# Standard Safety Special Edition: ECDIS assisted grounding

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for service and security

The Standard

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Images were kindly supplied by D. Goddard MBE

**With ECDIS units being installed on increasing numbers of ships worldwide, The Standard Club is concerned about the proper implementation of this new technology.**

## Case study

In early 2012, a ship en route from Africa to South East Asia experienced a grounding incident when it touched bottom on a charted bank in the Indian Ocean. Investigations revealed significant deficiencies in the way the vessel's passage was planned and executed, which resulted in an accident that was avoidable.

In addition to paper charts (the ship's primary means of navigation), the ship was also fitted with an ECDIS. Whilst this ECDIS was a type approved model, it was not supplied with official electronic navigational charts (ENCs). Lack of ENCs meant that the ship's ECDIS set-up did not meet carriage requirements and could only be used as an electronic chart system (ECS) and an aid to the ship's paper charts.

The officers on board did not have sufficient training in the use of their ECS and little use was made of its safety features. The deck officers displayed no awareness of the hazards associated with using unofficial products to navigate in a region where survey data is notoriously unreliable. The master and officers seemed over-reliant on the information provided by the ECS.

In this article, we explore the differences between ENCs and commercial charts, and consider the responsibilities of the master and officers to ensure safe passage, using ECDIS.

- Paper charts are being replaced with electronic charts as navigation becomes increasingly reliant on electronic systems.
- Passage planning has changed, but the same precision and safety checks are still crucial.
- CATZOCs are increasingly important, in the absence of source data diagrams, to inform mariners about the reliability of the survey data that forms the charts.

## Official ENCs versus commercial charts

Prior to the introduction of ECDIS legislation, shipping companies equipped their vessels with a variety of official and unofficial chart products.

SOLAS defines a nautical chart as:

*'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'.*

A key point in this definition is that only charts/ENCs produced by an official body (a government authorised Hydrographic Office) will satisfy SOLAS chart carriage requirements. Unofficial products, however capable, do not fall under the definition of a nautical chart. However, many officers have used unofficial commercial charts, which have several disadvantages:

**1. Symbology**

All official ENCs share a common symbology, which is listed in IHO Special Publication No 52 (S-52). Because ENCs produced by different national Hydrographic Offices look the same, mariners need only to familiarise themselves with one scheme of symbols and ENC coverage is seamless. Unofficial charts, on the other hand, vary in appearance between brands, therefore chart portfolios that mix ENCs and unofficial charts cannot be seamless. Using electronic charts with differing symbology also increases the risk of a navigation error and should be avoided wherever possible. It should be noted that ECDIS training is conducted using official charts, therefore, recent attendees will be most familiar with official S-52 symbols.

**2. Frequency of updates**

ENCs and their associated products are updated weekly, as are official paper charts, to ensure their validity. Most unofficial chart producers issue updates less frequently, with one major producer issuing updates only three times a year. Also, whilst much of the data with which unofficial charts are corrected derives from official sources, the validity of these updates cannot be guaranteed.

**3. Standards of data transfer**

Converting hydrographic data into a usable chart format is a complex process that requires rigorous quality control. Every sounding, contour, bottom feature and landmark must be recreated in digital form with a high level of accuracy. To ensure the quality of the ENC production process, the IHO published Special Publication No.57 (S-57), which governs 'transfer standards for digital hydrographic data'. Only ENCs from official sources are governed by these stringent rules; unofficial commercial products are not.

Every object on an ENC has a SCAMIN value attributed to it. When the display scale on an ECDIS is set to a scale smaller than an object's SCAMIN value, the object will disappear. This feature reduces clutter and improves ENC drawing speed, but can result in a navigational danger being missed.

## Passage planning in the digital age

One of the primary aims of ECDIS is that it should serve to ease the burden of passage planning. However, the core principles of passage planning are unchanged and the same levels of intellectual curiosity, precision and skill are required to ensure that the passage planned is a safe one.

In the case study, the passage planning officer plotted the track on paper charts and transferred the waypoints to the ECS. Whilst the master checked the initial plan on the paper charts, no check was made of the ECS plan, despite multiple mid-voyage amendments due to weather routeing. As a result, discrepancies between the two tracks in relation to the shoal were missed.

Passages should always be planned and executed on the primary means of navigation. On some vessels, ECDIS may be the primary means, which makes for an easy transfer to paper charts. Passages plotted on an ECDIS should be subjected to three layers of safety which combine human scrutiny with automatic safety tools. These layers of safety should always be employed when a plan is prepared, amended or executed.

