if:*

- the required position, heading and speed sensor data are valid and selected,
 - the pre-planned track has been checked for plausibility and correctness of geometric and ship-dependent limits (see Annex E) before becoming the active track,
- and if:*
- *the ship's position* relative to the selected track,
 - *the difference between track course and actual heading,*
 - *the ship's manoeuvrability*

will result in a safe approach manoeuvre to the track. A safe approach manoeuvre is a planned manoeuvre which is within the manoeuvring characteristics of the vessel and which does not result in an unexpected turning direction.

For this purpose, the system shall allow the user at least one of the following options:

- a) to select the TO-waypoint or a leg on a pre-planned track and to select the maximum allowable difference between the bearing to the TO-waypoint and the actual heading;
- or
- n) to define a temporary track to go to the pre-planned track. The temporary track shall meet all ship manoeuvring characteristics which apply to a pre-planned track (~A).

5.1.1.3 Primary position-fixing system, heading and speed

(See 6.2.2.2)

(A2/5.1.3) *The primary position-fixing system used for track control shall be an electronic position-fixing system (EPFS) approved by the International Maritime Organization. See 5.3.1 for detailed requirements.*

Position, heading and speed can each be based on a single sensor/source or optionally from multiple sensors/sources.

5.1.1.4 Position monitoring

(6.4.5.3)

(A2/5.1.4) *The ship's position shall be continuously monitored by a second or additional independent position source.* If the ship is fitted with a second EPFS and position is available from this EPFS its position shall be used for position monitoring. Otherwise, estimated position by dead reckoning (DR) as a minimum shall be used as the second position source for position monitoring. The DR position shall be derived from a shipborne heading sensor and a speed and distance measuring equipment (SDME). There shall be a user selectable limit covering at least the range of 0,01 NM to 1 NM (or the equivalent in other units) for raising the alert. *This monitoring need not be an integral part of the track control system.*

5.1.1.5 Approaching course change behaviour (~A)

(See 6.4.5.12)

A graphical description of the sequences described here is given in Figure A.1.

(A2/5.1.5) In the case of track control by a sequence of waypoints, an early course change indication shall be given by a category B warning (CCW) at a user-selectable time no earlier than 5 minutes, but no later than 1 min before the wheel-over line. Acknowledgement shall rectify the CCW.

When, due to quick succession of legs, a CCW for the wheel over line of the NEXT-waypoint would be required before the wheel over line of the TO-waypoint, the CCW for the NEXT-waypoint shall be delayed until the wheel over line of TO-waypoint.

NOTE As information for decision making (see MSC.302(87) 8.1) it is recommended to include at least the direction of the upcoming turn and the planned course over ground of the upcoming leg in the alert description text. Also the time until wheel over can be included.

EXAMPLEs of information for decision making in a course change alert:

“Ship turns to STB to 012°”

“STB turn to 012°”

“In 33s ship turns to STB from 356° to 012°”

“In 33s STB turn from 356° to 012°”

5.1.1.6 Course change behaviour (~A)

(See 6.4.5.12)

A graphical description of the sequences described here is given in Figure A.1.

(A2/5.1.6.1) In the case of track control by a sequence of waypoints, if the CCW has been acknowledged before wheel-over, an audible indication representing the Morse letter “C” shall be given at the wheel-over line, unless this audible indication coincides with the audible signal of the CCW.

(A2/5.1.6.1) In the case of track control by a sequence of waypoints, a category B alarm (CCA) shall be given as escalation of an unacknowledged CCW at the wheel-over line.

(A2/5.1.6.2) The system shall provide means for the officer of the watch to confirm the course change at wheel-over by acknowledging the CCA. Acknowledgement shall rectify the CCA.

(A2/5.1.6.3) With or without the confirmation (acknowledgement of the CCW or CCA), the ship shall follow automatically the track.

(A2/5.1.6.4) If the actual course change alarm is not confirmed (acknowledged) by the officer of the watch within 30 s of wheel-over, a back-up navigator call (BNC) shall be given. When the BNC has been sent, it shall be removed when the mariner:

- acknowledges the CCA;
- intentionally disengages track control by selecting a different steering control mode.

The CCW or CCA shall be terminated when the mariner intentionally disengages track control by selecting a different steering control mode.

