**S-98 - Annex C**

**HARMONISED PORTRAYAL FOR ECDIS AND INS**

**Document History**

Changes to this Specification are coordinated by the IHO S-100 Working Group. New editions will be made available via the IHO website. Maintenance of the Specification shall conform to IHO Resolution 2/2007 (as amended).

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# Introduction

This Annex contains guidance for the implementation of harmonised portrayal and other user interaction functionalities for S-101 Electronic Navigational Chart (ENC) and other S-100 based data products in an Electronic Chart Display and Information System (ECDIS). It describes how specified S-100 products are to be used and displayed simultaneously on the navigation screen. It does not address the portrayal processes or architectures, which are addressed in S-100 Parts (especially 9 and 9A). It is based on the general principles described in S-100 Part 16A, and the requirements for ECDIS specified in the relevant International Maritime Organization (IMO), International Hydrographic Organization (IHO), and International Electrotechnical Commission (IEC) standards.

This Annex is intended as the successor to the IHO S-52 standard for chart content and display in ECDIS. It contains material from S-52 that has been updated for S-100, but does not include symbol specifications (the S-52 “presentation library”) or portrayal rules because symbols and portrayal rules are now defined in the IHO GI Registry and portrayal catalogues for individual product specifications. This document focuses on the principles for portraying S-101 ENC and S-100 based data on ECDIS. The principles described herein are intended to be compatible with the corresponding requirements for ECDIS portrayal of S-57 ENCs.

This Annex does not revoke nor does it supersede S-52 in its applicability to the use of S-57 information on ECDIS. It assumes ECDIS will support both S-52/S-57 and S-101 ENCs for the foreseeable future. Such systems should continue to follow the S-52/S-57 principles for S-57 information.

ECDIS presentation and user interactions are determined by the following standards:

* IMO standards control presentation, performance, and user experience. They include standards and guidelines for display and user interaction, including alerts.
* IHO standards provide the framework for data content, primarily in S-100. S-100 also provides an abstract specification for visual interoperability; for ECDIS, details about interoperability are specified in S-98.
* IEC standards describe methods and required results for equipment and system testing.
* Data product specifications describe the content, data formats, symbols, portrayal rules, packaging, and delivery, of individual data products. For ECDIS, the basic data product is S-101 (Electronic Navigational Charts). Other products describe additional information relevant to navigation, for example, bathymetry, currents, water levels, regulated areas, services and weather.

The standards that are current at the time of writing of this Annex are listed in the References section. More detailed information about the various standards is provided in Part 16A.

Application developers should obtain an up-to-date set of applicable standards and specifications from the relevant organisations. Developers must conform to the mandatory requirements of the particular standards which apply to an application or system. In case of a conflict between this Annex and a mandatory requirement in an applicable standard, the requirement in the standard supersedes the guidance in this Annex.

The specifications in this Annex also apply to navigation displays in an Integrated Navigation System (INS) which fulfil the role of an ECDIS.

Users of this document should refer to IEC publications when dealing with implementation testing.

# References

## Normative references

A.1021(26) Code on Alerts and Indicators (2009), IMO Resolution A.1021(26), 2009.

IEC 60945 Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results. International Electrotechnical Commission (IEC), Fourth Edition, 2002.

IEC 61174 Maritime navigation and radiocommunication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results. International Electrotechnical Commission (IEC), Edition 4.0, 2015.

IEC 61924-2 Maritime navigation and radiocommunication equipment and systems – Integrated navigation systems – Part 2: Modular structure for INS – Operational and performance requirements, methods of testing and required test results. International Electrotechnical Commission (IEC), Edition 1.0, 2012.

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. International Electrotechnical Commission (IEC), Edition 2.0, 2014.

MSC.191(79) Amendments to the Performance Standards for the Presentation of Navigation-Related Information on Shipborne Navigational Displays, IMO Resolution MSC.191(79), 2004. As amended by MSC 466(101).

MSC.232(82) Revised Performance Standards for Electronic Chart Display And Information Systems (ECDIS), IMO Resolution MSC.232(82), 2006.

MSC.252(83) Performance Standards for Integrated Navigation Systems (INS), IMO Resolution 252(83), 2007.

MSC.302(87) Adoption of Performance Standards for Bridge Alert Management, IMO Resolution 302(87), 2010.

MSC.466(101) Amendments to the Performance Standards for the Presentation of Navigation-Related Information on Shipborne Navigational Displays (Resolution MSC.191(79)), 2019.

MSC.1593 Interim Guidelines for the Harmonized Display of Navigation Information Received via Communication Equipment, IMO MSC.1/Circ.1593, 2018.

MSC.1609 Guidelines for the Standardization of User Interface Design for Navigation Equipment, IMO MSC.1/Circ 1609, 2019.

S-97 IHO Guidelines for Creating S-100 Product Specifications, IHO Publication S-97 1.1.0 (June 2020).

S-98 Data Product Interoperability in S-100 Navigation Systems, IHO Publication S-98 (Draft).

S-100 Universal Hydrographic Data Model, IHO Publication S-100 5.0.0 (In preparation).

SN.243/2 Guidelines for the Presentation of Navigational-Related Symbols, Terms and Abbreviations, IMO SN.1/Circ.243/Rev.2, 2019.

## Informative references

ISO 19117 Geographic Information - Portrayal. ISO Standard 19117 Edition 2, 2012.

S-4 IHO Publication S-4, Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO, Edition 4.8.0, October 2018. (Parts B and C in particular.)

S-52 IHO Publication S-52, Specifications for Chart Content and Display Aspects of ECDIS, Edition 6.1.1, June 2015.

S-63 IHO Publication S-63, IHO Data Protection Scheme, Edition 1.2.1, March 2020.

SVG-Tiny Scalable Vector Graphics (SVG) Tiny 1.2 Specification, W3C Recommendation 22 December 2008, <http://www.w3.org/TR/2008/REC-SVGTiny12-20081222>.

# Terms, Abbreviations, and Notation

## Terms

chart window

The portion of the screen that is displaying chart feature information in a graphical representation similar to that of a nautical chart.

co-attribute (of an attribute)

A sub-attribute of the same complex attribute; an attribute of the same feature or information type.

colour token

An identifier for a colour in a palette.

palette

Collection of colours defined in CIE and/or sRGB colour space and identified by a colour token.

sub-attribute

An attribute of a complex attribute.

navigation display or navigation screen

The ECDIS or INS display(s) which is being used for route monitoring or collision avoidance.

NOTE: Displays showing only non-S-100 information (e.g., radar, meteorological information) are excluded from the scope of this document.

## Abbreviations

AIS Automatic Identification System

CSS Cascading Style Sheets

EBL Electronic Bearing Line

ECDIS Electronic Chart Display and Information System

ECS Electronic Chart System

ENC Electronic Navigational Chart

HO Hydrographic Office

INS Integrated Navigation System

IEC International Electrotechnical Commission

IHO International Hydrographic Organization

IMO International Maritime Organization

SENC System Electronic Navigational Chart

SVG Scalable Vector Graphics

VRM Variable Range Marker

XML EXtensible Markup Language

XSLT EXtensible Stylesheet Language Transformations

## Notation

AC(CCCCC)

Area colour fill using colour token CCCCC.

AC(CCCCC,n)

Transparent area colour fill using colour token CCCCCC, with transparency = *n*.

AP(AAAAAAnn)

Area pattern identified by the name AAAAAA suffixed by digits *nn* to distinguish variations of a basic pattern.

SY(AAAAAnn)

Symbol identified by the name AAAAAA suffixed by digits *nn* to distinguish variations of a basic symbol.

LC(AAAAAAnn) or LC(AAAAAAAA)

The first variant means the complex (composite) line style identified by the name AAAAAA, suffixed by digits *nn* to distinguish variations. The second variant means the complex (composite) line style identified by the name AAAAAAAA.

