LOSS PREVENTION Briefing

NORTH
SERVICE, STRENGTH, QUALITY

LOSS PREVENTION BRIEFING FOR NORTH MEMBER SHIPS / MAY 2017

ECDIS – ENC Accuracy

Contents

Introduction

The accuracy of the data on your ENC is as varied as paper charts. Like paper charts the data contained in the ENC is only as accurate as the original survey data from which it was made up.

The bridge team should always use ENCs with caution as the accuracy of the original survey will never be 100%.

Whilst using ECDIS brings many benefits to the navigator, the watchkeeping officer must understand the accuracy of the data they are using, and then in turn be prudent in the amount of reliance they place in the ENCs being used.

This briefing serves to provide the watchkeeper using ECDIS with information on determining the accuracy of the information displayed on their ENC.

For a glossary of the terms used in this briefing please refer to appendix 2 here.

ECDIS – ENC Accuracy

ECDIS Specific Familiarisation

Prior to using an ECDIS, watchkeeping officers should have always attended an approved generic ECDIS course. Once on board it is important, as outlined in North's LP Briefing on ECDIS found here, that the users undergo shipboard familiarisation training on the specific ECDIS carried on their vessel.

This briefing demonstrates how the ECDIS user can identify inaccuracies in ENCs in generic terms. You should ensure that you can access this information on the ECDIS specific to your vessel.

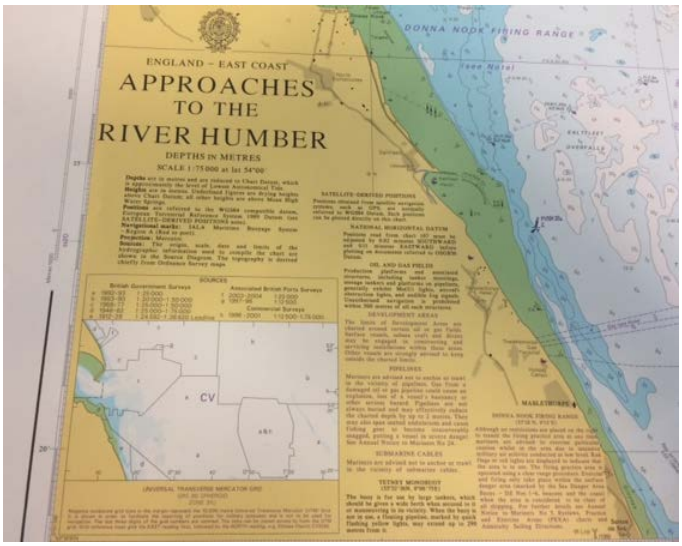
IHO S-57

The International Hydrographic Organisation Transfer Standard for Digital Hydrographic Data S-57 is the standard that dictates which data is supplied for use on ECDIS. This includes how digital hydrographic data is passed between national hydrographic offices.

As well as this, one of the goals of the IHO S-57 is to reduce ENC data overlaps between nations that produce them. Unlike paper charts it is the responsibility of the nation whose territory the ENC covers to maintain its accuracy. Therefore, if there is an overlap of data between two producing nations, there can be data anomalies for these charts.

ENC Data Source

Survey data accuracy may vary dramatically. On a paper chart, the navigator can check the chart notes for data sources, GNSS accuracy etc. This is initially reviewed by the deck officer performing the voyage plan, and from the information provided in those notes appropriate safety margins for the passage are developed.



Example of paper chart notes

However ENCs do not have such notes. The primary method of displaying the accuracy of an ENC is through Zones of Confidence, known as CATZOC.

CATZOC and M_QUAL

When an ENC is produced, it is divided into areas. The accuracy of the data in these separate areas is based on the original source data with regards to positional accuracy, depth accuracy and sea floor coverage. These three sets of data are then assessed by the ENC producer together. Together they are then represented as one result, this is known as a "meta – feature".