5.1.1.7 Change of waypoints

(See 6.4.2.2, 6.4.2.3, 6.4.2.4, 6.4.2.5, 6.4.3.1.6, 6.4.3.1.8, 6.4.3.1.9)

(A2/5.1.7) *In the case of track control by a pre-planned sequence of waypoints, it shall not be possible to modify the TO-waypoint, the FROM-waypoint and (~A) the NEXT-waypoint of the active track and their relevant associated waypoint data while in the track control mode without creating a new track and until:*

a) *the pre-planning of the new track is completed;*

and

o) *the starting requirements (5.1.1.2) are fulfilled.*

5.1.1.8 Turn performance (~A)

(See 6.4.3.2)

(A2/5.1.8) *The track control shall enable the ship to sail from one leg to another by turns based:*

a) *on a preset turn radius;*

or

p) *on a radius calculated on the base of a preset rate of turn and the planned speed;*

and

within the turning capability of the ship.

5.1.1.9 Adaptation to steering characteristics

(See 6.4.4.1, 6.4.4.3)

(A2/5.1.9) *The track control shall be capable of manual or automatic adjustment to different steering characteristics of the ship under various weather, speed and loading conditions.*

The user manual shall contain information on the facilities for adjustment to weather, speed and loading conditions.

NOTE The minimum adjustments for various weather and speed conditions are defined and covered by the tests for adaptation to speed, currents and sea states in this document [see 6.4.4].

When the track control system uses speed for adaptation to steering characteristics, if the loss of the speed impairs the track control performance, an alert may be provided indicating the performance reduction. When estimated performance is reduced below the requirements of this standard, an alert shall be provided.

5.1.1.10 Permitted tolerance

(See 6.4.3.2.2, 6.4.4.2)

(A2/5.1.10) *Means shall be incorporated to prevent unnecessary activation of the rudder due to normal yaw or sway motion, sensor data resolution and statistically scattered position errors.*

The quality of the track control shall be so that overshoot, oscillation and constant track deviation are within tolerable limits (see 6.4.3.2.2) both for straight and curved tracks.

Category B TCS shall comply with the requirements for curved track TCS, except that, after having passed the wheel-over, the actual cross-track distance is merely used for monitoring until completion of the automatic course change manoeuvre. Manual or automatic means shall be provided to adapt to variable drift and speed changes during a turn (e.g. facilitating manual adjustments of rate of turn or radius of turn).

The switching of position, heading and/or speed sensors shall not generate excessive rudder activities.

5.1.1.11 Override function

(See 6.4.6.5, 6.4.8)

(A2/5.1.11) A track control system shall be able to accept a signal from the override facilities to terminate track control mode and switch to these override facilities. After change-over to override, return to track control shall require user intervention (see 5.1.1.2).

5.1.1.12 Heading control mode

(A2/5.1.12) A track control system may be operated in heading control mode. In this case, the performance standards of heading control systems are to be applied.

NOTE The IMO performance standards for heading control are given in IMO resolution MSC.64(67) annex 3 and these are incorporated into ISO 11674.

5.1.1.13 Manual change over from track control to manual steering

(See 6.4.6.5)

(A2/5.1.13.1) Change over from track control to manual steering shall be possible at any rudder angle.

(A2/5.1.13.2) Change over from track control to manual steering shall be possible under any conditions, including any failure in the track control system.

(A2/5.1.13.3) After change over to manual steering, return to automatic track control shall require operator (user) intervention.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

NOTE For example, the heading monitoring and its alerts may remain active if they are also part an active function other than track control.

5.1.1.14 Manual change over from track control to heading control

(See 6.4.6.5)

This subclause only applies if the heading control is included in the track control system.

(A2/5.1.14.1) Any change over from track control to heading control shall be possible under all conditions of normal operation.

(A2/5.1.14.2) To maintain the course, the heading control system shall:

- if sailing on a leg, take over the actual heading as the preset heading,
- (~A) if sailing on a curved track, take over the actual heading as the preset heading.

(~A) If sailing on a curved track, the system may provide the additional option, based on an intended operator selection, to complete the turn with the track course of the next leg as the preset heading for the heading control system. This operator selection shall only be available after the turn has started and shall be clearly and unambiguously indicated.

(A2/5.1.14.3) Any switching back to track control shall require operator (user) intervention.

When the automatic track control function is intentionally disengaged, all active alerts related to track control only shall be terminated.

NOTE For example, the heading monitoring and its alerts may remain active if they are also part an active function other than track control.