LS(style, width, CCCCC)

Simple line style with continuity specified by *style* (“solid”, ‘”dot” or “dash”), thickness specified by *width,* drawn in the colour identified by colour token CCCCC. Other elements such as dash interval, cap and join types may be added if they are significant to the description.

(Name of feature or information type)

Features and information types are referenced by their names in camel-case or space-separated names in initial capitals (“LandArea” or “Land Area”).

(Name of attribute)

Attributes are referenced by their names in camel-case with initial letters in lower case, or space-separated names in all lower case (“visuallyConspicuous” or “visually conspicuous”).

# Compliance Levels

Compliance to this document is defined in terms of the following compliance levels:

Level 1: Systems capable of displaying S-101 and S-57 ENCs and conforming to the rules set forth in this document for S-101 and the rules in S-52 for S-57, but not capable of displaying any other S-100-based product.

Level 2: Systems meeting the requirements for Level 1, and also capable of displaying any other S-100-based product classified at S-100 compliance category 4; but not implementing S-98 interoperability.

Level 3: Systems meeting the requirements for Level 2 and implementing S-98 interoperability.

For all levels, systems must comply with the applicable IMO performance standards and pass the applicable tests in IEC standards.

# System Concepts and Limitations

## ECDIS concept, limitations and challenges

Electronic Chart Display and Information System (ECDIS) means a navigation information system which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulations V/19 and V/27 of the 1974 SOLAS Convention, as amended, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and if required display additional navigation-related information.

The concept of ECDIS is outlined in the introduction section of the IMO Performance Standards MSC 232(82). The following contains additional ECDIS related considerations.

1. ENC is an integral part of ECDIS and therefore should be defined as the base layer for the portrayal harmonisation framework. Additional layers can be classified as two main types, additional information to that of the ENC or enhanced information to that of the ENC. Additional information would be information that is not contained in the ENC, while enhanced information are layers that contain improved, detailed or higher resolution information than the ENC.
2. ECDIS, used together with official data, [is] accepted as complying with the up-to-date charts carriage requirements for nautical publications required by regulation V/19 of the 1974 SOLAS Convention amended in 2009. Electronic chart systems not meeting these ECDIS specifications of IHO and IMO, or ECDIS using non-official data, are known as ECS (Electronic Chart Systems).
3. Chart information may be used in conjunction with a radar overlay on ECDIS. Integration of tracked radar targets provided for collision avoidance radar (ARPA), targets tracked by AIS (Automatic Identification System) into the ECDIS display is another option, as well as other navigational information may be added to the ECDIS display. In addition, in certain cases the chart information may displayed in conjunction with other S-100 based product specifications such as surface currents, ocean weather or ice information.
4. Colours and symbols defined in the S-101 portrayal catalogue are conceptually based on the symbology of conventional paper charts. However, due to the special conditions of the ECDIS chart display as a computer-generated image, the ECDIS presentation of ENC data may differ from the appearance of a conventional paper chart, especially when simplified portrayal mode is used. There may be considerable differences in symbology in shape, colour and size, and in the placement of text in particular.
5. ECDIS combines chart and real-time navigational positioning information. Modern navigation systems (i.e. GNSS) may offer a more accurate positioning than was available to position some of the surveys from which the digital chart data ENC was derived. Further, other products may not be encoded to the same accuracy or precision as ENC data or ship’s positioning.
6. The display categories specified in the IMO Performance Standards and the IHO priorities of the various types of chart information (alarms, updates, mariner's and non-HO chart data, etc.) are applied to features by the display plane and drawing order assignments in individual portrayal catalogues. The drawing order may be modified if interoperability is activated.
7. Depth information should only be displayed as it has been provided in the ENC and not adjusted by tidal height. If the ECDIS has integrated the use of a S-100 based tidal product specification, it may display the adjusted tide as an italicized offset to the sounding in the ENC.
8. In the initial period of S-100 roll-out, S-100 compatible ECDIS are likely to be “dual-fuel” in that they will have both S-57 and S-101 ENCs. It is possible that there will be situations where the navigation screen has to display both S-57 and S-101 ENCs. The user experience aspects of such situations are discussed in Clause C-20.

The versatility of ECDIS poses several challenges for ECDIS display design. These challenges are discussed below.

The diversity of information displayed on an ECDIS may include:

* physical chart information, for example, coastline, depth contours, buoys,
* traffic routeing; specified areas; cautions; etc.,
* supplementary HO information from light list, etc.,
* mariner's notes; additional local chart information; manufacturer's information,
* chartwork such as planned route; electronic bearing lines and range rings; etc.,
* own ship's position and velocity vector; ship's head and rate of turn; past track;
* fix accuracy, or position check from secondary positioning system,
* possibly, shiphandling options, based on ship's characteristics, alphanumeric navigation information (ship's latitude, longitude, heading, course, etc.),
* information from radar and other sensors,
* information from AIS,
* navigational indications and alarms generated by ECDIS,
* possibly, telemetered information from shore authorities (traffic, real-time tides etc.),
* possibly, ice information,
* reminders (for example, time to contact pilot station),
* possibly, messages from other displays.

The flexibility of portrayal may include:

* displaying/removing various types of chart and non-chart information,
* selecting standard chart display or a thinned out display, and either paper chart symbols or simplified symbols,
* using cursor interrogation for further detail,
* overlaying/removing radar video or radar target information (in order to: confirm ship's positioning; aid radar interpretation; show the entire navigation situation on one screen),
* overlaying/removing various other sensor information, or information telemetered from shore,
* changing the scale or orientation of the display,
* selecting true motion or relative motion,
* changing screen layout with windowed displays, text information in the margins, etc.,
* possibility of pull-down menus and other operator interaction devices being alongside the operational navigation display and so interacting with it,
* giving navigation and chart warnings such as "too close approach to safety contour"; "about to enter prohibited area"; "overscale display"; "more detailed (larger scale) data available"; etc.,
* possibly, a diagrammatic representation of a computer evaluation of grounding danger,
* possibly, a diagrammatic representation of the immediate vicinity of the ship to aid in close quarters manoeuvring,
* other future developments, as new presentation requirements and techniques appropriate to ECDIS are developed.

## INS concept, limitations and challenges

The concept of an Integrated Navigation System (INS) is outlined in the IMO Performance Standards MSC 252(83). INS workstations have multifunctional displays providing at least route monitoring and collision avoidance functions, and may provide manual or automatic navigation control functions. In addition to these functions, an INS generally also provide route planning, navigation control data and status, and alert management functions. INS integrate sources, data, and displays into one navigation system. An INS may consist of multiple task stations.

Since the concept of ECDIS is included in the INS concept, the principle described in clause C-7.1 of having ENC as the base layer applies - but in the context of an INS it applies to components playing the role of an ECDIS. Components playing other roles will generally use ENC or similar data, but this may depend on function and task.

The considerations related to portrayal and user interaction for an INS are outlined below:

1. An INS may have multiple workstations, and the considerations for a workstation depend on the task it is being used for at the moment.
2. An INS may substitute for some carriage requirements for navigational equipment. The INS is required to fulfil the requirements for the systems it replaces. For example, an INS component used for the tasks of route monitoring and route planning must meet the requirements for an ECDIS, which are described IMO MSC 232(82). This means that the portrayal and user interaction considerations for an ECDIS described in C-5.1 apply to the workstation playing the role of an ECDIS.
3. All tasks of an INS should use the same electronic chart data and other navigational databases such as routes, maps, tide information. If ENCs are available, they should be used as a common data source for INS.
4. The INS should support mode and situation awareness on the part of the operator and take human factors into consideration to keep the workload within the capacity of the operator.
5. An INS should combine, process and evaluate data from connected sensors and sources. Data integrity should be monitored. Failure of data exchange should not affect any independent functionality.
6. The INS should offer default display configurations for the tasks route monitoring and collision avoidance selectable at each task station to provide the bridge team and pilot with a standardized display. This configuration should be accessible by a simple operator action.
7. The INS should provide operational modes for open sea, coastal, confined waters (pilotage, harbour berthing, anchorage). It is recommended that the INS provides means to generate pre-defined or operator-defined display modes, that are optimally suitable to the navigation task.
8. Integrated graphical and alphanumeric display and control functions should adopt a consistent human machine interface (HMI) philosophy and implementation.
9. Information should be presented consistently within and between different sub-systems. Standardized information presentation, symbols and coding should be used according to resolution MSC.191(79).
10. The alert management should distinguish between unacknowledged and acknowledged alarms or warnings. A caution should be indicated by a steady visual indication. No acknowledgement should be necessary for a caution.