## Three layers of safety

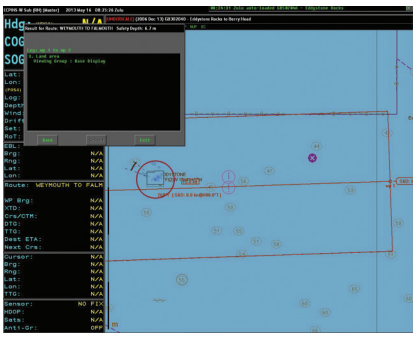
### 1. Visual 1:1 check

The route planning function on ECDIS allows passage plans to be completed far quicker than with traditional paper charts, which often results in too little scrutiny of a route's safety. A visual check should be conducted on the largest scale of chart and the scale selected should be the chart's 1:1 or compilation scale. A chart which is displayed at too small a scale (under-scale) suffers from SCAMIN (scale minimum), which causes chart data to be omitted from the display. ENCs viewed at too large a scale (over-scale) suffer from distortion. An over-scaled ENC also reduces the amount of useful chart information displayed ahead of the vessel.

The visual check should cover latitudes and longitudes, and distances from hazards and chart notes, in a similar manner to that done with paper charts, in the presence of the master.

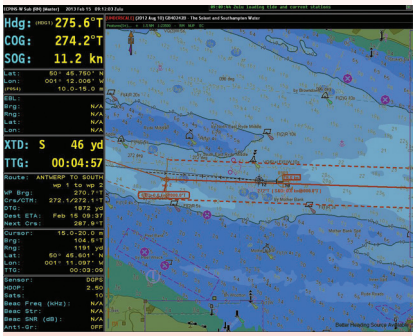
### 2. Automatic route scan

An automatic route scan can be conducted during which the ECDIS scans for dangers on both sides of the track out to the width of the cross-track corridor (XTC) using an alarm to warn when a danger is detected. The XTC can be set to a distance appropriate to where the ship will be operating and the distance from navigational dangers. Many brands of ECDIS will generate a large list of alarms and warnings when the route scan function is used. A user must learn how best to interpret the results from their particular brand of ECDIS. The number of alarms can be managed by having appropriate XTC settings.

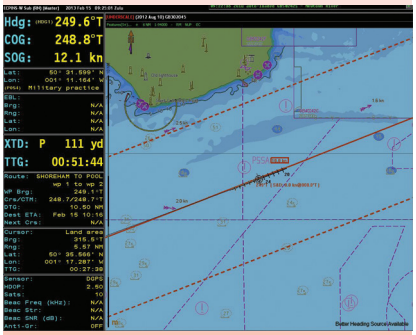



Automatic route scan

The XTC is an adjustable value which will generate an alarm when the vessel's GPS position moves too far from the track. The XTC appears on screen as two parallel lines to the track.




Cross-track corridor

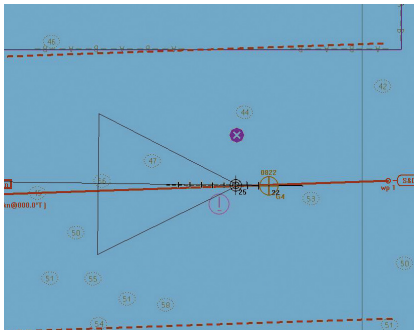



Cross-track corridor

Whilst placing waypoints, a note should be made of how far the nearest navigational danger is. In open water, this may be hundreds of miles, but in pilotage waters, this distance may be only a few cables. The XTC should be set so that no dangers exist within the XTC zone. When operating in open water with no hazards, the XTC can be set to a distance appropriate to maintain track and provide sufficient sea room to manoeuvre for traffic, etc. By ensuring that no dangers are within the XTC, the number of alarms generated by the route scan will be greatly reduced.

### 3. Anti-grounding function

The final layer of safety is the anti-grounding function. This tool allows the ECDIS to scan ahead of the ship to a distance set by the user. It acts as a final layer of safety should a navigational danger be missed by the visual check or route scan. The scanned area is sometimes displayed as a cone or column on screen and should be set to a distance appropriate to the amount of navigable water ahead of the vessel. This value should be determined for each stage of the voyage and noted in the passage plan. The functionality of the anti-grounding function varies between brands; users should determine the capabilities of their ECDIS equipment's anti-grounding function.



