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FINAL EDITORIAL REVIEW DRAFT

RTCM RECOMMENDED STANDARDS FOR ELECTRONIC CHART SYSTEMS (ECS)

FINAL EDITORIAL REVIEW DRAFT FUTURE VERSION 2.1

*DEVELOPED BY
RTCM SPECIAL COMMITTEE NO. 109*

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I II III 1.0 SCOPE

This standard specifies the RTCM recommended minimum requirements for Electronic Chart Systems (ECS). In order to better define requirements applicable to various classes of vessels operating in a variety of areas, certain parameters herein contain more than a single “standard” option. In effect, three very general classes of vessels have been identified: ‘I’ represents larger vessels; ‘II’ represents smaller vessels primarily operating in coastal waters or inland rivers; and ‘III’ represents vessels not covered in I or II. An annotation is made in the left margin to indicate which class(es) of vessel(s) is being referenced. Users, manufacturers, and regulatory authorities thus have a means of differentiating between the needs of various vessels.

I II III 2.0 DEFINITIONS

2.1 Electronic Chart System (ECS). An aid to navigation that electronically displays the current position and relevant nautical chart data from the ECS database.

2.2 ECS Database. The electronic chart database for use in ECS equipment. The ECS Database may be compiled from a number of sources. It may be in either vector or raster data presentation format.

2.3 Working Database. A database, separate from or in addition to the ECS Database, containing additions, changes and updates to the ECS Database.

2.4 Standard Display. The defined minimum level of the content of the ECS Database that is on display under certain prescribed circumstances.

2.5 Operating Mode. Any mode of the ECS in which the system is in service and monitoring selected navigation information, whether or not it is displayed on the display screen. This includes alphanumeric display modes, menu modes, and modes where the operator can select or adjust settings.

2.5.1 Planning Mode. An ECS operating mode in which the electronic chart area displayed is determined by the operator for the purposes of looking ahead, studying and planning the intended route and viewing navigational notes.

2.5.2 Navigation Mode. An ECS operating mode in which the electronic chart area displayed is determined by the vessel’s present position. In this mode the vessel’s position is always on the display for all levels of electronic chart display resolution (zoom).

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2.6 Non-operating Mode. An ECS may make diagnostic and initial configuration modes available while the system is not in service or monitoring navigation information.

2.7 Electronic Chart Display Resolution. Depiction of detail, represented by the smallest distance apart at which two objects can be seen to be separate, depending on the pixel size, i.e., the size represented by a pixel, in meters on the ground, of the ECS Database as represented on the display device.

2.8 ECS Database Resolution. The resolution in meters on the ground of the ECS Database.

2.9 Vector Data Presentation. Method of representing individual chart features digitally by points, lines and polygons given through their coordinates and appropriate code(s).

2.10 Raster Data Presentation. Method of representing all, or part, of a chart digitally by a matrix-like scheme of pixels or grid-points.

2.11 Nautical Chart. A special-purpose map or book, or a specially compiled database from which such a map or book is derived, that is issued officially by or on the authority of a Government, authorized Hydrographic office or other relevant government institution and is designed to meet the requirements of marine navigation.

2.12 True Motion Display. A display in which own ship and other dynamic data such as radar targets move with own true motion, while the position of all charted information remains fixed.

2.13 Relative Motion Display. A display in which own ship remains stationary, while all charted information and dynamic data such as radar targets move relative to own ship's position.

2.14 Operator Action. An operator action shall be achieved by hard-key soft-key or voice actuation, including any necessary cursor movement.

3.0 GENERAL REQUIREMENTS

I II III 3.1 IEC 60945

3.1.1 Except where stated below, or where there is a conflicting requirement in this standard, ECS shall meet the Minimum Performance Standard (Section 3) of IEC 60945, Edition 2.

3.1.2 Exceptions to IEC 60945:

- .1 clause 3.1.1 - approval testing by type test authorities
- .2 clause 3.4.1.2 - equipment markings

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- .3 clause 3.5.3 - equipment markings
- .4 clause 3.8.2.2 - fault diagnosis and repair
- .5 clause 3.8.2.3 - fault diagnosis and repair
- .6 clause 3.9 - equipment labeling

3.2 Diagnostics

I II III 3.2.1 Equipment shall be designed with either manual or automatic self-test of major hardware and software functions. Information may be provided by the manufacturer to aid the diagnosing of faults. (See 15.8.9)

I II 3.2.2 At turn on, and each time a new ECS Database is installed, the ECS shall employ diagnostic and error checking routines to ensure that the ECS Database(s) and updates and additions made by the operator are correctly stored within the ECS.

I II 3.3 Power Interruption

3.3.1 If primary power to the ECS equipment is interrupted for a period of 45 seconds or less, the ECS shall resume operation automatically without operator intervention other than restoring power. When operation resumes, all settings, routes, destinations, zoom levels and screen displays shall be as they were before power loss, with the exception of items that are influenced by external inputs that may have changed. (See 15.9.3.1 and 15.9.3.3)

3.3.2 If primary power to the ECS is interrupted warning shall be given to the operator. (See 15.9.3.2)

Note: Reference to "primary power" is not imply a requirement for a "secondary power" source.