IMO Performance Standards (MSC.252(83)) state that for each task it is used for, the INS should fulfil the relevant modules of the performance standards for standalone equipment for the task. An INS display being used for route monitoring will be subject to the ECDIS performance standards, and therefore the relevant INS display will have largely the same limitations and challenges described in clause C-5.1. The potential availability of other workstations in an INS allows manufacturers somewhat more flexibility in designing solutions, but this is limited by human factors constraints related to compatibility and divided attention.

Given the complexity of the issues and the necessity for compatibility, this document does not distinguish between INS and ECDIS displays for the purpose of harmonised portrayal. If the data products are shown on the same screen, the same rules apply for INS and ECDIS displays, and the treatment should be the same for INS as for ECDIS. If the data products are on different INS screens, the treatment should be compatible in the sense of the guidelines in IMO Circ.1609.

## The concepts of ENC/SENC

IMO MSC.232(82) defines Electronic Navigational Chart (ENC) and System Electronic Navigational Chart (SENC) as follows:

3.2 Electronic Navigational Chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution, and conform to IHO standards. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.

3.3 System Electronic Navigational Chart (SENC) means a database, in the manufacturer’s internal ECDIS format, resulting from the lossless transformation of the entire ENC contents and its updates. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is equivalent to an up-to-date paper chart. The SENC may also contain information added by the mariner and information from other sources.

# User Interface Design

## General principles

The guidelines in IMO MSC.1609 (Guidelines for the Standardization of User Interface Design for Navigational Equipment) must be applied to the design of user interfaces for navigation systems. The general principles are described in MSC.1609 and summarised in S-100 Part 16A.

Operator control of information should be effective and simple.

* The operator interface should provide clear, simple control of the display such that there is no danger of confusion, or of failure to retrieve important chart information in a stressful situation.
* There should be enough commonality between the user interfaces of the various makes of ECDIS that a pilot, or watch officer new to the ship, can use an unfamiliar type of ECDIS. However, over-strict standardisation will hamper development of an effective interface.

The mariner should have full control over any automatically linked display changes, including the option to inhibit such changes.

The capability to flash a symbol should be used only rarely in very special cases. It should be used to draw attention rather than to simulate a real flashing object.

## User interface elements

IMO Circulars SN.243/Rev.2 and MSC.1609 define symbols for navigation-related symbols and functions respectively. For ECDIS and INS, this entails the following requirements and recommendations:

1. For feature and information data objects in S-100 datasets, the symbols defined in the IHO GI registry and specified in the respective data product specifications must be used, subject only to such modifications as may be specified by an approved interoperability catalogue conforming to S-98 (ECDIS Interoperability).
2. For navigation-related symbols, the symbols and icons defined in Annex 1 to SN.243/Rev.2 are strongly recommended. The terms and abbreviations in Annex 2 to SN.243/Rev.2 should be used where terms or abbreviations are needed in the user interface.
3. For navigation-related functions, use of the standard symbols and icons for navigation-related functions defined in Appendix 2 of MSC.1609 is strongly recommended. The terms and abbreviations defined in the same Appendix should be used where terms or abbreviations are needed in the user interface.
4. For functions and symbols to use when S-98 interoperability is activated on the display, see Sections C-9.2 and C-9.3 of this Annex.
5. Where a standard symbol, icon or term is not available, manufacturers may define a new symbol, icon or term, but such symbols, icons and terms should not conflict with those defined by IMO or IHO. New abbreviations should be defined only for new symbols, icons, or terms, and should not conflict with existing abbreviations. Manufacturers are encouraged to discuss the need for new symbols, icons, terms or abbreviations with IMO and IHO.
6. While many symbol and icon definitions in SN.243/Rev.2 and MSC.1609 do not specify colours for the standard symbols and icons, the general principles of user interface design and likely environmental and lighting conditions (e.g., use of red light on the bridge, day/night/dusk lighting, prominence vs. distraction tradeoffs) should be kept in mind when determining colours for these symbols and icons. The colour assignment table in Part 16A may be consulted to assess possible colours, but developers should note that assignment of a colour in that table does not necessarily preclude its use for navigation-related symbols or functions.
7. Logical grouping of information should be consistent with the groups specified in Appendix 3 of MSC.1609. Note that Appendix 3 does not specify where the groups should appear on the screen or the order of information elements within groups, nor is the list exhaustive.
8. Access to user interface functions should be consistent with Appendix 4 of MSC.1609, keeping in mind the clarifications in the Introduction to that Appendix.
9. Management of default and user settings should be consistent with Appendix 5 of MSC.1609.

# Data Layers

Since there is at present no restriction on which data layers can be displayed other than IMO Performance Standards’ requirement that the data does not degrade the displayed SENC information and should be clearly distinguishable from the SENC information, navigation systems should be prepared to display any S-100 data product that satisfies the technical requirements, i.e., is classified as S-100 compliance category 4 (“IHO S-100 and IMO harmonized display compliant” - see S-100 5.0.0 4a-5.5).

## Data products and information layers

### Basic products and layers

Navigation displays such as the ECDIS main screen must be able to display the following data layers:

* S-101 ENC data as the base layer, which may be replaced by S-57 ENC data where S-101 data is not available. Raster navigational chart (RNC) may be displayed if neither is available.
* Radar, ARPA and AIS target data overlays.
* Own ship information such as own ship symbol, heading and course information, safety contours, alerts and highlights caused by interaction or course with other data.
* Mariner-plotted information such as mariner-plotted hazards.
* S-102 Bathymetric Surface (Edition 2.0.0 and later).
* S-104 Water Level information for Surface Navigation.
* S-111 Surface Currents.
* S-124 Navigational Warnings.
* S-129 Underkeel Clearance.
* S-421 Route Plan.

The list is taken from IMO performance standards and extended with S-100 data products considered to be necessary.

### Other data products

In addition, navigation displays such as the ECDIS main screen should be able to display the following data products and allow them be turned on at mariner option:

* S-122 Marine Protected Areas.
* S-123 Marine Radio Services.
* S-127 Marine Traffic Management.
* S-412 Weather and Wave Hazards.
* S-411 Sea Ice (when conformant to S-100 compliance category 4[[1]](#footnote-1)).

### Future data products (informative)

Other data products are in early stages of development, and are unlikely to need display capabilities for the next several years. These include:

* S-125 Marine Navigational Services.
* S-126 Marine Physical Environment.
* S-128 Nautical Product Catalogue.
* S-413 Weather and Wave Conditions.
* S-414 Weather and Wave Observations.

### User selection of displayed data products

The user interface must provide a way for the mariner to select data layers from non-ENC S-100 data products to be added to or removed from the navigation display window.

NOTE (informative): Except for S-101 ENCs, there may be a 1/1 mapping between S-100 data products and data layers for display purposes. However, as with ENCs, some products may be divided between different layers, or a layer may be shared by different products, so manufacturers should not depend on a 1/1 mapping for implementation purposes.

## Mitigation of data overload

Each additional data layer multiplies clutter and the potential for hiding critical information. General user interface principles as well as IMO guidance (MSC.232(82), MSC.1609) recommend avoiding cluttering screens with too much information. To reduce the likelihood of screen clutter when multiple data products are loaded on the screen, the ECDIS should try to limit the number of simultaneous layers to those necessary to perform a specific task. Preliminary investigations by KHOA/KRISO/NOAA suggest that only two or three layers will be turned on at any given moment.