This meta-feature is called "Quality of Data" or M_QUAL. This M_QUAL is then given a symbol to show the ENC user the level of confidence for the data in that area, this is known as a Zone of Confidence or CATZOC. There are six possible CATZOC zones that can be assigned:

ECDIS – ENC Accuracy

ZOC Table:

1	2	3		4	5
ZOC [1]	Position Accuracy [2]	Depth Accuracy [3]		Seafloor Coverage	Typical Survey Characteristics [5]
A1	± 5 m + 5% depth	=0.50 + 1%d		Full area search undertaken. Significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 0.6 ± 0.8 ± 1.5 ± 10.5		
A2	± 20 m	= 1.00 + 2%d		Full area search undertaken. Significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder [7] and a sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 1.2 ± 1.6 ± 3.0 ± 21.0		
B	± 50 m	= 1.00 + 2%d		Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder [8], but no sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 1.2 ± 1.6 ± 3.0 ± 21.0		
C	± 500 m	= 2.00 + 5%d		Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 2.5 ± 3.5 ± 7.0 ± 52.0		
D	worse than ZOC C	Worse Than ZOC C		Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed				

CATZOC zones table. (Also see appendix)

M_QUAL data can be referred to during the passage planning process and can affect the navigators choices on the safety factors that they apply to the route being planned, for example the under keel clearance maybe increased if the M_QUAL shows a low CATZOC.

CATZOC Symbols

Once the M_QUAL is known, and the CATZOC zone is assigned to an area on the ENC, the navigator can view these symbols on the ENC usually in the "All / Other" display function on their ECDIS.

The greater the number of stars that appear in the symbol, the greater the level of accuracy for that area.

Five or Six stars show a good level of accuracy in the source data. Four stars shows only medium accuracy, this means that the positional accuracy or seafloor coverage is not guaranteed.

Two and Three stars signify low accuracy survey data. This can mean that the original survey data is very old or was collected from an unreliable data source such as non-survey vessels, or maybe soundings that where collected on passage, indicating the seafloor coverage was low. Poor data for seafloor coverage would mean that seafloor features not shown on the ENC may reduce the indicated sounding by up to 10%.

CATZOC Symbol for zone A1

CATZOC Symbol for zone D

Members are advised to ensure adequate guidance is in place in their SMS for the bridge team. In particular regarding incorporating safety margins into the vessel's passage in relation to CATZOC zones. Safety margins can have an impact commercially on the vessel. For example if a charterer requires the vessel to load down to her marks the vessel may well encroach on set safety margins at the resulting draft. Therefore the vessels SMS should consider such situations and give the Master guidance on the actions required in such an event.

Every area of an ENC that has a sounding will have a symbol assigned to it:

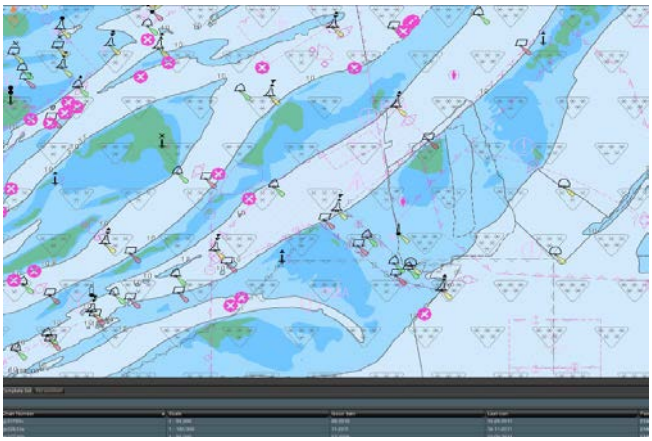


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231

ECDIS – ENC Accuracy

Therefore the CATZOC symbol goes some way to replace the original paper chart source data information.

Here is an example of the original source data information from a paper chart:

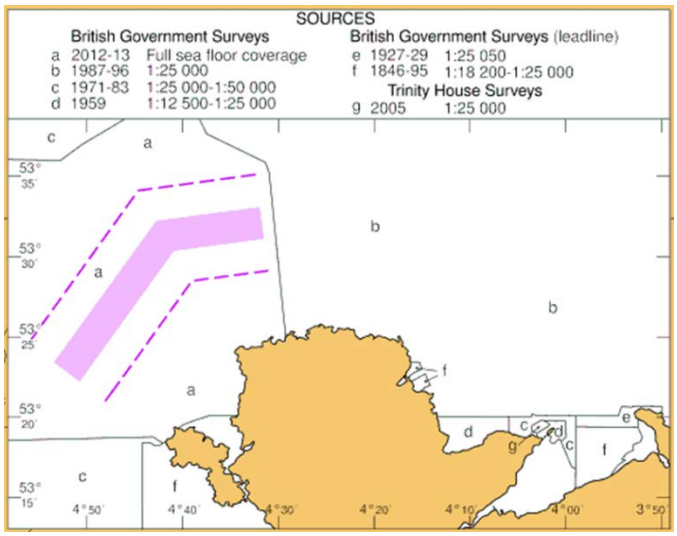
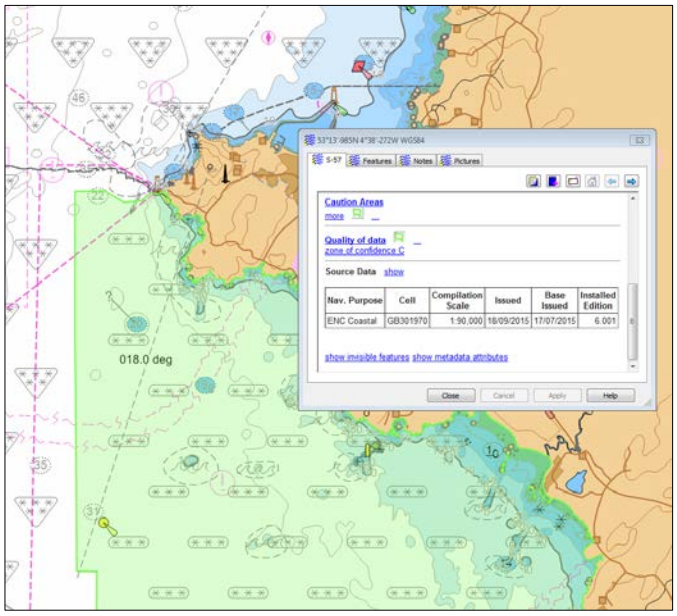


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231

And for the same area, here is the ENC with M_QUAL data showing:



ECDIS Screen Shot showing M_QUAL data note. Image [or information] courtesy of the UKHO, source ADMIRALTY NP231

As can be seen in the above example, the ENC shows CATZOC C:

ZOC [1]	Position Accuracy	Depth Accuracy		Seafloor Coverage	Typical Survey Characteristics
C	±500 m	= 2.00 + 5%d		Full area search not achieved, depth anomalies may be expected. Low accuracy survey or data collected on an opportunity basis such as soundings on passage.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy (m)		
		10	± 2.5		
		30	± 3.5		
		100	± 7.0		
		1000	± 52.0		

This correlates with the original information from the paper chart.

However as CATZOC symbols only consider the three elements described above, they cannot simply replace the original paper chart information notes. It is therefore important that the ECDIS user does not rely entirely on the CATZOC symbol alone.

IHO S-52

The IHO S-52 is the Standard for Displays on ENC's in ECDIS.

S-52 provides specifications and guidance regarding the issuing and updating of Electronic Navigational Charts (ENC), and their display in ECDIS.

As of August 2017 the *S-52 Presentation Library edition 4.0* will enter into force. There are several important changes coming into force with this document and some are listed in appendix 3 of this briefing.

Notably, the new standard has an impact on the ENC CATZOC features. Under the new standard the CATZOC feature will be subject to independent mariner selection, and can be turned on and off in any display mode. Also in locations where ENC's overlap the ECDIS system will itself determine which chart to display.

Mariners should be aware of the contents of S-52 presentation Library edition 4.0, and IHO S-52 Standard for Displays on ENC's in ECDIS edition 6.1 prior to using the ECDIS on board their vessel.