Anti-grounding cone

### Quality of survey

In our case study, immediately prior to the grounding, the master and officer of the watch relied heavily on the ECS and made critical decisions based on what was displayed. The vessel's track passed in close proximity to a charted shoal in an area notorious for the poor quality of survey data. Officers should always be mindful that the hydrographic data used to populate an ENC or unofficial chart is, in the majority of cases, the same data used to produce its paper equivalent. The world has not been re-surveyed since the mandatory introduction of ECDIS and large areas of the Pacific and Indian Ocean were last surveyed many years ago. Information about the quality of survey data is included in ENCs in a categorised zones of confidence (CATZOC) format.
A study of CATZOCs should always form part of the passage planning appraisal process.

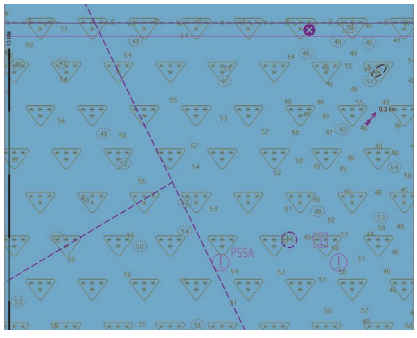
## CATZOC – An unfamiliar system

Despite their inclusion in most generic ECDIS courses, many mariners are unfamiliar with the CATZOC system, preferring the older source data diagrams, which are a familiar feature of Admiralty paper charts.

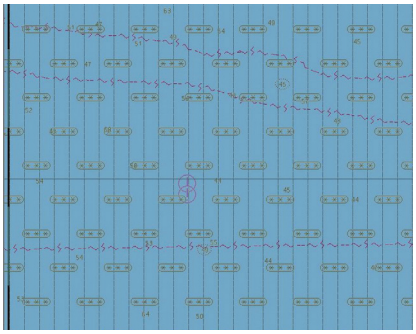
### The meaning of CATZOCs

The purpose of the CATZOC system is similar to that of source data diagrams; they enable the mariner to make sensible decisions on the degree of reliance to place on the chart when planning a passage or conducting navigation.

The CATZOC system enables surveying authorities to encode hydrographic data within five categories or CATZOCs. Survey data can be graded A1, A2, B, C, D or U. Each category is also depicted by a CATZOC symbol which appears when this layer is selected for display on an ECDIS. When displayed by ECDIS, CATZOCs are distinguishable by the shape of the symbol and number of asterisks contained within it.



CATZOC B



CATZOC C

### CATZOCs and ECDIS

It should be noted that CATZOCs are a mandatory attribute of the S-57 format, which provides the specifications for all electronic navigation charts made for use with ECDIS. It is therefore imperative that officers serving on-board ships equipped with ECDIS are fully conversant with the CATZOC system and are able to distinguish between different CATZOC symbols and recognise their relevance to the safety of navigation.

Unlike source data diagrams on paper charts, CATZOCs are only visible when the user has selected the appropriate ENC layer for display. During passage planning, it is essential that CATZOCs are displayed and noted for all stages of the voyage. On-board procedures for passage planning should include CATZOCs as part of the list of ENC layers to be displayed during passage planning.

A quick guide to ENC symbols, including those used in the CATZOC system, is available on the United Kingdom Hydrographic Office website.

## Summary

ECDIS is a unique tool and, despite its many advantages, it requires careful management to ensure safe navigation. In order to properly manage a ship's ECDIS equipment, managers must ensure that the ISM manuals contain the relevant checklists and procedures, that their officers are properly trained and that their equipment is of the approved official type.

The vessel featured in our case study suffered from a **number of failures** of this kind with the primary factors in the grounding being:

1. The use of unofficial chart products.
2. Over-reliance on an electronic chart system when paper charts were the primary means of navigation.
3. Poor passage planning procedures, including:
   a. Failure to assess the survey reliability for all stages of the voyage;
   b. Failure to compare and synchronise the planned track plotted on both the paper charts and ECS;
   c. Failure to recheck the passage plan after significant changes had been made;
   d. Failure to use the full range of ECDIS safety features.
4. Poor training and understanding of the hazards associated with electronic navigation.

To avoid a similar incident happening on board your ship, the **following tips** should be considered by both masters and ship's officers:

1. Never use **unofficial** chart products.
2. Invest the same level of effort and intellectual curiosity into **planning** a passage on ECDIS as you would for a plan on paper charts.
3. Consult your ECDIS **manual** to determine the capabilities and **limitations** of the particular brand, with specific reference to the anti-grounding function, automatic route scan and the safety depth/ contour relationship.
4. **Alterations** to a passage plan should always be **followed up** with another automatic route scan and a visual check, conducted on the largest scale chart available at the compilation scale for each chart.
5. Be aware that much of the **survey data** displayed on ENCs derives from data that is many years old and therefore you should **consult CATZOCs** during the passage planning phase.

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