This Annex therefore recommends that, as far as possible, only two or three layers should be displayed simultaneously. The IHO interoperability catalogue for ECDIS is based on this recommendation.

Detection of and response to possible data overload should be guided by the role a particular system is playing at the moment (e.g., a display being used for planning may be able to treat potential overloading in a laxer manner than navigation displays being used for route monitoring and collision avoidance). See clause C-9.3.10 for user interface recommendations relating to possible data overload.

# Portrayal Process, Catalogue Elements, and Alerting

This section provides a brief summary of the portrayal process, the main elements of portrayal catalogues, and the alerting model. More details about the process and definitions of portrayal catalogue elements and the alerting model are available in S-100 Parts 9 and 9a.

Later sections of the present document describe how the portrayal elements should be used in an ECDIS implementation.

## Overview of the portrayal process

The system has feature data within its internal database that needs to be portrayed. The System Portrayal Engine transforms the feature data into drawing instructions according to the portrayal rules defined in the portrayal catalogue. The drawing instructions are intermediate data used by the rendering engine to produce the portrayal output. Drawing instructions include such things as references to symbol definitions, priority and filtering information. The symbol definitions contain the details of all graphical elements used for the portrayal. The drawing instructions are processed by the rendering engine to produce the final display according to the output device.

S-100 5.0.0 describes two different portrayal mechanisms, one based on XSLT templates and the other on a scripting architecture based on Lua. The basic portrayal process is the same for both, and is described in S-100 Part 9; variations to the process and input/output that are required for Lua portrayal catalogues are described in Part 9a.

When interoperability is activated and there is an interoperable product loaded to the display, either feature data or drawing instructions (depending on the implementation architecture) are further filtered and/or have their priorities adjusted as specified in the interoperability catalogue. Interoperability processing is described in S-100 Part 16 and S-98.

## Elements of portrayal catalogues

Symbols, area fill patterns and line styles are part of the portrayal catalogue, as are elements for specifying grouping and layering of display content. The following clauses provide a short description of these elements.

Many portrayal components (symbols, line styles, viewing groups, colour profiles, context parameters, etc.) are listed in the IHO GI registry (Version 3.1 or later).

### Pixmaps

Pixmaps can be used for defining pattern fills for areas that are not sufficiently described to be symbolised, or for which no symbol exists in the GI registry.

### Colour coding scheme

The portrayal catalogue uses a colour scheme, which classifies colours by their usage. Each colour usage is represented by a five-letter colour token. Each colour token corresponds to a colour definition given in CIE and sRGB coordinates in one of a set of colours; each set is intended for a different bridge lighting condition. Each such set of colours is referred to as a “palette” and is generally identified by a descriptive name, such as “Day-Bright”, “Dusk” and “Night”. A particular colour token is often assigned different CIE/sRGB coordinates in different palettes (especially day/night/dusk palettes).

A “colour profile”, as the term is used in S-100, is a collection of different palettes within a single XML file. An ECDIS must, at a minimum, have palettes for day, night, and dusk conditions available on the system.

Symbols, fill styles and line styles refer to the colour tables by using the standardized colour tokens as part of the symbol definition.

### Symbols

The portrayal catalogue provides a set of symbols, which are generally based on the traditional paper chart symbols. The symbols for point features are generally based on the traditional paper chart symbols and, in addition a set of more compact, but more visible, 'simplified' buoy and beacon symbols are provided for use under difficult viewing conditions.

### Area fills

The portrayal catalogue offers various ways to fill areas. They can be filled with an opaque colour; with a colour shown with some transparency; or with a pattern of symbols (fill pattern) or with a centred symbol. Fill patterns and centred symbols are introduced as a solution for the symbolization of areas in special situations. A fill pattern showing arrows does not have a certain position on the chart like the paper chart arrow symbol. It shows up as long as any part of the traffic separation lane can be seen on the screen. A centred symbol moves to the centre of the part of the area that remains in the display window. Fill patterns or centred area symbols may be used to symbolize the case when the entire display window lies within an area.

The portrayal catalogue provides two options for area boundaries, referred to as “plain” and “symbolised”.

Centred symbols must be used with symbolized boundaries to symbolize the case when the entire display window lies within an area.

Area boundaries should not be visible on the edge of the display window when the display window is enclosed by an area. However, if the boundary is actually on the edge of the display window, it should be visible.

### Line styles

The portrayal catalogue uses two types of line styles: simple line styles and complex line styles. Simple line styles are solid, dashed or dotted lines with varying colour and thickness (width or stroke width). Complex (or “composite”) line styles are composed of repeating line patterns.

Simple line styles are generally described by continuity, width, and colour. The full specification of a simple line style may also include other elements such as dash interval, cap and join types (see S-100 9-12.4 and 9a-11.2.2.3), defaults for which may be set in the portrayal catalogue. Complex line styles consist of additional elements, described in S-100 9-12.4 and 9a-11.2.2.3.

Complex linestyles may be one-sided (symbols, text, etc., which are part of the line extend to only one side of the line) or two-sided (symbols, text, etc. extend on both sides of the line).

### Text

S-101 and several other product specifications utilize a cartographic feature called **TextPlacement** that is used in association with a feature to optimise placement of labels (specifically, either feature name or light characteristic description string).

There are three types of text instructions possible in portrayal catalogues:

* Text relative to a point
* Text that will be drawn along a line.
* Text placed relative to an area local CRS. Note that this can cause the text to be drawn at multiple locations.

However, explicit cartographic placement along curves or relative to area/local CRS cannot be explicitly encoded in S-101 datasets, though it can be encoded in portrayal rules in a portrayal catalogue (S-100 9a-11.2).

### Style sheets

Cascading Style Sheets (CSS) files are used to provide different sets of stroke and fill style instructions to be applied to symbols. This mechanism allows changing colours and line weights used in the symbols by swapping CSS files according to the desired colour scheme.

In principle, any style attribute can be set in a CSS file, but the CSS files in IHO portrayal catalogues will affect only a limited set of style attributes, namely, stroke and fill colours, line cap and join styles. Note also that the style precedence rules will affect whether the style attribute in a CSS file will actually be applied to a displayed element.

### Display planes

Display planes are used to split the output of the portrayal functions into separate lists. An example of this is the separation of chart information drawn under a radar image and chart information drawn over a radar image.

### Display priorities

Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first.

The display priority must be of a value between '00' and '99', where '99' identifies the highest priority. The display priority applies irrespective of whether a feature is a point, curve or surface. If the display priority is equal among features, curve features have to be drawn on top of surface features whereas point features have to be drawn on top of both. If the display priority is still equal among features of the same type of geometry (curve, surface or point) the given sequence in the data structure of the SENC, or some other neutral criterion, must be used for a decision as to which feature is drawn on top. Text must be drawn last (except for own ship etc.), in priority 80-89.

Display priorities are also called “drawing priorities” in S-100 Parts 9 and 9a.

### Viewing groups

The viewing group controls the content of the display. It provides an on/off switch in the portrayal catalogue for any drawing instruction assigned to the corresponding viewing group.

### Viewing group layers

A viewing group layer defines a collection of viewing groups whose visibility can be simultaneously toggled by an application.

### Display modes

A display mode defines a collection of viewing group layers which can be simultaneously toggled by an application.

### Foundation mode

The foundation mode defines a collection of viewing groups that forms the foundation of the portrayal and cannot be removed from the display. The content of these viewing groups should comply with Display Base rules in IMO MSC.232(82).

### Rules

A portrayal rule is a set of machine processable statements that describes the transformation of feature data into drawing instructions.