4.0 DISPLAY OF INFORMATION

I II III 4.1 Chart Display

4.1.1 The ECS shall be capable of displaying at least the following minimum ECS database content regardless of the format of the ECS database: (See 15.7.1.2, 15.8.1)

- .1 coastline; distinguished by land tint
- .2 drying line
- .3 boundaries: e.g. fairways, channels
- .4 indication of cautionary notes

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- .5 depth contours shall be included and shall consist of at least one of 2, 5 or 10 meters (or comparable in other units) when available in the source data
- .6 indication of isolated dangers
- .7 bridges; horizontal and vertical clearances
- .8 overhead cables; vertical clearance
- .9 units of depths and heights
- .10 indication of fixed & floating aids to navigation
- .11 aids to navigation markings or number
- .12 place names
- .13 traffic routing systems: e.g., separation zones, traffic lanes
- .14 restricted areas
- .15 caution areas
- .16 areas to be avoided
- .17 military practice areas
- .18 anchorage prohibited areas

4.1.2 When in the Planning or Navigation modes, the ECS shall present at least the minimum ECS database content, designated the "Standard Display" at any time by a simple operator procedure consisting of no more than two operator actions. The information included in the Standard Display is indicated in Sections 4.1.1 and 4.2.2. (See 15.8.6.5)

4.1.3 When power is applied to the system, the display shall contain at least the Standard Display except as provided for in Section 3.3 - Power Interruption. (See 15.8.1)

4.1.4 Except as noted in Section 4.2.5, it may be possible for the operator to add and remove selectively from the Standard Display any categories of information without limit or restriction. An indication shall be provided when the display contains less than the Standard Display. (See 15.8.2.2 and 15.8.2.3)

4.2 Symbols

- I II 4.2.1 In Planning mode it shall be possible to display: (See 15.9.1.2)
 - .1 planned route

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.2 operator controlled cursor

.3 waypoint

4.2.2 In Navigation mode it shall be possible to display: (See 15.9.2.2)

I	II	III	*	.1	own ship
I	II	III	*	.2	past track
I	II		*	.3	planned route
I	II	III		.4	operator controlled cursor
I	II			.5	waypoint
I	II	III		.6	course-over-ground vector
I	II	III		.7	mark (e.g., hazards, wheel-over-point, etc)
I	II			.8	ship's heading (if connected to heading reference equipment)
I	II			.9	vessel tracking symbols (if connected to vessel tracking equipment)
I	II			.10	annotated mark (text)
I	II			.11	temporary route

* Indicates part of the Standard Display

4.2.3 The ECS shall have the ability to display the following measured, calculated or provided alphanumeric data: (See 15.7.1.3)

I	II	III	.1	ship Latitude/Longitude	LAT/LON
I	II	III	.2	speed-over-ground	SOG
I	II	III	.3	course-over-ground	COG
I	II		.4	distance to waypoint (from own-ship)	DTW
I	II		.5	bearing to waypoint (from own-ship)	BTW
I	II		.6	cursor range (from own-ship)	RNG
I	II		.7	cursor bearing (from own-ship)	BRG
I	II		.8	cross-track-distance (left/right of intended track)	XTD
I	II	III	.9	datum shift or datum name	DLAT/DLON
I	II	III	.10	position sensor correction	dLAT/dLON
I	II	III	.11	magnetic variation	VAR

4.2.4 Required units. The ECS shall use the following units for display of information:

.1 position – latitude and longitude in degrees, minutes and decimal

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minutes (See 15.7.1.1.1)

.2 distance – nautical miles, statute miles, yards, feet or meters (See 15.7.1.1.2)

.3 speed – knots or miles per hour; (See 15.7.1.1.3)

.4 time – hours, minutes and seconds (See 15.7.1.1.4)

.5 direction – degrees (See 15.7.1.1.5)

.6 depth/elevation – meters, fathoms or feet (See 15.7.1.1.6)

4.2.5 Required display items. The ECS shall have the ability to display the following in the Planning and Navigation modes:

- | | | | |
|---|----|-----|---|
| I | II | III | .1 chart scale bar or screen range (See 15.8.3.3) |
| I | II | | .2 scale boundaries if the ECS Database contains multiple scales (See 15.8.3.3) |
| I | II | III | .3 orientation and direction of North, if other than North-up (See 15.8.4.1) |
| I | II | III | .4 chart geodetic datum if different from WGS84, and an indication if datum adjustment is applied (See 15.6.1.1) |
| I | II | III | .5 indication if own-ship position adjustments are applied (See 15.8.6.4) |
| I | II | | .6 when displaying distances longer than 600 NM, whether distance and bearing calculations are based on a great circle or rhumb line path. (See 15.7.1.2.6) |
| I | II | | .7 chart projection (See 15.7.1.2.9) |

5.0 PROVISION AND CORRECTION OF CHART INFORMATION

- | | | |
|---|----|---|
| I | II | 5.1 The ECS Database in use shall contain the date to which it is current, including Notices to Mariners that have been applied. (See 15.5.2) |
|---|----|---|

5.2 Chart Updating

- | | |
|---|---|
| I | 5.2.1 The ECS shall provide the capability to edit the Working Database or provide a simple means for the operator to replace the entire ECS Database, or portions thereof. When a means for manual editing of the Working Database is provided, these edits must be: (See 15.8.8.1, 15.8.8.2, 15.8.8.3 and 15.8.8.4) |
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| .1 legible and not reduce the legibility of the surrounding navigable area |
| .2 stored separately from the ECS Database |

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.3 verifiable and distinguished from the displayed ECS Database information.