5.1.1.15 Steering mode indication

(See 6.4.7.1)

(A2/5.1.15) *Adequate indication shall be provided to show which method of steering is in operation.*

If HCS is an integral part of the TCS, the TCS shall at least indicate if the TCS, HCS or a manual/external mode is in operation. If HCS is not an integral part of the TCS, the TCS shall at least indicate if the TCS or a manual/external mode is in operation.

When the TCS is activated and has multiple internal modes available, it shall clearly indicate which internal mode is in operation.

The indication shall at least be provided at all locations where the steering mode can be changed in the TCS.

5.1.1.16 Heading and Heading monitoring

(A2/5.1.16) *Heading monitoring shall be provided to monitor the actual heading information by independent heading sources. The heading monitor is not required to be an integral part of the track control system. See 5.1.3.4 for the alerts based on the heading monitoring. There shall be a user selectable limit covering at least the range of 5° to 15° for raising the alert.*

If the TCS does not include the heading monitoring function, the installation manual shall provide instructions to fit equipment with a heading monitoring function.

5.1.1.17 End of pre-planned track

(See 6.4.5.10)

At the end of the pre-planned track, until the user takes over, the system shall continue in track control mode extending the final leg.

See also 5.1.3.10.

5.1.2 Accuracy and performance constraint documentation

(See 6.2.2.1)

(A2/5.2.1) *A short qualitative description of the effect of:*

.1 *the accuracy of the sensors for position, heading and speed;*

.2 *changes of course and speed;*

.3 *actual speed through the water; and*

.4 *environmental conditions*

on the track control system shall be provided to the user in appropriate documentation.

5.1.3 Alerts**5.1.3.1 General**

The equipment shall comply with IEC 62923-1 and IEC 62923-2.

For alerts required by this document, standard alert identifiers are specified in Table F.1.

5.1.3.2 Failure or reduction in power supply

(See 6.4.5.2)

(A2/5.3.1) *In case of failure or reduction of power supply to the track control system which effects its safe operation, an alert or status signal shall be given as follows.*

When the TCS has multiple power inputs, and remains in safe operation after failure of one power input due to the presence of another power input, the TCS shall on failure of one power input raise a 'power fail' caution, see Table F.1 for details.

In case of total power input failure to the TCS, where the TCS remains able to raise an alert, it shall raise a 'power fail' warning or, if applicable, a 'track control stopped' alert, see Table F.1 for details.

In case of total power failure to the TCS, the TCS shall provide a status signal (at least by normally closed contact or HBT sentence transmitted with a frequency of at least 1 Hz to enable external equipment to raise an alert within 3 s.

The installation manual shall contain a description of the available status signal(s) and a requirement for external equipment to monitor at least one status signal and provide an alert on power failure. The installation manual shall contain an instruction that the equipment needs to be installed in an environment providing the monitoring of at least one status signal and an alert on power failure.

The 'power fail' alerts shall not be provided if no track control mode is active.

5.1.3.3 Position monitoring alert

(See 6.4.5.3)

(A2/5.3.2) *A 'doubtful position' warning shall be given when the position monitor detects a deviation beyond a preset limit, see 5.1.1.4. See Annex E.*

NOTE Although the detection function is called "position monitor", a functional title is required by IEC 62923-1, such as 'doubtful position'.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.1.3.4 Heading monitoring alert

(See 6.4.5.4)

(A2/5.3.3) *A 'doubtful heading' warning shall be given when the heading monitor detects a deviation beyond a preset limit, see 5.1.1.16. See Annex E.*

NOTE 1 Although the detection function is called "heading monitor", a functional title is required by IEC 62923-1, such as 'doubtful heading'.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

NOTE 2 For example, the heading monitoring and its alerts may remain active if they are also part an active function other than track control.

5.1.3.5 Failure and alert status of sensor

(A2/5.3.4) *In the case of any failure or failure status received from the position-fixing sensor or the heading sensor in use:*

- 1) *an alert shall be generated at the track control system* as specified in 5.4.2 and 5.4.3;
2) *the system shall provide guidance of the user to a safe steering mode* as specified in 5.4.2 and 5.4.3; *and*
3) *a back-up navigator call shall be given if an alarm is not acknowledged by the officer of the watch within 30 seconds* as specified in 5.1.3.12.

Fall-back procedures consequential to the failure and failure status are stated in 5.4.