Other Information Available from M_QUAL Data

The producers of an ENC chart can add in additional data concerning other elements related to the accuracy of the ENC. The additional information can include the following:

ECDIS – ENC Accuracy

S-57 Code	Description
DRVAL1	**Depth Range Value 1** – Defines the minimum depth that can be found in the area. This may be used when the area has been swept so that it is known that the area is not shallower than this particular depth, but the details of the seabed below this depth have not been determined. In some cases this may allow a survey with a very high positional and depth accuracy, but which has not attained full seafloor coverage, to be given a five or six star CATZOC rating as we know that there will not be any uncharted features shallower than this swept depth. It is therefore always advisable to use the pick report to check this information when planning a route, even where intending to sail in areas with apparently high accuracy surveys, to ensure this value does not conflict with the chosen safety depth value.
POSACC	**Positional Accuracy** – This allows the ENC producer to define more precisely the positional accuracy in a particular area. This may be better than otherwise indicated by the CATZOC rating, particularly where this rating has been reduced because other factors are at a lower value.
SOUACC	**Sounding Accuracy** – This allows the ENC producer to define more precisely the depth accuracy expected in a particular area. This may be better than otherwise indicated by the CATZOC rating, particularly where this rating has been reduced because the other factors are at a lower value. This attribute may also be assigned to individual soundings and / or depth areas in the ENC data.
SURSTA SUREND	**Survey Start / End** – This defines the ranges of dates within which the source survey information being displayed in the area was captured, and therefore indicates how up-to-date the information is. This is particularly important in areas of unstable seabeds which are known to change regularly (e.g. in areas with shifting sand banks).
TECSOU	**Technique of Sounding** – this defines the equipment and techniques used to derive the charted information. The ENC producer can choose one or more from a list of options, which include items such as 'found by echo-sounder', 'found by lead-line', 'satellite imagery', and 'swept by side-scan sonar'. This attribute may also be assigned to individual soundings in the ENC data.

Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – Shows some additional information examples for M_QUAL

The navigator is able to view this using the ECDIS "Pick Report" function. This function scans the M_QUAL feature for more information.

Survey Reliability Information

To show the limits of individual surveys, the producer of the ENC can add Survey Reliability areas or M_SREL, into the ENC data:

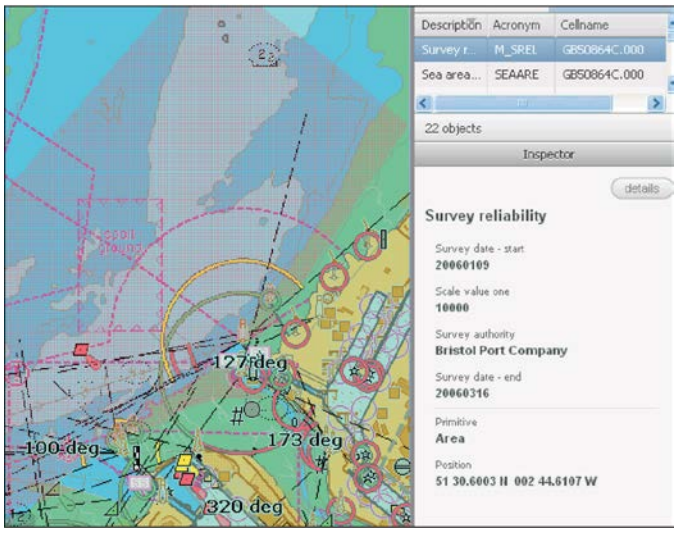


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – shows an individual survey taken by the Bristol Port Company, and shows the area the survey encompassed.

Once again, the producer can add much additional data to the M_SREL for the ECDIS user. The S-57 codes and descriptions are shown here for this data:

S-57 Code	Description
QUAPOS	**Quality of Position** – This allows the ENC producer to describe the likely positional accuracy of the features in that area from a list of options. This includes options such as 'position doubtful', 'unreliable', or 'precisely known'.
QUASOU	**Quality of Sounding Measurement** – This allows the ENC producer to describe the likely depth accuracy of features in an area, and is chosen from one or more of the available options. This includes 'unreliable sounding', 'least depth known', or 'maintained depth'. This attribute may also be assigned to individual soundings in the ENC data.
SCVAL1 SCVAL2	**Scale Values 1 and 2** – This allows the ENC producer to define the largest (value 1) and smallest (value 2) scale of the survey data used to compile the ENC data in that area (i.e. 1:10,000 in the example illustrated above).
SDISMX SDISMN	**Sounding Distance Maximum and Minimum** – This defines the maximum and minimum spacing between the principal sounding lines of a survey, and therefore gives an indication of the likelihood of uncharted features appearing between these lines (depending of course on the equipment used as outlined by the technique of sounding described below).
SURATH	**Survey Authority** – Defines the authority responsible for producing the survey (i.e. 'Bristol Port Company' in the example illustrated above).
SURSTA SUREND	**Survey Start / End** – Defines the ranges of dates within which the source survey information being displayed in the area was captured, and therefore indicates how up-to-date the information is. This is particularly important in areas of unstable seabeds which are known to change regularly (e.g. in areas with shifting sand banks). In the example illustrated above, this is between 9th January 2006 and 16th March 2006.
SURTYP	**Survey Types** – Defines the format of the survey, and where the ENC producer can select one or more from a pre-defined list of options. This includes options such as 'controlled survey', 'remotely sensed', or 'passage survey'.
TECSOU	**Technique of Sounding** – Defines the equipment and techniques used to derive the charted information. The ENC producer can choose one or more from a list of options, which include items such as 'found by echo-sounder', 'found by lead-line', 'satellite imagery', and 'swept by side-scan sonar'. This attribute may also be assigned to individual soundings in the ENC data.

Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – Shows some additional information examples for the M_SREL.

ENC Datums

ENCs are comprised of three sets of datum's, namely sounding, vertical and horizontal datums.

It is important navigators understand these as they will affect the voyage plan. For example, when calculating the under keel clearance, the sounding datum is taken, and the tidal height applied to this. Similarly when considering vertical clearance, for example air draft; the user should be aware of the datum details for the ENC.

When transiting from area to area, the datum can change, the ECDIS may not alarm to show there has been a change in the datum, therefore the watchkeeping officer should monitor the "pick report" function on the ECDIS. Any variants should be considered in the passage plan, in particular for under keel clearance and air drafts. For vertical and sounding datums, there is on occasion more than one datum used for any ENC area cell, this can override the general information datum on the ENC. In this case the watchkeeping officer should check the "pick report" function for the vertical datum of data and the sounding datum of data, known as M_VDAT and M_SDAT respectively.

ECDIS – ENC Accuracy

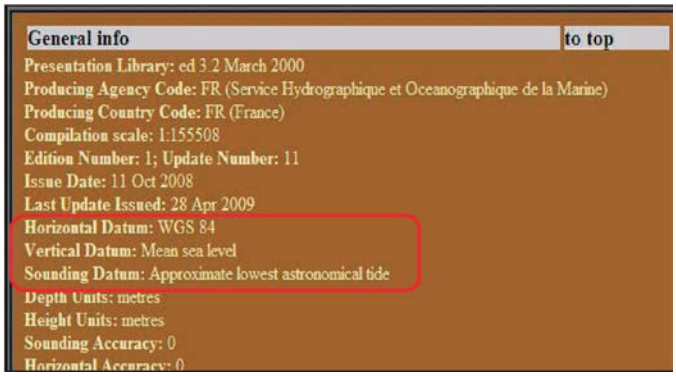


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – Shows an ECDIS pick report and the 3 datums used.

Navigators should also exercise caution with respect to physical object datum, such as bridges, as these may be based on different datums, each object should therefore be individually checked during passage planning.

Horizontal datum is commonly WGS84, and this is the case with ENCs so that the vessel position is compatible with the charted information.

Where it is not possible to position the information on the chart to WGS84 datum, inaccuracies may exist in the ENC. In this case the vessel's position will essentially be correct, however the charted information, for example the coastline, maybe out of position relative to the vessel owing to a different datum. In this case, the producers will reflect the inaccuracies in the assigned CATZOC symbol, or often in text notes or caution areas. As such the ECDIS users should ensure that they are aware of the CATZOC symbol and that text labels are switched on. If there is a significant area of inaccuracy, this should show in the ECDIS "pick report" function.

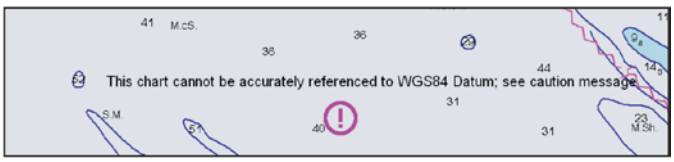


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – Shows an example of a cautionary text note on an ENC.