I II 5.2.2 At a minimum the ECS shall provide a means for the operator to mark objects for further reference to the paper chart, or to text describing the change involved. (See 15.8.8.5)

I II III 5.2.3 The ECS shall provide a simple means for the operator to replace the entire ECS Database, or portions thereof, as provided by the ECS Database manufacturer. (See 15.5.3)

6.0 MESSAGES AND WARNINGS

6.1 The ECS shall provide messages, which may be in the form of text or other indications on the screen that alert the operator but do not require an acknowledgement. At a minimum, the following messages shall be displayed:

I II III .1 display resolution is in meters/pixel at a larger scale than the ECS Database resolution (over-zoom condition or magnified) (See 15.8.3.1)

I II .2 zoom level is such that elements of the ECS Database are not properly displayed (under-zoom condition) (See 15.8.3.1)

I II .3 better resolution data is available in the ECS Database (See 15.8.3.5)

I II .4 indication of the operating mode (i.e. Planning or Navigation) (See 15.9.1.1 and 15.9.2.1)

I II .5 screen display is less than the Standard Display (See 15.8.2.3)

I II .6 scale of the chart has changed automatically (See 15.8.3.5)

6.2 The ECS shall provide warnings in the form of acoustic alarms and visual indications for the following conditions and require an operator acknowledgement:

I II III .1 loss of positioning data is detected (See 15.8.6.2, 15.8.6.3)

I II .2 off-course deviation limits are reached (See 15.9.2.1)

I II III .3 the ECS Database is not referenced to WGS-84 and a datum adjustment has not been applied (See 4.2.5.1 and 15.6.1.2)

I II .4 primary power has been interrupted (See 15.9.3.2)

The ECS Manufacturer may provide the operator with means to reset an acoustic alarm after it sounds.

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7.0 DISPLAY OF ADDITIONAL INFORMATION

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| I | II | III | 7.1 If additional information is added to the ECS display, it shall be clearly distinguishable from the ECS Database information. (See 15.8.7.1) |
| I | II | III | 7.2 Radar information, if added to the ECS display, may include the radar image and/or vessel tracking data. When radar information is displayed, the ECS shall provide for the following: (See 15.8.7.5) <ul style="list-style-type: none"> .1 the radar information shown on the chart display shall match in scale and orientation the electronic chart information (See 15.8.7.2) .2 the radar reference point and the own-ship position from the position sensor shall be adjustable to a common reference point (See 15.8.7.3 and 15.8.7.6) .3 the capability shall be provided for the operator to remove the radar image and/or the vessel tracking data from the ECS display by a simple operator procedure consisting of no more than two operator actions (See 15.8.7.4) |
| I | II | | 7.3 AIS information, if added to the ECS display, may include vessel-tracking data. (See 15.8.7.5) |

8.0 PRESENTATION MODES

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|---|----|-----|---|
| I | II | III | 8.1 It shall be possible to display the ECS Database in north-up orientation. Other orientations are permitted. (See 4.2.5.3 and 15.8.4.1) |
| | | | 8.2 True Motion/Relative Motion Display |
| I | | | 8.2.1 An ECS shall provide for true motion displays. Additional display motions are permitted. (See 15.8.4.2) |
| | II | III | 8.2.2 An ECS shall provide for either relative or true motion display. Additional display motions are permitted. (See 15.8.4.2 and 15.8.4.3) |
| I | II | III | 8.2.3 When true-motion is in use in the Navigation mode, screen redraw shall take place automatically before own ship reaches the border of the display, keeping own-ship on screen. (See 15.8.4.2) |
| I | II | III | 8.3 Refresh of the Standard Display in Navigation mode shall take less than 5 seconds. Demands by the mariner that cannot be predicted by the ECS, such as display at a different scale or in a different area may take more than 5 seconds. (See 15.5.5) |

9.0 DISPLAYS

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| I | II | III | The selection of monochrome or color assignments is determined by the ECS manufacturer. |
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I 9.1 The ECS display shall have a color display capability of at least 16 colors. Displayed information shall be clearly visible to an observer, in the conditions of light normally experienced on a vessel by day and by night. (See 15.7.2.2)

II III 9.2 The ECS display may be either a color or monochrome display. Displayed information shall be clearly visible to an observer, in the conditions of light normally experienced on the bridge of a ship by day and by night. (See 15.7.2.2)

10.0 SCREEN REQUIREMENT

I II 10.1 Character/Symbol Display Height. The ECS shall be capable of displaying symbols, including alphanumeric characters, with a minimum height of 3.0 mm. (See 15.7.2.3)

I II III 10.2 Image Aspect Ratio. The aspect ratio of the image displayed on the screen shall be 1:1, such that shapes are correctly proportioned.