5.1.3.6 Selection for use of faulty sensor signals

(See 6.4.5.6)

(A2/5.3.5) *It shall not be possible to select any sensor signal tagged with a fault or invalid status*, including signals received in simulated, manual and estimated (DR) mode, for automatic track control.

5.1.3.7 Cross-track alert

(See 6.4.5.7)

(A2/5.3.6) A 'cross-track' *alarm shall be provided when the actual position deviates from the track beyond a preset cross-track limit*. This shall be a user selectable limit covering at least the range of 0,01 NM to 1 NM (or the equivalent in other units) for raising the alert. See Annex E.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.1.3.8 Course difference alert

(See 6.4.5.8)

(A2/5.3.7) A 'course difference' warning *shall be given if the actual heading of the ship deviates from the track course beyond a preset value*. The preset course difference limit shall be a user selectable limit covering at least the range of 5° to 45° for raising the alert (see Annex E).

NOTE This makes the mariner aware of an increasing steering angle in order to encourage the mariner to evaluate the ship's behaviour, e.g. in traffic or in respect to the environmental circumstances.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.1.3.9 Low speed alert

(See 6.4.5.9)

(A2/5.3.8) *If speed through the water in the fore/aft direction is lower than a predefined limit necessary for steering the ship* under track control (minimum manoeuvring speed for track control) a 'Low speed' warning *shall be given*.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.1.3.10 End of track alert

(See 6.4.5.10)

In the case of track control by a sequence of waypoints, an 'end of track' warning shall be given at a user-selectable time no earlier than 5 minutes, but no later than 1 min before the last waypoint. The acknowledgement of the warning shall rectify the warning.

When, due to quick succession of legs, an 'end of track' warning would be required before the wheel over line of the penultimate waypoint of the pre-planned track, the 'end of track' warning shall be delayed until the wheel over line of the penultimate waypoint of the pre-planned track.

If the 'end of track' warning is not acknowledged, the alert priority shall be escalated from warning to alarm at the last waypoint.

The 'end of track' alarm is associated with BNC activation (see 5.1.3.12).

For category A systems, the 'end of track' warning shall be given at the end of each leg.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.1.3.11 Track control stopped alert

(See 6.4.5.11)

A 'track control stopped' warning shall be given if the system automatically switches over to heading control mode. If the 'track control stopped' warning is not acknowledged within 30 s the warning shall escalate to alarm. A 'track control stopped' alarm shall be given if the system automatically switches over to manual steering.

The 'track control stopped' alert title or alert description text shall, if practicable, include the automatically selected mode or advice to the mariner to switch over to heading control mode or manual mode (see 5.4.1).

The track control stopped alarm is associated with BNC activation (see 5.1.3.12).

The acknowledgement of the 'track control stopped' alert or the intentional disengagement of the track control function shall rectify the alert.

5.1.3.12 Handling of the Back-up Navigator Call (BNC)

(See 6.4.5.13)

This clause applies to alerts associated with BNC in this document.

A graphical description of the sequences described here is given in Figure J.5.

Activation of BNC shall use the emergency call function of the BNWAS (see IEC 62616) by applying at least one of the following means:

- contact closure or equivalent circuit, or
- IEC 61162 interface using the ALR sentence (see Annex K.2 and IEC 62616).

Power failure of track control system shall not activate the BNC.

BNC shall be activated in accordance with the following:

- If within 30 s of the alarm's occurrence, the alarm has not been acknowledged and has not been temporarily silenced, and the alarm condition has not been rectified, then the BNC shall be activated.
- If within 30 s of the alarm's occurrence, the alarm has not been acknowledged and has not been rectified, but has been temporarily silenced by the operator, then the following will apply:

When the silencing expires, the BNC activation shall function as if the alarm condition just arose, but any further silencing shall not result in further delay of the BNC. Note that the

648 silencing specified here is the temporary silence function which expires, reactivating the
649 audible announcement, after 30 s.

650 As soon as all of the alarms associated with BNC activation are acknowledged or rectified, the
651 BNC shall be deactivated.