In some cases the ECDIS user may well see M_ACCY associated with a cautionary area. This indicates that the area shown has had an average shift of data applied to it, this is usually due to a large number of differences to the WGS84 datum within one area.

Chartered Depths

On a paper chart, accurate soundings are in italic, and soundings gathered from more unreliable sources are non-italic, as shown below, these are often referred to a "hairline soundings":

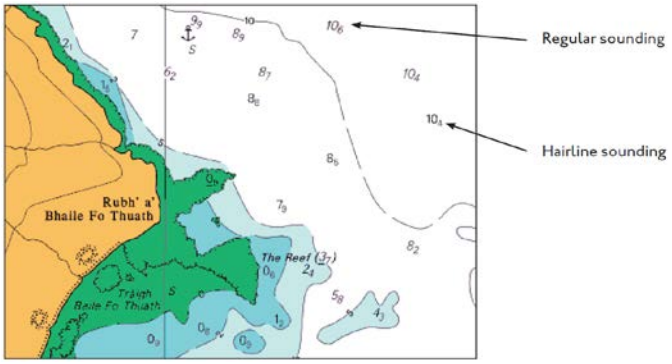


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 - A paper chart example of reliable and hairline soundings.

However on an ENC, there is usually no italic soundings, therefore soundings from an unreliable source are circled instead:

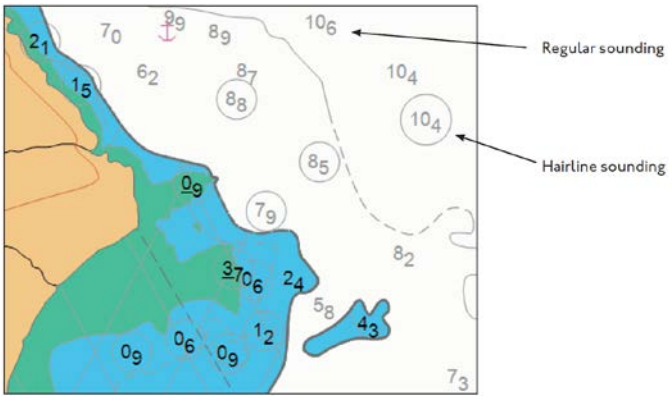


Image [or information] courtesy of the UKHO, source ADMIRALTY NP231 – The same ECDIS chart showing the reliable and hairline soundings.

README Files

The user should know that general information on all the positional inaccuracies in the ENC can be found in the README file, it is recommended therefore that these are always referred to during the appraisal phases of passage planning.

Practical Guides to ENC Use

There are several publications available from national hydrographic offices containing information regarding ECDIS use. With regard to ENC accuracy, the following publications are recommended:

- UKHO NP231 Guide to the Practical Use of ENCs.
- IHO S-57 IHO Transfer Standard for Digital Hydrographic Data.
- IHO S-52 Specifications for Chart and Display Aspects of ECDIS Edition 6.1
- IHO Presentation Library S -52 Annex A Edition 4.0

Appendix I – CATZOC Table:

ZOC Table:

1	2	3	4	5
ZOC [1]	Position Accuracy [2]	Depth Accuracy [3]	Seafloor Coverage	Typical Survey Characteristics [5]
A1	± 5 m + 5% depth	=0.50 + 1%d Depth (m) / Accuracy (m) 10 / ± 0.6 30 / ± 0.8 100 / ± 1.5 1000 / ± 10.5	Full area search undertaken. Significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
A2	± 20 m	= 1.00 + 2%d Depth (m) / Accuracy (m) 10 / ± 1.2 30 / ± 1.6 100 / ± 3.0 1000 / ± 21.0	Full area search undertaken. Significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder [7] and a sonar or mechanical sweep system.
B	± 50 m	= 1.00 + 2%d Depth (m) / Accuracy (m) 10 / ± 1.2 30 / ± 1.6 100 / ± 3.0 1000 / ± 21.0	Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder [8], but no sonar or mechanical sweep system.
C	± 500 m	= 2.00 + 5%d Depth (m) / Accuracy (m) 10 / ± 2.5 30 / ± 3.5 100 / ± 7.0 1000 / ± 52.0	Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
D	worse than ZOC C	Worse Than ZOC C	Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed			