10.3 Display Screen Requirements. The ECS shall have a display screen meeting minimum requirements as follows:

I .1 -300 mm (11.8 in)- diagonal measurement with 800 x 600 pixels (See 15.7.2.4.1)

II .2 -200 mm (7.8 in)- diagonal measurement with 640 x 480 pixels (See 15.7.2.4.2)

III .3 -125 mm (4.9 in)- diagonal measurement with 160 x 160 pixels (See 15.7.2.4.3)

11.0 MODES OF OPERATION

I II 11.1 The ECS shall have a Planning mode.

11.1.1 The Planning mode is used by the operator to look ahead, study the chart and plan routes. Any area of the ECS Database may be viewed at various levels of zoom. (See 15.9.1)

11.1.2 ECS shall provide the capability for the operator to construct and modify routes for use in planned voyages. (See 15.9.1.2 and 15.9.1.3)

11.1.3 The capability shall be provided to construct routes that consist of both single waypoints (direct destination) and multiple waypoints. (See 15.9.1.2 and 15.9.1.3)

11.1.4 Provision may be made for the operator to specify a limit of deviation from the selected route. (See 6.2.1, 15.9.1.1)

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- 11.1.5 If the ECS provides for the manual entry of coordinates, provision may be made to match the coordinates of the datum in use. The precision of the entered data shall be preserved and used in navigation calculations.
- I II III 11.2 The ECS shall have a Navigation mode.
- 11.2.1 In the Navigation mode the ECS shall be capable of continuously plotting the ship's position. (See 15.9.2.1)
- 11.2.2 It shall be possible to return to the Navigation mode from any other operating mode by a simple operator procedure consisting of no more than two operator actions. (See 15.8.6.5)
- 11.2.3 In the Navigation mode the ECS shall be capable of employing at least 75% of the usable screen area to display the electronic chart. (See 15.7.2.1)
- 11.3 Positioning System
- I II 11.3.1 At a minimum, the ECS will accept positioning information from navigation receivers using the Recommended Minimum Sentences (RMA and RMB or RMB and RMC) from either the NMEA 0183 or IEC 61162-1 standard. (See 15.9.2.1.4)
- III 11.3.2 If an Electronic Position Fixing System receiver is built-in, an external interface is not required. (No test is required.)
- I II III 11.3.3 The ECS shall be capable of processing and displaying position input data every 2 seconds at a minimum. The latency between data input and screen-display shall be less than 1 second. (See 15.8.6.1)
- I II III 11.3.4 If the ECS Database is not referenced to WGS 84 and the datum or datum shift is known, the ECS shall accommodate differences between the datums of the ECS Database and the positioning system. At a minimum the ECS shall:
- .1 accept and apply a delta-latitude/longitude to correct for datum shifts between the electronic chart, electronic position fix and other input data containing positional information (See 15.6.1.1)
 - .2 provide a means for the operator to select location data from the display in either the chart datum or the positioning system datum (See 15.8.5)
- I II III 11.3.5 To compensate for positioning system errors, provision may be made for the operator to manually adjust the ship's position. This adjustment is in addition to, and separate from, the datum correction. (See 15.8.6.4)

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- I II 11.4 Track Recording. The ECS shall provide the ability to store and display past track of at least one point every 60 seconds or 0.1 mile. A minimum of 60 minutes or 6 miles of data shall be stored automatically. (See 15.9.2.1.6)
- I II III 11.5 ECS shall provide the ability for the operator to display the coordinates of a selected position or feature on demand. (See 15.8.5)
- I II III 12.0 CALCULATIONS
- 12.1 Distance and bearing calculations shall be on the reference ellipsoid associated with the datum in use. (See 15.6.1.1)
- 12.2 Distances measured on the display between displayed features or selected points should have an accuracy no less than that afforded by the resolution of the display at various scales. (See 13.4, 15.6.2)
- 12.3 Latitude/longitude to screen X-Y: The end points of lines displayed on the display screen, the result of locating waypoints or of calculations, shall be located with an accuracy of one pixel for all levels of zoom. (See 15.5.1.3)
- 12.4 Screen X-Y to latitude/longitude: Locations of points-of-interest taken from the screen display (using a cursor) shall be accurate to the Electronic Chart Display Resolution in meters. (See 15.6.2)
- 13.0 ECS DATABASE
- I II III 13.1 The ECS Database may be compiled from multiple sources.
- I II III 13.2 The ECS Database in use should be derived from nautical charts and/or related publications of a government-authorized office. The minimum content of the ECS Database shall include at least the following data elements available from the largest scale charts and/or related publications:
- * .1 coastline; distinguished by land tint
 - * .2 drying line
 - * .3 boundaries: e.g. fairways, channels
 - * .4 a. indication of cautionary notes
 - .4 b. contents of cautionary notes relating to safety of navigation; notes containing items of general interest are not required
 - * .5 a. depth contours consisting of at least one of 2, 5 or 10 meters (or comparable in other units) when available in the source data
 - .5 b. spot soundings
 - * .6 a. indication of isolated dangers
 - .6 b. details of all isolated dangers