652 **5.1.3.13 Remote acknowledgments of alerts**

653 (See 6.4.5.14)

654 Remote temporary silencing and remote acknowledgement shall be possible as described in
655 IEC 62923-1.

656 **5.2 Ergonomic criteria**

657 **5.2.1 Operational controls**

658 **5.2.1.1 Controls for track control**

659 (See 6.4.8)

660 (A2/6.1.1) *Means shall be provided to:*

661 .1 *accept or calculate the course between subsequent waypoints; and*

662 .2 *adjust radius or rate of turn, all user settable track control related limits, limits for alert*
663 *functions and other control parameters.*

664 Means may include but are not limited to a keyboard, knob or input at a screen.

665 NOTE There are restrictions described in 5.1.1.7.

666 **5.2.1.2 Change over controls**

667 (See 6.4.6.5, 6.4.8)

668 (A2/6.1.2.1) *Track control to manual control*

669 *Changing over from track control to manual steering shall be possible by a single operator*
670 *action.*

671 (A2/6.1.2.2) *Track control to heading control*

672 *If the track control system can be operated with a heading control system, changing over from*
673 *track to heading control shall be possible by a single operator action.*

674 (A2/6.1.2.3) *Location of change over controls*

675 The installation manual shall contain instructions that *the steering mode selector switch or*
676 *override facility, if installed, shall be located at or in the immediate vicinity of the main conning*
677 *position.*

678 **5.2.2 Presentation of information**

679 **5.2.2.1 Continuously displayed information**

680 (See 6.4.7.1)

681 (A2/6.2.1) *The following information shall be displayed clearly and continuously in the vicinity*
682 *of the main conning position; but not necessarily on a single display:*

683 .1 *mode of steering (see 5.1.1.15); for category B systems, an additional “assisted turn”*
684 *indication shall be provided during course change manoeuvres;*

- 685 .2 *sources of actual selected position, heading and speed;*
686 .3 *status and failure of selected heading, speed, and position sensors (if any);*
687 NOTE 1 The status for heading includes the heading correction, if available, see 5.3.2.
688 .4 *track course and actual heading;*
689 .5 *actual position, cross-track distance including direction and speed over ground;*
690 .6 *TO-waypoint and NEXT-waypoint;*
691 .7 *time and distance related to the wheel-over of the TO-waypoint;*

692 NOTE 2 In the case the TO-waypoint is the last waypoint in the active pre-planned track, the time and distance
693 relates to passing the last waypoint.

- 694 .8 *next track course (i.e. the course of the next leg); and*
695 .9 *selected track identification.*

696 *Items .4, .5, .7 and .8 shall be displayed numerically.*

697 **5.2.2.2 Information to be provided on demand**

698 (See 6.4.7.2)

699 (A2/6.2.2) *The following information shall be provided at least on demand:*

- 700 .1 *a list of pre-planned waypoints including:*
701 – *waypoint numbers or identifiers,*
702 – *co-ordinates,*
703 – *courses and distances between waypoints,*

704 NOTE Distances are approximately from wheel-over point to wheel-over point along the curved track (since
705 accurate values are ship dependent, see IEC 61174).

- 706 – *turn radius or rates of turn of the curved track(s) (~A);*
707 .2 *all user settable track control related limits and other preset control parameters;*
708 .3 *geodetic datum in use.*

709 **5.2.2.3 Presentation**

710 (See 6.4.7.1)

711 (A2/6.2.3) *Logically related values such as preset and actual values shall be displayed as a*
712 *pair of data.*

713 **5.3 Interfacing**

714 **5.3.1 Sensors**

715 (See 6.2.2.2)

716 (A2/7.1) *The track controller (TCS) shall be connected to position, heading and speed sensors*
717 *which meet the standards of the International Maritime Organization. For track control the*
718 *heading measurement system shall be a gyro-compass or equivalent.*

719 NOTE 1 The heading source used for monitoring need not be a gyro-compass or equivalent.

720 NOTE 2 Information flowing within the EUT can use proprietary interfaces and contain proprietary data.

721 **5.3.2 Status information**

722 (See 6.4.5.5)

(A2/7.2) *All connected sensors shall be able to provide status, including failure information.*
 The track control system shall check for received status and failure information. If a sensor used for track control does not provide status or failure information, the track control system shall perform corresponding plausibility checks.

NOTE In principle, gyro compasses provide heading information that is corrected for speed and latitude using the HCR sentence, but under some circumstances that correction may not have been applied. TCS may not be informed about the status of the correction. If the status information is not available, TCS performance may be degraded.

If the HCR sentence is received from the heading measurement system, the track control system shall indicate the correction status.