### Context

The context is a set of parameters passed into portrayal processing at the top level. Context parameters are accessible only in processing rules in the same portrayal catalogue, but can be accessed by any of the rules in that portrayal catalogue. These parameters can be used to provide contextual information to the execution of transformation rules in portrayal processing. Examples are settings of depth values for the safety depth, shallow and deep contours.

### Validity times

Drawing instructions can be designated as being valid only during a specified interval, which may be open-ended at either beginning or end, or a single time point (with beginning and end the same). Intervals may be specified in terms of date, time (of day), or date-time endpoints.

The start and end instants are defined by their date/time component of the smallest granularity. For example, if the end instant is specified a date without a time of day, and the interval is “right-closed”, the end instant is midnight at the end of the specified day (240000 in ISO 8601 terms). This is consistent with the S-100 treatment of *dateStart* and *dateEnd* attributes (see S-100 Part 3 clause 3-8 (Interpretation of models of time intervals and period), but note that the open/closed nature of the interval affects the interpretation for Part 9 time intervals — if the same interval is specified as “right-open” the end time point is midnight at the beginning of the specified day (000000 in ISO 8601 terms).

## Alerts

The alerts catalogue describes messages, highlighting or events which are generated or triggered when the vessel route (either actual track, during route monitoring, or planned, during route planning) interacts with the geometry of a feature. The events are alarms, warnings, cautions, or indications as described in IMO MSC.252(83).

The alerting model allows product catalogue developers to attach alerts to features (optionally satisfying specified conditions on attribute values) which are considered to be hazards to navigation.

# Visual Interoperability

Ensuring visual interoperability in the presence of simultaneously displayed layers is an important aspect of user interfaces for navigation screens. IHO Publication S-98 (Data Product Interoperability in S-100 Navigation Systems) specifies the structure of the interoperability catalogue for ECDIS and INS.

While the interoperability catalogue provided by IHO will provide a normative interoperability catalogue for ECDIS, S-98 permits extensions, substitutes and customizations provided the minimum functions provided by the IHO catalogue are maintained and interoperability is not degraded (S-98 §§ 12.1.1–12.1.3).

## Phased implementation of interoperability

S-98 is designed with four levels of interoperability, of increasing power and complexity.

ECDIS implementations of interoperability should be capable of applying Level 2 interoperability and should therefore comply with the “S-98 – Main” document plus S-98 Part B. Note that Level 2 interoperability functionality is a superset of Level 1 functionality, which means that compliant systems must be capable of both Level 2 or Level 1 interoperability (or turning it off altogether, for “Level 0” interoperability).

Implementation of Levels 3 and 4 (Parts C and D of S-98) is not required in this edition of the Annex.

Implementors should consult S-100 Part 16 for the formal specification of the interoperability catalogue model and XML schema, which are common to all interoperability catalogues. S-98 is a restriction of the common interoperability model intended for implementations on ECDIS.

## Symbols and icons with interoperability ON

When interoperability is turned on, symbols and icons for chart display of features in interoperating products are selected by interoperability operations or rules, and will be one of the following:

* The standard symbol defined in the portrayal catalogue for the individual product.
* The substitute symbol, if any, defined in the *substituteSymbolization* sub-element of an **S100\_IC\_DrawingInstruction** element of the interoperability catalogue.
* A symbol defined in the hybrid portrayal catalogue (only for Level 3 or 4 interoperability).

## User interface functions for interoperability

The terms and abbreviations defined in this clause are to be treated like the standard terms and abbreviations as described in SN.243/Rev.2 Annex 2. In particular, as required in that document, terms should be shown in lower case and abbreviations in upper case. Exceptions are noted in the tables.

Implementation of the user interface functions for interoperability specified in this clause is required only for systems which implement S-98 interoperability.

[Multiple entries in a cell indicate alternate choices. The final version of this annex should have only one entry in each cell, which may be different from all the entries currently listed.]

### General navigation functions

The following interoperability functions should be added to the user interface, extending Table 1 (General Navigation Functions) in IMO MSC.1609:

| **Explanation** | **Term** | **Abbreviation** | **Icon (“hot key”)** |
| --- | --- | --- | --- |
| [If none, delete this table before finalizing draft.] |  |  |  |

Table 1 - Additional general navigation functions

### Control of chart display functions

The following functions should be added to the user interface, extending Table 2 (Control of Chart Display Functions) in IMO MSC.1609:

| **Explanation** | **Term** | **Abbreviation** | **Hydrographic Symbol** | **Icon (“hot key”)** |
| --- | --- | --- | --- | --- |
| Selector for interoperability level | Level 1 visual integration  Information layer merge Level 1 | VINTEG L1  INFO LYR MRG L1 | (none) |  |
| Level 2 visual integration  Information layer merge Level 1 | VINTEG L2  INFO LYR MRG L2 | (none) |  |
| Level 3 visual integration  Information layer merge Level 1 | VINTEG L3  INFO LYR MRG L3 | (none) |  |
| Level 4 visual integration  Information layer merge Level 1 | VINTEG L4  INFO LYR MRG L4 | (none) |  |
| No visual integration  Information layer merging off | VINTEG OFF  INFO LYR MRG OFF | (none) |  |
| Selector for predefined combination in the currently active interoperability catalogue (see notes 1, 2) | Visual integration ruleset  Information layer merging ruleset | VINTEG RULES  INFO LYR MRG RULES | (none) |  |

Table 2 - Additional functions for control of chart display

Notes:

1. This function should be disabled when interoperability is OFF or the interoperability level of the catalogue as a whole (attribute *interoperabilityLevel* of **S100\_IC\_InteroperabilityCatalogue**) is 1. Level 1 catalogues do not include predefined combinations.
2. This function should display a list of predefined combinations in the currently active interoperability catalogue. Names of predefined combinations can be found in the *name* attribute of **S100\_PredefinedCombination** in the interoperability catalogue. The name should be displayed; other information (description, use condition, level) should either be displayed at the same time or accessible from the display.

### Functions for control of chart functionality

The following functions should be added to the user interface, extending Table 3 (Control of Chart Functionality) in MSC.1609:

| **Explanation** | **Term** | **Abbreviation** | **Icon (“hot key”)** |
| --- | --- | --- | --- |
| To toggle interoperability | Visual integration  Layer merging | VINTEG  LYR MRG |  |

Table 3 - Additional functions for control of chart functionality

### Database functions

The following functions should be added to the user interface, extending Table 4 (Database Functions) in MSC.1609.

| **Function** | **Term** | **Abbreviation** | **Icon (“hot key”)** |
| --- | --- | --- | --- |
| To review available interoperability catalogues | Rulesets for layer merging | LYR MRG INDX |  |

Table 4 - Additional database functions

### Function groups

Interoperability functions should be in the “Chart display settings” group in Table 6 (Groups of Functions) in MSC.1609.