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- * .7 bridges; horizontal and vertical clearances
- * .8 overhead cables; vertical clearance
- * .9 units of depth and height and associated vertical datums
- * .10 a. indication of fixed & floating aids to navigation
- * .10 b. aids to navigation markings or numbers
- .10 c. details of aids to navigation normally found on paper chart
- .10 d. ranges with leading lines
- * .11 place names
- * .12 a. traffic routing systems: e.g., separation zones, traffic lanes
- .12 b. recommended routes
- .13 submarine cables & pipelines
- .14 ferry routes
- .15 special areas: e.g., fishing grounds, offshore production areas, dumping areas
- * .16 restricted areas
- * .17 Caution areas
- * .18 Areas to be avoided
- * .19 Military practice areas
- * .20 Fishing prohibited areas
- .21 Pipeline areas
- .22 Cable areas
- .23 Anchorage areas
- * .24 Anchorage prohibited areas
- * .25 Scale of the source of the ECS Database
- .26 Geodetic datum and the offset for WGS84 if known. ("Unknown" if data not available)
- .27 Source of ECS Database (e.g. Source: NOAA and private, produced by XYZ Corporation)
- .28 ECS Database edition date
- .29 Date ECS Database is current to
- * Indicates part of the Standard Display

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I 13.3 The ECS shall indicate when government-authorized office information in the ECS Database in use is altered or supplemented by information from other sources. (See 15.5.4)

I II III 13.4 The ECS Database Resolution for each scale shall be at least $\{2.0 \times 10^{-4}\}/\{\text{CHART SCALE}\}$ in meters per pixel. (This requirement applies to centers of discrete features; starting, turning and end points of linear data; and all nonlinear data.) For example:

<u>Scale</u>	<u>Ground Resolution</u>
1:1,000	0.2 meter
1:10,000	2.0 meter
1:50,000	10.0 meter

Note: Positional accuracy is dependent on the accuracy attainable from the vessel positioning system, screen measurement accuracy and the accuracy of the original survey that positioned the charted feature (often positioned prior to GPS causing it to be the largest component of error). (See 15.3)

I II 14.0 CONNECTIONS WITH OTHER EQUIPMENT

The ECS should not degrade the performance of any equipment providing sensor inputs. Nor should the connection of optional equipment degrade the performance of ECS below this standard. (See 15.2)

15.0 TEST STANDARDS

I II III 15.1 Installation and Technical Documentation

15.1.1 The equipment under test (EUT) shall be installed in compliance with the manufacturers' installation manual.

15.1.2 Where equipment is divided (e.g. route planning on one display and route monitoring on the other,) the entire configuration shall be tested together.

15.1.3 The manufacturers shall provide sufficient information and documentation for the equipment to be installed, understood and operated.

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- I II 15.2 Interfaces
- For ECS that accept positioning information from navigation receivers tests may be performed using a stimulator with internal or interfaced equipment or a simulator that transmits data using the NMEA 0183 or IEC 61162-1 standards. During testing, digital signals shall be input into the ECS equipment that contain at a minimum the position, time of position and speed over ground of the own ship. Signals may also be provided as necessary to represent radar returns appropriate to the equipment and the position of the ship. No connection of optional equipment shall degrade the performance of ECS below this standard.
- I II 15.3 Environmental
- All the general requirements of IEC 60945 appropriate to its category, i.e. “protected”, shall be carried out. The manufacturers shall declare any preconditioning required before environmental checks. For the purposes of this standard the following definitions for “performance check” and “performance test”, required by IEC 60945, shall apply:
- Performance check – reconfigure the ECS EUT and check by non-quantitative visual checks that the system is still operative
- Performance test – the “performance test” for ECS EUT shall be identical to the “performance check”
- 15.4 Preparation
- I II III 15.4.1 Power Up
- The installed EUT shall be powered up in accordance with the manufacturers’ recommended procedures. Signal generators shall be activated in a coherent manner to represent a stationary ship at the position selected. All the necessary selections to configure the equipment for the test environment shall be undertaken in accordance with the manufacturers’ recommendations and settings.
- I II III 15.4.2 Required test items
- For the purpose of these tests the manufacturer’s preferred ECS database shall be used.
- 15.5 ECS Database
- I II III 15.5.1 Load the ECS Database and observe that it contains the minimum required data elements. (13.2)
- I II 15.5.2 Check that the source, edition date and currency date of the ECS database coverage is available. (5.1)