Appendix 2 - Glossary of Terms

CATZOC	Zone of Confidence
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigation Chart
GNSS	Global Navigation Satellite System
IHO	International Hydrographic Office
M_QUAL	Quality of Data
M_SREL	Survey Reliability Information
UKHO	United Kingdom Hydrographic Office

Appendix 3 – IHO S-52 Mariner Benefits

IHO S-52 Changes	Mariner's Benefits
"Detection and Notification of Navigational Hazard" has been added. For each ENC feature and its associated attributes this defines the priority of the alert to be raised when a navigational hazard is detected.	Ensures all ECDIS raise the required alerts in a consistent manner, reducing training needs and improving safety at sea. Reduces the number of alarms raised as a result of ECDIS safety checking.
A new section "Detection of Areas, for which Special Conditions Exist" has been added. Lists the ENC features and attributes that will raise an indication or alert in the ECDIS as defined by the mariner.	Ensures all ECDIS raise the required alerts in a consistent manner, reducing training needs and improving safety at sea. Reduces the number of alarms raised as a result of ECDIS safety checking.
Detecting the Safety Contour: The IMO ECDIS Performance Standard (PS) states that rocks, wrecks and obstruction detected inside the safety contour should result in an indication on the ECDIS. The previous edition of S-52 included rocks, wrecks and obstructions to the detection of the safety contour, resulting in alarms, as opposed to indications, being raised. They have been moved to "Detection and Notification of Navigational Hazards".	Reduces the number of alarms on ECDIS, whilst ensuring that the mariner remains aware of dangers as rocks, wrecks and obstructions will still be detected if they meet the "Detection and Notification of Navigational Hazards" criteria.
Added a new symbol `Indication Highlight' - designed for warning and caution conditions that require an indication highlight on the ENC.	Clear and unambiguous presentation of features that require an indication highlight.
New standardized symbols have been added to identify where automatic ENC updates have been applied.	Ensures the mariner is aware of updates that have been applied automatically to their ENCs.
New symbol to indicate where in the ENC features with temporal attributes are located.	Will allow mariners to quickly identify where features that have temporal attributes are located, such as seasonal buoys, traffic separation schemes etc.
A means for the mariner to insert a date or date range within the ECDIS to display date dependent features.	Will allow the mariner the ability to plan and check routes, viewing the conditions they will encounter on a given date or time period in the future.

Ability to turn isolated dangers in shallow water on/off.	In certain circumstances mariners must navigate across the safety contour, this change allows the mariner the flexibility to navigate in shoal areas with or without the isolated danger symbol displaying on the ENC.
Mandatory selector for the display of the shallow water pattern.	Important feature in ECDIS as it becomes increasingly difficult to detect the changes in the ENC depth shades during night navigation.
Added guidance on the implementation of the optional "*hover-over"* function available for a limited number of ENC features.	If provided, the hover-over function speeds up the process of ENC enquiry by the mariner. The new guidance ensures that the hover-over function does not result in the ENC presentation becoming obscured.
Display of complete tidal stream panel in ECDIS pick report.	Provides the mariner with tidal data in a form that is similar to the paper chart equivalent
Changes to S-52 display provisions: • Anchorage area — display of name in ENC; • Fairway - display of name in ENC; • Nautical publication — new visible presentation for the meta feature nautical publication.	Allows the mariner to navigate to an anchorage without the need to repeatedly interrogate each area on the ENC by: 1. Presenting the name of fairway on the ENC for quick identification of location; 2. Presenting a graphical indication on the ENC to give mariners the ability to easily select the nautical publication feature using the pick report.
Standardisation of the ECDIS pick report.	Ensures all ECDIS present pick report information in a consistent manner, reducing training needs and improving safety at sea.
The viewing groups may be used by the mariner to customise the ENC information presented on the ECDIS display. The names of these viewing groups have been standardised.	Ensures all ECDIS use viewing group nomenclature in a consistent manner, reducing training needs and improving safety at sea.