5.3.3 Standards

(See 6.2.2.2)

(A2/7.3) *The track control system shall be capable of digital, serial communication with the ships navigation system and comply with the IEC 61162 series, see Annex K.*

The manufacturer shall specify which IEC 61162 part each physical interface supports.

5.4 Fall-back arrangements

5.4.1 Failure of track control function

(See 6.4.6.1)

Figure 1 illustrates the typical EUT configurations for the following requirement.

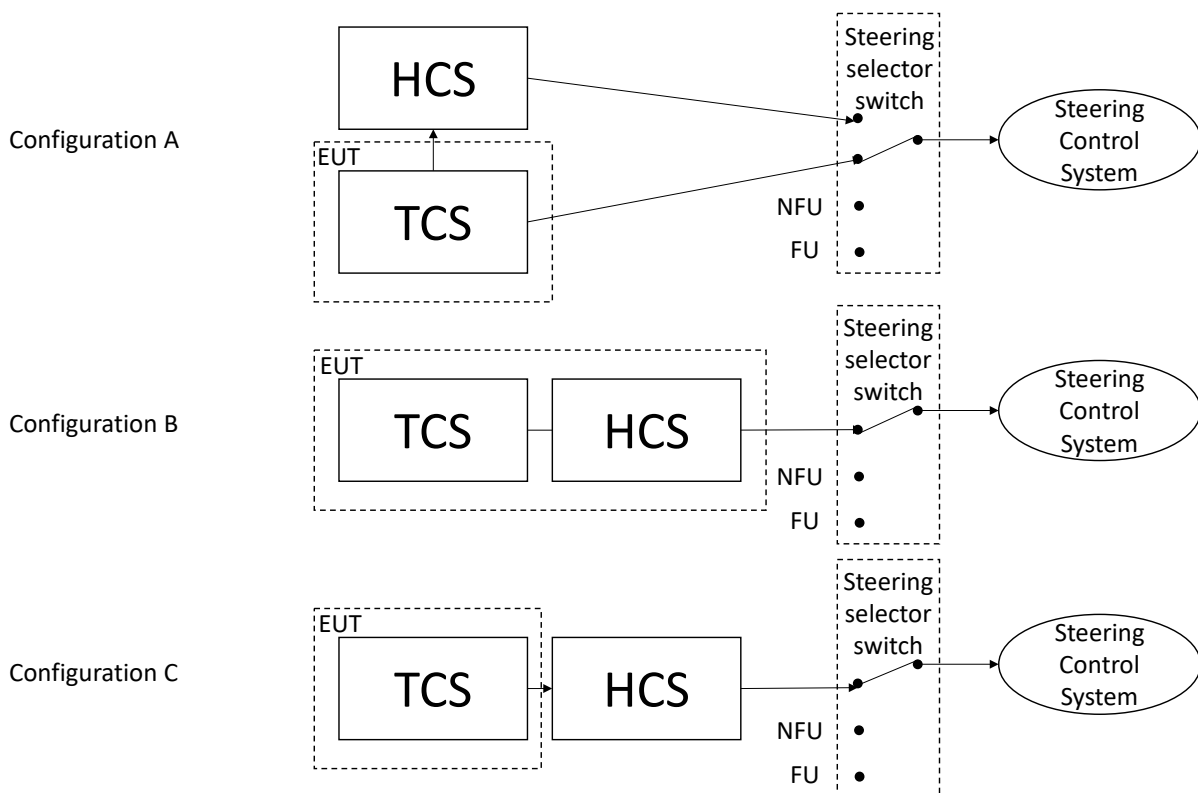


Figure 1 – EUT typical configurations

Configuration A and C:

(A2/8.1.1) *If the system does not include a heading control mode, then the system shall transmit the HTC sentence to command the heading control system to automatically switch over to heading control mode and:*

- if sailing on a leg, the HTC sentence shall include a command to *take the actual heading as the preset heading for the heading control*, or a command to take the calculated heading available at the moment of TCS failure, in such a way that the actual COG is approximately maintained;
- if sailing on a curved track, the HTC sentence shall include a command to approximately complete the pre-planned course change manoeuvre (~A).

NOTE 1 Approximately indicates that the heading is no longer corrected for any errors in relation to the planned track.

NOTE 2 This requirement does not mandate that a HCS is installed.