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| I | II | III | 15.5.3 Load different ECS database coverage and ensure that the chart coverage has changed. (5.2.3) |
| I | | | 15.5.4 Add to an ECS database coverage a set of supplemental from a non government-authorized and ensure the addition is indicated. (13.3) |
| I | II | III | 15.5.5 Observe that each refresh of the Standard Display is completed in less than 5 seconds. (8.3) |
| I | II | III | 15.6 Accuracy |
| | | | 15.6.1 Check that the system can perform datum transformations using the scale supported by the database, i.e. not over-scaled; that the accuracy of the transformation is consistent with the ECS database coverage: |
| I | II | III | .1 transformation between the local datum and WGS-84 if the ECS uses databases with datums other than WGS-84; (12.1) |
| I | II | III | .2 ensure an alarm is issued when there is no transformation to WGS-84. (6.2.3) |
| I | II | III | 15.6.2 Check that the system can perform the following calculations using the scale supported by the database, i.e. not over-scaled; that the accuracy of the calculations is consistent with the ECS database coverage; and that the accuracy of measurement is consistent with the display resolution: |
| | | | .1 true distance and azimuth between two geographical points (12.2) |
| | | | .2 geographic position from known position and distance/azimuth (12.3) |
| | | | 15.7 Visual requirements |
| | | | 15.7.1 Units and legend |
| I | II | III | 15.7.1.1 Check that at least the following units are included: |
| | | | .1 position – latitude and longitude in degrees, minutes and decimal minutes (4.2.4.1) |
| | | | .2 distance – nautical miles, statute miles, yards, feet or meters (4.2.4.2) |
| | | | .3 speed – knots or miles per hour (4.2.4.3) |
| | | | .4 time – hours, minutes and seconds (4.2.4.4) |
| | | | .5 direction – degrees (4.2.4.5) |
| | | | .6 depth/elevation – meters, fathoms or feet (4.2.4.6) |

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15.7.1.2 Observe that the following elements are always available for inclusion in a standard legend of general information: (4.1.1.9, 4.2.3.9, 4.2.5.6)

I	II	III	.1	units for depth
I	II	III	.2	units for height
I	II	III	.3	scale of display
I	II	III	.4	sounding/vertical datum
I	II	III	.5	horizontal datum
I	II		.6	great circle / rhumb line indication
I	II	III	.7	date and number of last update affecting the ECS database coverage currently in use
I	II	III	.8	edition date of the ECS database coverage currently in use
I	II		.9	chart projection

15.7.1.3 Observe that the following elements are available as an alphanumeric display of general information. (4.2.3)

I	II	III	.1	ship Latitude/Longitude	LAT/LON
I	II	III	.2	speed-over-ground	SOG
I	II	III	.3	course-over-ground	COG
I	II		.4	distance to waypoint (from own-ship)	DTW
I	II		.5	bearing to waypoint (from own-ship)	BTW
I	II		.6	cursor range (from own-ship)	RNG
I	II		.7	cursor bearing (from own-ship)	BRG
I	II		.8	cross-track-distance (left/right of intended track)	XTD
I	II	III	.9	datum shift or datum name	DLAT/DLON
I	II	III	.10	position sensor correction	dLAT/dLON
I	II	III	.11	magnetic variation	VAR

15.7.2 Display characteristics

I	II	III	15.7.2.1	Measure the displayed chart area while in Navigation mode and check that it is at least 75 percent of the required usable screen area. (11.2.3)
I	II	III	15.7.2.2	Ensure that the displayed information is clearly visible to an observer, in the conditions of light normally experienced on the bridge of the ship by day and by night. (9.1, 9.2)

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| I | II | 15.7.2.3 Measure a displayed character and check that it is a minimum height of 3.0 mm. (10.1) |
| | | 15.7.2.4 Measure the display screen and ensure it meets the following minimum requirements: |
| I | | .1 300 mm (11.8 in) diagonal measurement with 800 x 600 pixels (10.3.1) |
| | II | .2 200 mm (7.8 in) diagonal measurement with 640 x 480 pixels (10.3.2) |
| | III | .3 125 mm (4.9 in) diagonal measurement with 160 x 160 pixels (10.3.3) |
|
15.8 Functional Requirements | | |
| The following tests shall be performed in Planning mode and Navigation mode. The initial latitude/longitude position shall be consistent with the ECS database used for the test. | | |
| I | II | III |
| | | 15.8.1 Standard Display |
| Follow manufacturer's instructions to initialize the ECS as if power had never been applied. Enter the initial latitude/longitude position. Confirm that the scale displayed conforms to the scale of the ECS database. Confirm that the data elements of the Standard Display are shown. (4.1.1, 4.2.2) | | |
| I | II | III |
| | | 15.8.2 Additional Display Functions |
| 15.8.2.1 If additional information can be added to the ECS display, confirm that the additional information can be displayed on demand. (4.1.4, 7.1, 7.2) | | |
| 15.8.2.2 If additional information can be added to the ECS display, confirm that additional information is clearly distinguishable from the ECS database information. (4.1.4, 7.1, 7.2) | | |
| 15.8.2.3 If information can be removed from the Standard Display, remove a standard data element and confirm that the ECS provides an indication that less than the Standard Display is shown. (4.1.4) | | |
| 15.8.3 Scale and Navigational Purpose | | |
| I | II | III |
| | | 15.8.3.1 If an over-zoom capability is provided, display the information at a larger scale than that of the ECS database (over-zoom) by zooming in, and then confirm that the indication is provided. (6.1.1) |
| I | II | |
| | | 15.8.3.2 Display the information at a smaller scale than that of the ECS database (under-zoom) by zooming out, and then confirm that the indication is provided. (6.1.2) |
| I | II | |
| | | 15.8.3.3 Verify that scale boundaries can be shown on demand. (4.2.5.2) |