The following group(s) should be added to the function groups in the user interface, extending Table 6 (Groups of Functions) in MSC.1609:

| **Group of Functions** | **Term** | **Abbreviation** | **Icon (“shortcut”)** |
| --- | --- | --- | --- |
| [If none, delete this table before finalizing draft.] |  |  |  |

Table 5 - Additional function groups

### Function accessibility

The following functions should be added to the list in MSC.1609 of functions accessible by single or simple operator action (Table 2 in MSC.1609 App. 4):

| **Function** | **Equipment** | **Access** |
| --- | --- | --- |
| Toggle visual interoperability without loading or unloading data products to the display | ECDIS | Single operator action |
| Load data products in a predefined combination and activate interoperability | ECDIS | Simple operator action  (S-100 § 16-4.4.2.6) |
| Change interoperability level when interoperability is active | ECDIS | Simple operator action  (S-100 § 16-C-5) |
| Change predefined combination to a different predefined combination covering the currently loaded products on the display at the current level | ECDIS | No operator action other than selecting predefined combination. Interoperability rules from the new predefined combination must be applied automatically.  (S-100 § 16-C-5.) |
| Load additional product to the display and apply interoperability rules when there is a predefined combination covering the new set of loaded products at the current level | ECDIS | No operator action other than loading product. Interoperability rules from the applicable predefined combination must be applied automatically.  (S-100 § 16-C-5.) |

Table 6 - Additional functions accessible by single or simple operator action

### Condition-dependent enhancements to user interface

The terms, abbreviations, and icons in Table 7 may be used to enhance (as a suffix, prefix, superimposition, etc.) the terms, abbreviations and icons defined in this Annex when the appropriate condition holds (e.g., the function is not available). Manufacturers who have implemented equivalent functionality using other methods (e.g., greying out icons for unavailable functions) should use their existing methods instead, to keep the user interface consistent.

| **Explanation** | **Term** | **Abbreviation** | **Icon** |
| --- | --- | --- | --- |
| Function not available  (superimposed on pictorial icon) | [Unavailable]  ([ ] brackets included) | [UNAVL]  ([ ] brackets included) | (see note 1) |
| Function not available  (for text “icon”) | (see note 2) |

Table 7 - Modifying terms, abbreviations, and icons

Notes:

1. The colour of the superimposed icon should be red or grey, but may be adapted to both common understandings of colours and current viewing conditions, e.g., day/dusk/night. It should also be adapted to ensure that icons for unavailable functions are not more prominent in the interface than icons for available functions. The opacity should be set to allow the underlying icon to be visible. The stroke thickness may be adapted to the interface.
2. The strikethrough stroke should be of noticeable weight, proportional to the size of the text.

### Status display

Interoperability status (indicating whether visual interoperability rules are being applied to the display) and current interoperability level should be indicated by a status indicator in the user interface, located outside the chart graphic.

### Settings

The default and user ECDIS settings related to interoperability are listed in Table 8. The principles in MSC.1609 Appendix 5 also apply to interoperability settings, and are reproduced below:

*User settings*

*A facility should be provided to store and recall user-specific settings to suit the conditions at hand. At least two such configurations should be available to be stored for recall. Selection for recalling a stored configuration should be followed by an action to confirm the selection.*

*Default settings*

*A facility should be provided to apply a set of default settings to return the equipment to a known default state. The default settings are intended to provide a basic and minimal mode of operation for the system or equipment that can be built upon by the user.*

*Default settings are not intended to provide a redundant setting in the event of an equipment failure of loss of input.*

| **Function** | **Setting** |
| --- | --- |
| Interoperability toggle | Interoperability Off |
| Selector for interoperability level | Remain unchanged if previously set  (selector disabled, because the default setting is interoperability Off) |
| Predefined combination | Remain unchanged if previously set |
| S-100 data products displayed on screen  (see IMO MSC.1609 for AIS, Radar, Own Ship, and Track settings) | S-101 + any active data products in overlay mode |
| Selected interoperability catalogue | IHO-provided catalogue |

Table 8 - Additional settings configured in response to “Default” selection

The defaults in Table 8 supplement the defaults specified in MSC.232(82), MSC.252(83) and IEC 61174.

If a system does not implement an interoperability level, the corresponding user interface elements must either be omitted from the interface altogether, or if they are present in the user interface, disabled with an indication that they are non-functional, such as a strike-through (for text) or superimposition of a “not available” icon (for icons) as shown in Table 7.

NOTE: The symbols and icons in this clause are, as of June 2020, only candidates. Manufacturers are invited to provide feedback and user testing results, including proposed alternatives, so that they can be standardised.

### Display overload indications

Clause C-7.2 describes possible problems with data overload and the likely practical limits on the number of data products simultaneously loaded to a navigation display.

If the number of layers loaded on the display appears to be excessive, the ECDIS should provide a noticeable but unobtrusive (i.e., non-blocking) visual indication of possible visual overload.

The criteria for deciding when the number of layers appears to be excessive are left to manufacturers, but a trigger level of 4 S-100 data products is suggested. (In the absence of sufficient data products and applications to experiment with, it is hard to be more definite.) Manufacturers may vary the trigger level depending on experience or particular conditions; for example, displays being used for route planning may allow one or two more products before triggering the indicator.

# Display Organisation and Operation

## Display of non-S-100 information

This clause describes the display of information that is not from S-100-based data products, S-57, radar, or AIS.

### Distinguishing between official data and additional data

IMO Performance Standards (MSC.232(82) section 1.5) states that ECDIS should enable the mariner to execute all route planning, route monitoring, and positioning at present performed on the paper chart and section 3.3 states that the SENC may contain information from other sources than ENCs. This specification requires that ECDIS distinguish between official data and such additional data from users (mariners) and manufacturers. The colour and symbol usage for mariners’ and manufacturers’ data in the IHO GI Registry and the portrayal catalogues for S-100 data products are designed to implement this while ensuring the display remains clear and uncluttered.

IMO Guidelines (SN.243/Rev.2 and MSC.1609) describe "Mariner's Navigational Features" for route planning and route monitoring chartwork, and for adding mariner's and manufacturer's information to the SENC. The descriptions are in the same format as chart features, in order to avoid the ECDIS having to deal with two differently coded types of data. The colours, symbols, categories and display procedures that apply to all these features are included in the S-101 Portrayal Catalogue, along with the procedures for chart features.

Mariners may alter the IMO categories for Mariner's Features (but not for ENC features). Note, however, that IMO MSC.232(82) section 11.4.1 requires that own ship’s position and selected planned route should always appear when the display covers either, and these “features” must therefore remain in Display Base.

Note that Mariner's Features should be kept independent of data from official or non-official producers in the SENC, and that mariners' information does not need to be split into datasets.

In referring to Mariner's Features it is important to distinguish between:

* "Add/Enter", "Revise" or "Delete" mariner's or manufacturer's information; this refers to the contents of the SENC, and:
* "Display" or "Remove" the information; this refers to the ECDIS display.

### Mariner’s information on the route monitoring display

In addition to the ability to enter manual chart corrections and to carry out route planning and route monitoring chartwork, the mariner should be provided with the capability of adding at least the following symbols, lines and areas to the SENC, and should be able to revise or delete them:

* the caution “(!)” or information “[i]” symbol, used to call up a note on the text display by cursor picking,
* simple lines and areas with or without colour fill, set up for cursor picking to give an explanatory note in the text display,
* any of the chart symbols from the portrayal catalogue,
* text notes.

Information added by the mariner should be in normal chart colours as specified in the portrayal catalogue.

Other information added by the mariner should be distinguished by the colour orange (colour token NINFO) except for colour fill, which should use transparent yellow (colour token ADINF).

Mariner's information should not overwrite official information.

### Manufacturer’s information on the route monitoring display

If the manufacturer should add non-chart information to the SENC, they should use the following symbols, lines and areas:

1. the circled “!” caution symbol SY(CHINFO11), or boxed “i” information symbol SY(CHINFO10), used to call up a note on the alphanumeric display by cursor picking,
2. simple lines, or areas without colour fill, set up for cursor picking to give an explanatory note in the alphanumeric display (colour fill should not be used).
3. Non-chart information entered by the manufacturer should be distinguished by the colour yellow (colour token ADINF). It should not overwrite HO ENC information.

If the manufacturer should add non-official information to the SENC it should be symbolised in the same way as official chart information and distinguished from official chart information as described for the various cases below:

1. Limited non-official data is added to existing official data to augment the chart information. Each feature should be marked by the special identifiers.
2. An area of non-official data is located in waters for which official chart data exists; it is superimposed on the official data. In some cases the non-official data may be more appropriate for the intended purpose, for example it may be more detailed.

In this situation it is at the mariner’s discretion whether to use the official or the non-official data.

If the mariner selects the non-official data, the boundary of this data should be identified on the ECDIS display by the line LC(NONHODAT) and the warning “Unofficial data displayed; refer to official RNC or paper chart” should be displayed.