Configuration B:

(A2/8.1.1) *If the system includes a heading control mode which is still available then the system shall automatically switch over to heading control and*

- if sailing on a leg, *take the actual heading as the preset heading for the heading control*, or a calculated heading available at the moment of TCS failure, in such a way that the actual COG is approximately maintained;
- if sailing on a curved track, the pre-planned course change manoeuvre shall be approximately completed and the track course of the next leg shall be taken over as the preset heading (~A).

NOTE 3 HTC and HTD sentences are available in IEC 61162-1.

NOTE 4 Approximately indicates that the heading is no longer corrected for any errors in relation to the planned track.

Configurations A, B and C

(A2/8.1.2) The installation manual of the TCS shall include an instruction to install the TCS in combination with the steering control system so that in the event of failure of the TCS, *if the heading control is not available, the rudder angle shall be maintained* so that:

- if sailing on a leg, the actual heading is approximately maintained;
- if sailing on a curved track, the actual rate of turn is approximately maintained (~A).

NOTE 5 Approximately indicates that the rudder angle is no longer corrected for any errors in relation to the planned track or the commanded heading.

See 5.1.3.11 for the track control stopped alert.

When the 'track control stopped' alert is raised, if other TCS alerts are active, they shall be terminated. The alert description text of the 'track control stopped alert' shall include information regarding the terminated alerts. At least when the TCS alert conditions 'course change', 'off track' or 'end of track' occur while the 'track control stopped alert' is active, the associated alerts shall not be raised, but instead the alert description text shall include information about these conditions.

For advice on failure of track control mode when dual controllers are installed, see Annex C.

5.4.2 Failure of position

(See 6.4.6.2)

NOTE integrity and plausibility checks may be available to the TCS, e.g. from an INS using the NSR sentence.

While track control is active, if a valid position becomes unavailable or, when results of optional integrity and plausibility checks are available to the TCS and the position becomes marked as not passing these checks, then:

- either track control shall be stopped immediately (see 5.4.1); or
- the track control system shall provide a warning instructing the mariner to change steering mode and shall continue using position dead reckoning. The alert description text shall indicate that dead reckoning is in use for the position and contain guidance either about the available steering modes or about available alternative position sensors. Within 10 minutes of the failure having been detected track control shall be stopped (see 5.4.1). If a valid position becomes available before track control has been stopped, the system shall continue track control and shall rectify the warning.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

5.4.3 Failure of the heading

(See 6.4.6.3)

NOTE 1 The requirements in (A2/8.2) for the actual rudder angle to be maintained on failure of the heading measuring system and associated alarms are covered by 5.4 and 5.1.3.

NOTE 2 Plausibility checks may be available to the TCS, e.g. from an INS using the NSR sentence.

While track control is active, if a valid heading becomes unavailable or, when the result of an optional plausibility check is available to the TCS and the heading becomes marked as failed, then:

- either track control shall be stopped immediately (see 5.4.1); or
- the track control system shall provide an alarm instructing the mariner to change steering mode and shall continue to use the heading updated using other information such as rate of turn or speed components. The alert description text shall indicate that a calculated heading is in use and contain guidance either about the available steering modes or about available alternative heading sensors. Within 1 minute of the failure having been detected track control shall be stopped (see 5.4.1). If a valid heading becomes available before track control has been stopped, the system shall continue track control and shall rectify the alarm.

When the automatic track control function is intentionally disengaged by the mariner, all active alerts related to track control only shall be terminated.

6 Test requirements and results

[CLAUSE 6 has not yet been adjusted for changes made in previous clauses.]

6.1 General

All tests in this clause are intended to be executed in a laboratory environment with a simulator. Additional onboard tests may or may not be required.

6.2 General requirements

6.2.1 Environmental tests

6.2.1.1 General

The EUT shall meet the test requirements of IEC 60945. The equipment shall comply with the requirements of IEC 60945 that are appropriate to its category or alternatively, evidence of prior testing shall be supplied.

The manufacturer shall declare which equipment or units are 'protected' or 'exposed'. The manufacturer shall declare any 'preconditioning' required before environmental checks.

For the purposes of this standard, the following tests and checks shall be used for environmental tests:

- performance check: short functional check to show that the equipment under test is still operational without investigating all details of its functionality, for example power on equipment and activate a function.
- performance test: detailed test of the equipment covering all functions provided. A performance test shall ensure that the full functionality is available under the present environmental conditions, power supply and input/output conditions, for example satisfactorily performing a subset of scenario 3.
- inspection: visual check of the equipment or documentation.