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| I | II | III | 15.8.3.4 Confirm that a scale bar or screen range can be provided as part of the display. (4.2.5.1) |
| I | II | | 15.8.3.5 Chose an area covered by multiple scale data. Start at the smallest scale available and zoom out until an indication of that data is available at a better resolution. Accept the change and ensure the change of chart scale is displayed (6.1.3) |
| I | II | III | 15.8.4 Mode and Orientation |
| | | | 15.8.4.1 If the orientation is other than North-up, confirm that the North direction is identified. (4.2.5.3, 8.1) |
| | | | 15.8.4.2 If relative motion is provided for use in Navigation mode, confirm that screen redraw takes place automatically and own ship remains near the center of the display. (8.2.2) |
| | | | 15.8.4.3 If true motion is provided for use in Navigation mode, reset the display and confirm that the generation of the neighboring area screen redraw takes place automatically before own ship reaches the border of the display, keeping own-ship on screen. (8.2.2, 8.2.3) |
| I | II | III | 15.8.5 Object Information |
| | | | Select a point, which may be a feature, symbol or position, and display its geographic coordinates in either the chart datum or the positioning system datum. (11.3.4.2, 11.5) |
| I | II | III | 15.8.6 Position Integration |
| | | | 15.8.6.1 Connect a continuous positioning system, with an update rate of 2 seconds or less, to the ECS and verify that the correct position is displayed within one second of message receipt. (11.3.3) |
| | | | 15.8.6.2 Remove the positioning input to the ECS and ensure that a screen message and acoustic alarm are given. (6.2.1) |
| | | | 15.8.6.3 Simulate a message from the positioning device that indicates an error condition causing loss of positioning data, and observe that a screen message or acoustic alarm is given. (6.2.1) |
| | | | 15.8.6.4 If the capability is provided, adjust the position manually. Observe that the amount of the correction is displayed on the screen and that the position changes accordingly. Recheck after 30 minutes to see if it remains unchanged. (4.2.5.5, 11.3.5) |
| | | | 15.8.6.5 Systematically operate the ECS in each mode (other than the Navigation mode) and check to see if the system can be returned to the Navigation mode in no more than two operator actions. (4.1.2, 11.2.2) |

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| I | II | III | <p>15.8.7 Radar and Plotting Information - Navigation Mode Only</p> <p>Where the capability for displaying radar and plotting information is provided as part of the ECS:</p> <p>15.8.7.1 Observe the display without radar overlay, switch on the radar overlay and plotting information and ensure that the ECS database information is not degraded, and is clearly distinguishable. (7.1)</p> <p>15.8.7.2 Observe the display at the lowest scale without radar information. Then, with the radar set to a different scale than the ECS, switch on the radar overlay and plotting information and ensure that these match in scale and orientation. Repeat for all combinations of scale settings between the radar and the ECS. (7.2.1)</p> <p>15.8.7.3 Ensure that the radar information and the displayed position of the ship may be adjusted manually; note that the accumulated offset is clearly indicated to a common reference point. Vary the radar antenna offset and confirm that the position of radar overlay and vessel-tracking data change accordingly. (7.2.2)</p> <p>15.8.7.4 Ensure that the radar and plotting information may be removed by no more than two operator actions. (7.2.3)</p> <p>15.8.7.5 If the capability is provided, set the ECS to accept and display transferred plotting targets; set the simulator to stabilized, north-up mode and to 12-mile range; check that the target information is being accepted and displayed correctly. (7.2, 7.3)</p> <p>15.8.7.6 Vary the radar antenna offset and confirm that the position of radar overlay and plotting information on the ECS changes accordingly. (7.2.2)</p> <p>15.8.8 Chart Updating</p> |
| I | | | <p>15.8.8.1 Verify that the system can receive and install ECS database updates. (5.2.1)</p> <p>15.8.8.2 If a means is available to edit the working Database verify the edits meet the following: (5.2.1)</p> <ul style="list-style-type: none"> .1 legible and not reduce the legibility of the surrounding navigable area .2 stored separately from the ECS Database .3 verifiable and distinguished from the displayed ECS Database information. |
| I | II | | <p>15.8.8.3 Display – Show and Verify</p> <p>Display the ECS Database to ensure that the contents of the updates have been included. (5.2.1)</p> |

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15.8.8.4 Manual Editing of the Working Database

Check that the following manual edit procedures may be carried out and that the edits are distinguishable: (5.2.1.3)

- .1 add new features, locating them at selected positions
- .2 delete an existing feature
- .3 mark features for further reference
- .4 add textual information