1. An area of non-official data is located wholly outside the area covered by official data (although it may share a boundary with the official data) but is shown on the same display as official data.
2. The entire display contains nothing but non-official data. The warning “No official data available; refer to official RNC or paper chart.” should be displayed. In this case, special identifiers need not be used.

The mariner should be able to remove all manufacturer's information if the need should arise.

### Supplemental display items

The following information should be shown on demand on the same screen as the chart display or on an additional graphic or text display:

* Positional data and time;
* legend;
* feature description and associated attributes (result of "cursor query") in human readable language, including the meaning given in the portrayal catalogue for any symbol selected by cursor-pick; textual information from ENC, for example, dataset name, compilation date, date of issue;
* record of updates for all data products;
* ECDIS Chart 1;
* colour differentiation diagram;
* black adjust symbol for contrast adjustment;
* list of categories which are removed from Standard Display;
* Edition numbers of S-101 and other Product Specifications in use;
* Details of navigational warnings, accessible in the following categories (this is the minimum set, manufacturers may add other categories or access methods, or substitute equivalent methods):
  + result of “cursor query” on MSI feature(s);
  + selection from a list of navigational warnings provided elsewhere (outside the chart graphic) on the same screen, or on an additional graphic or text display;
  + within a user-specified distance from the vessel’s current position;
  + within a user-specified distance from the planned route (the same distance as the previous item);
  + in the local NAVAREA, and neighbouring area when the vessel is near a NAVAREA boundary.

### Units

The units listed below should be indicated in the display legend:

Position: latitude and longitude in degrees, minutes and decimal minutes.

Depth: metres and decimetres.

Height: metres.

Distance: nautical miles and decimal miles, or metres.

Speed: knots and decimal knots.

### Legend

A standard legend of general information relating to the area displayed, applicable to the position selected by the mariner, should be shown on a graphic or text display. This legend should contain at minimum:

1. units for depth
2. units for height
3. scale of display; in addition overscale indication where appropriate
4. data quality indicator
5. sounding/vertical datum
6. horizontal datum
7. the value of the safety depth if used
8. the value of the safety contour selected by the mariner, as well as the value of the safety contour displayed (which may be different from that selected by the mariner)
9. magnetic variation
10. date and number of last update(s) affecting the datasets currently in use
11. edition number and date of issue of the datasets
12. chart projection

See C-14.10.3 for details about the listed items.

Since attempting to display all the above items for all displayed data products may lead to an unduly large legend, manufacturers may suppress information from data products other than ENCs. If this is done, the suppressed information should be available through simple operator action, such as a temporary expansion of the legend activated by clicking on a target in the legend. (Note that some of the items will be the same for all data products - in particular, units and datums should be the same for all products, or converted to present the same display result, in order to reduce the chances of user error.)

## Priority of information

### Priority layers

The IMO Performance Standard divides SENC information into three categories that determine what data is to be on the display: Display Base (always present on the display); Standard Display (the default display); and Other Information (displayed on demand). (MSC.232(82), section 3 and Appendix 2).

There are 10 basic priority layers for the drawing sequence of the data on the display, ordered from higher to lower priorities in the list below:

1. ECDIS visual alarms/indications (For example, caution, overscale)
2. Official-data: points/lines and areas + official updates
3. Notices to Mariners, manual input and Navigational Warnings
4. Official-caution (ENC and other cautions)
5. Official-colour-fill area data
6. Official on demand data (for example, water levels, surface currents, underkeel clearance)
7. Radar and AIS information
8. Mariners data: points/lines and areas
9. Manufacturer's data: points/lines and areas
10. Mariners colour-fill area data

This list is not intended to indicate a drawing sequence, but to specify that the information content of category n+1 must not obscure the information content of category n, or any higher-priority category (n-1 etc.).

Category (7) should have a radar off switch to facilitate its removal.

The portrayal catalogues assign a category and a display priority (drawing sequence) to every feature (feature-attribute combination) in the ENC or other S-100 dataset.

### Radar priority

The priority of official chart data over radar is carried out by the single action "remove radar" control (IMO MSC.232(82) section 7.2). When present, the radar data is always written over the opaque area fills. Chart curve and point features should normally be written over the radar image, with some exceptions, as indicated by assignment to the UnderRADAR display plane in the portrayal catalogue. However, in order to meet the requirements of IMO MSC.232(82) section 11.4.14 to adjust the ship's position, the ECDIS may incorporate the capability of changing the radar priority of the portrayal catalogue. Operation of this feature should be clearly indicated.

Radar priority is indicated by assigning the feature to one of the following display planes:

| **Name** | **ID** | **Description** |
| --- | --- | --- |
| overRadar | OverRADAR | Content displayed on top of Radar image |
| underRadar | UnderRADAR | Content displayed underneath Radar image |

Table 9 - Radar display planes

As a fail-safe, features are automatically assigned to the OverRADAR display plane if the *displayPlane* field in the drawing instruction is empty.

When the RADAR overlay is present on the ECDIS chart display the OverRADAR assignment takes precedence over the feature’s display priority.

## Display categories

### IMO Categories

The IMO "Display Base" is that part of the Standard Display that should never be removed. It is a list of basic features which the IMO consider to be required at all times, in all geographic areas and under all circumstances. The IMO do not intend the Display Base to be sufficient for safe navigation on its own; therefore it should not be a display option to "Show Display Base" without any additions.

The IMO "Standard Display" is a list of features that the mariner may either add further features to, or remove features (except Display Base) from, in deciding what is to be displayed. As soon as any feature on this list is removed from the display, or any feature not on this list is added to the display, the display no longer shows the IMO "Standard Display".

The IMO category "Other Information" contains every feature in the SENC which is not classed as "Standard Display".

The mariners should be able to remove information selectively from "Standard Display", except that they cannot remove any feature of the "Display Base". The mariners should also be able to add selectively to the Standard Display any items of the "Other" category.

The portrayal catalogue assigns the IMO category in detail to every feature in the SENC, including Mariner's Navigational Features. The mariner may override the category for mariner's features, but not for chart features.

### Selecting features for the route monitoring display

Section 5.5 of the IMO Performance Standard (MSC.232(82)) requires that "It should be easy to add or remove information from the ECDIS display". For example, the mariner might want to retain "caution areas" from the Standard Display (see Table 13 of this document) but remove the other areas, including features such as protected areas (For example, "game preserve"). Another example is that they might want to add soundings from "Other", but omit submarine cables (which cause serious clutter at certain ocean terminals).

As an aid to adding and removing information from the display, the portrayal catalogue also assigns every feature in the SENC to a viewing set, and these sets are arranged in groups which are related to the lettered groups of INT 1 for the paper chart, a classification which is familiar to the mariner.

The manufacturer is responsible for organising SENC features, viewing sets and viewing groups for display in such a way that the mariner has reasonable flexibility in selecting what he sees without the selection process becoming too complex. Note that it is not necessary to provide access to each feature, viewing set or even viewing group individually.

Note that combined groups which include features from different IMO categories should not be linked permanently, since doing so would, in effect, drag additional features into the Display Base or Standard Display. For example, if a combined group includes soundings (which are "Other") and lights (which are "Standard Display"), this link should not cause soundings to be shown with the Standard Display on first switching on the ECDIS.

### Selecting text for the route monitoring display

The ECDIS manufacturer should provide the mariner with control over the selection and display of text on the route monitoring display.

Text should not appear automatically whenever the feature it is associated with appears on the display. (This includes text that is cartographically placed using a **TextPlacement** feature.) It should always be possible to remove text independently of the feature. The IMO Display Category for text is "other".

### Linkages between ECDIS options

Because vessels vary widely in their requirements and their operational procedures, linkages between options which reduce the flexibility of the ECDIS must be avoided.

## Drawing priorities

Display priorities control the order in which the output of the portrayal functions is processed by the rendering engine. Priorities with smaller numerical values will be processed first. In the S-100 portrayal model the display priority is known as the drawing priority.