6.2.1.2 Test site

Tests will normally be carried out at test sites, accredited by the type test authority. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure that it is operating normally before type testing commences.

6.2.1.3 Identification of the equipment under test (EUT)

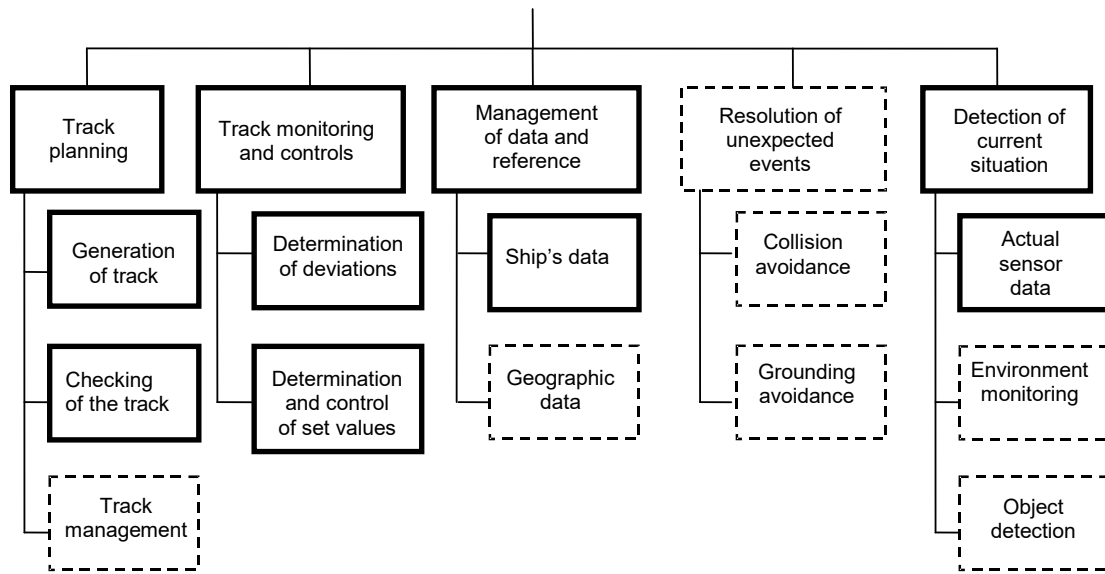
The IMO performance standards for track control systems do not require distinct hardware components supporting distinct functions. It is up to the manufacturer to perform the different tasks for track control in possibly different physical and logical parts of its system. This may result in different layout solutions for the

- physical parts involved,
- logical parts involved,
- general data flow between physical and/or logical parts,
- sensor interfaces,
- locations of required functions,
- user access (human machine interface).

Therefore, the EUT's special layout and its information flow have to be identified before it can be decided which tests are applicable. Identification should follow a functional approach in steps:

- a) identify functions to perform different tasks of track control;
- b) identify information flow between functions;
- c) identify dependencies between functions (see Annex D);
- d) identify in which parts of the system the required functions are performed.

Identification of functions can be taken from the functional model of an integrated navigation system that incorporates track control (track control affected parts in boxes with solid lines), see Figure 2.



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Figure 2 – Functional model of track control as part of an integrated navigation system

A general scheme of the EUT's components should be used to apply functions and their information flow to physical parts of the system.

6.2.1.4 Test of optional track control related modes

All track control related modes offered by the manufacturer shall be exercised.

6.2.2 Documentation

6.2.2.1 Equipment manuals

(See 5.1.2)

Verify that adequate information is provided to enable suitable qualified members of the ship's crew to operate and maintain the equipment properly.

6.2.2.2 Technical documentation for type approval

(See 5.1.1.3, 5.4.1, 5.4.2)

Manufacturer's documentation shall include:

- a test certificate according to IEC 60945;
- documentation of all system components and all relevant internal parts (parts lists, parts numbers, drawings, pictures, etc.) according to IEC 60945 test certificates;
- wiring diagrams of system components;
- data flow diagrams of system components;
- documentation of external interfaces available;
- documentation of sensor data use, derived sensor data validity, ships parameters and reference parameters in physical and logical system components;
- layout of the minimum system configuration and all other system configurations possible relevant to track control;
- identification of relevant system components including names and numbers;
- identification of relevant software revision numbers;