I II III 15.8.9 Self-tests of major functions

15.8.9.1 Perform manual or automatic self-tests of the major functions, which are supported by the EUT. Verify that the EUT provides appropriate display information and indications. (3.2.1)

15.8.9.2 Simulate the following sensor malfunctions (including for radar if provided for): (3.2.1)

- .1 interruption of sensor input (loss of signal)
- .2 invalid sensor information (status)
- .3 physical breakdown of sensor connection

15.8.9.3 Verify that the system provides suitable alarms or indication of system malfunction arising from failures. (3.2.1)

15.9 Operational requirements

I II 15.9.1 Planning mode

15.9.1.1 Ensure planning mode is indicated. (6.1.4)

15.9.1.2 For the routes to be planned as described below, the following general guidelines apply: (11.1.1, 11.1.3, 11.1.4)

- .1 the route shall be planned through an area covered by the ECS database
- .2 each leg shall be planned with an appropriate off-track limit (e.g. 100 m.), if the capability is provided
- .3 course changes shall be made, both to starboard and port, between different legs of the route and shall vary from 5 degrees up to 175 degrees
- .4 the length of the legs shall vary from 0.5 nautical miles to at least 3 nautical miles with a total length of at least 25 nautical miles

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.5 planned speed shall vary between 5 knots and 15 knots

15.9.1.3 Plan a route with at least 10 waypoints: (4.2.1, 11.1.2, 11.1.3)

- .1 set the planned route
- .2 retrieve the planned route and plan an alternate route
- .3 add three waypoints
- .4 delete three waypoints
- .5 change position of two waypoints
- .6 change the order of waypoints
- .7 save the alternate route

15.9.2 Navigation mode

15.9.2.1 Ensure navigation mode is indicated. (6.1.4)

15.9.2.2 While testing the Navigation mode, the following general guidelines apply:: (4.2.2, 6.2.1, 11.2.1)

- | | | | |
|---|----|-----|--|
| I | II | III | .1 using the manufacturers' identified database, select the standard display and select a route |
| I | II | | .2 use the route starting at a way point |
| I | II | III | .3 observe that the display shows own ship's position |
| I | II | | .4 simulate the Recommended Minimum Sentences (RMA and RMB or RMB and RMC) from either the NMEA 0183 or IEC 61162-1 standard as position input and verify ECS will accept and process the information (11.3.1) |
| I | II | | .5 simulate deviation from intended track and verify that the off-track alarm is activated |
| I | II | | .6 design the distance between two way points of a route to accommodate a 60 minute transit and follow this track while recording vessel movement. At the end of 60 minutes ensure the ECS has the ability to store and display past track of at least one point every 60 seconds or 0.1 mile. |

I II 15.9.3 Power supply

15.9.3.1 Interrupt the primary power supply for 45 seconds, and ensure that the equipment does not need to be re-initialized manually. (3.3.1)

15.9.3.2 Check that proper warnings are given to the operator. (3.3.2, 6.2.1.4)

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15.9.3.3 Operator settings shall be checked that they have not changed.
(3.3.3)

APPENDIX A - REFERENCES

1.0 Normative References

This standard contains references to provisions of other standards. These cited provisions, through reference in this text, constitute provisions of this RTCM Recommended Standard. These normative references are listed below:

.1 International Maritime Organization, IMO Assembly Resolution A.694(17) General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System and for Electronic Navigational Aids.

.2 Minimum Performance Standards (Section 3.) of the International Electrotechnical Commission document Marine Navigational Equipment - General Requirements, Methods Of Testing And Required Test Results, IEC 60945 (1994), Second Edition, or succeeding editions.

.3 National Marine Electronics Association, NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 2.01, August 1, 1994, or succeeding editions.

.4 International Electrotechnical Commission, Digital Interfaces for Marine Navigation and Radiocommunication Equipment and Systems, IEC 601162-1 - Part 1: Single Talker and Multiple Listeners, Edition 1, 1995, or succeeding editions..

2.0 Informative References

A number of documents are recommended as sources of useful information, although they do not constitute provisions of these RTCM Recommended Standards. These informative references are listed below:

.1 International Hydrographic Organization, Specifications for Chart Content and Display Aspects of ECDIS, Special Publication No. 52.

.2 International Hydrographic Organization, Special Publication No. 52, Appendix 2: Colors and Symbols Specifications for ECDIS.

.3 International Hydrographic Organization, Special Publication No. 52, Appendix 3: Glossary of ECDIS-Related Terms, 2nd Edition, September 1993 or succeeding editions.

.4 International Maritime Organization, International Convention for the Safety of Life at

Sea, 1974 (as amended)

.5 Methods of Testing and Required Test Results (Section 4.) of the International Electrotechnical Commission document Marine Navigational Equipment - General Requirements, Methods Of Testing And Required Test Results, IEC 945 (1994), Second Edition, or succeeding editions.

3.0 Document Sources

.1 International Maritime Organization (IMO)

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.2 International Electrotechnical Commission (IEC)

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.4 National Marine Electronics Association (NMEA)

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