The drawing priority should be used to ensure that features that overlap each other are drawn in the right sequence. Thus, a feature with a higher priority should be drawn after (on top of) a feature with a lower drawing priority.

The drawing priority must be a value between '00' and '99', where '99' identifies the highest priority.

[NOTE: There are at present three sets of drawing priorities for S-100 development: 0-9, in the NIWC PC and the 2014 draft of S-101; 0-27 stepped by 3 in the (new) GI Registry; 0-99 stepped by 10 discussed during interoperability work and discussed at TSM5(?). The extra intermediate values are supposed to be used for refinements of layering when additional data products are added to the display. Is there general agreement to settle on 0-99? OEMs in particular are invited to comment.]

The drawing priority applies irrespective of whether a feature is a point, curve or surface. The following rules apply:

1. If two curve features, or two surface boundaries, or a curve and a surface boundary, are coincident, then the line symbolization with the higher drawing priority should suppress the line symbolization of the other feature (curve or surface). Therefore only the line symbolization of the feature (curve or surface) of the higher drawing priority is drawn.
2. Where two features share the same spatial edge and both have the same drawing priorities each line should be symbolized.
3. If the drawing priority is equal among features, curve features must be drawn over surface features whereas point features must be drawn over both.
4. If the drawing priority is still equal among features of the same type of geometry (curve, surface or point) the given sequence in the data structure of the SENC, or some other neutral criterion, must be used for a decision as to which feature is drawn on top.
5. The drawing of manual chart correction lines is an exception to the rule for suppressing overlapping lines. The manual chart correction lines (line styles LC(CHCRID01) and LC(CHCRDEL1)) should coexist with the underlying line. Both these manual chart correction line styles and the underlying line should be drawn.
6. Suppression only applies to curve features and surface boundaries. The rule for centred symbols, area patterns and point symbols is that all symbols should be drawn with the highest priority feature being drawn last independent of the geometric primitive (point, curve or surface).
7. Text must be drawn last (except for own ship etc.), in priority 80-89.
8. Overdrawing may be essential, for example in the case of a buoy, and its name and light flare. These are given offsets in the symbol library to avoid the symbols being drawn over one another.
9. Features of coverage spatial type (e.g., grids, point sets) and time series features are treated according to whether their portrayal is discrete or continuous. This can be discerned from the portrayal catalogue - continuous portrayals will not have symbol or numeric annotations (S-100 9-12.7)[[2]](#footnote-2).
   1. Features with discrete portrayals are treated as point features, while features whose portrayals are continuous are treated as surfaces.
   2. Portrayal by curves is not anticipated, but curves may be derived via system processing of coverage data (e.g., generating contours). Such “derived curve features” should be treated as curves. The portrayal catalogue must define appropriate linestyles.
   3. The boundaries of feature instances are not drawn unless encoded as separate features and symbolised with a linestyle in the portrayal catalogue.

Figure 1 below illustrates the application of rule (1). The coastline feature is symbolized with a solid line while the anchorage area is bordered with a dashed line. Both features share an edge that is part of the coastline. The symbolization of the coastline feature suppresses the border of the anchorage area since the drawing priority of the coastline symbolization is higher. (The nodes delimiting the shared curve are shown only for illustrative purposes.) Note that priorities have to be evaluated again, if the mariner’s selected viewing scale changes.

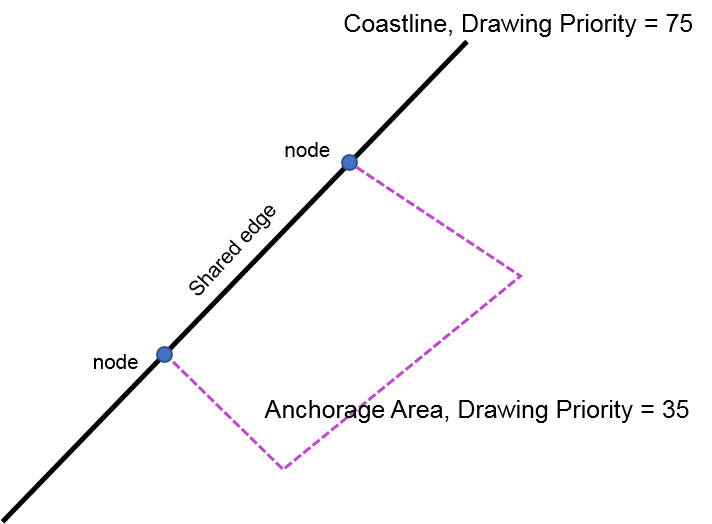


Figure 1 - Illustration of application of drawing priority (values from the new scale)

The following table gives an indication of how drawing priorities are allocated. Within each group priorities are adjusted to meet specific cases. *Italics* indicate S-100 data products other than ENC (only the “basic” and “other” products from C-7.1.1 and C-7.1.2 are included). The table below is indicative; definitive priorities are assigned in the portrayal catalogues.

| **Data Groupings**  (*italics* - data other than S-101) | **Drawing Priorities** (0-9 scale) | **Drawing Priorities** (0-27 scale - GI Registry) | **Drawing Priorities** (proposed) |
| --- | --- | --- | --- |
| no S-101 data filled area pattern | 0 | 0 | 0 |
| *Reserved* | -- | -- | 1-8 |
| S-101 Skin of the earth filled areas  *S-102 bathymetry coverages* | 1 | 3 | 10–19 |
| superimposed areas  *S-123 radio service areas*  *S-412 weather (non-hazardous)* | 2, 3 | 6, 9 | 20–39 |
| restricted area  *S-122 protected areas* | 5 | 15 | 50–59 |
| traffic areas  VTS areas  *S-129 go/no-go areas*  *S-127 traffic areas* | 6 | 18 | 60–69 |
| land features | 4, 5 | 12, 15 | 40–59 |
| water features  *S-111 surface currents coverages*  *S-104 water levels coverages*  *S-411 sea ice* | 3, 4, 5, 6 | 9, 12, 15, 18 | 30–69 |
| coastline features | 5, 6, 7 | 15, 18, 21 | 50–79 |
| routeing lines  *S-127 routeing lines* | 5, 6, 7 | 15, 18, 21 | 50–79 |
| symbols for lines and areas | 4, 5, 6 | 12, 15, 18 | 40–69 |
| hazards (bridge, safety contour)  *S-124 navigational warnings*  *S-102 safety contour*  *S-412 hazards and storms* | 8 | 24 | 80–89 |
| Aids to navigation | 8 | 24 | 80-89 |
| Text  *Operating times (schedules, etc.)* | 8 | 24 | 80–89 |
| Mariners VRM & EBL  *S-421(?)* | 9 | 27 | 90–98 |
| own ship | 9 | 27 | 99 |

Table 10 - Drawing priorities

NOTE: The rule of thumb for conversion between the new scale (z) and the 0-9 scale (x) and 0-27 scale (y) can be described by z ≈ 10x+5 ≈ 10y/3 + 5. The “no ENC data” and “own ship” categories are placed to the extreme ends of the new scale and a reserved range inserted for priorities 1-8.

## Viewing groups

The viewing group controls the content of the display. It provides an on/off switch in the portrayal catalogue for any drawing instruction assigned to the corresponding viewing group. A viewing group can be regarded as a filter on the list of drawing instructions.

Viewing groups are 'on' or 'off' switches for use by the Mariner to control the information appearing on the display, as required by IMO Performance Standards (MSC.232(82) App.2 section 3). An item in the viewing group table may be a chart feature; a Mariners' or other time-variable feature; a special symbol such as the "depth less than safety contour" pattern; or a non-ENC feature such as the shallow water pattern. Additional 'symbol viewing groups' have been added allow auxiliary symbols such as contour labels, the 'low accuracy' symbol, etc., to be switched on or off without affecting the primary symbolisation of the feature.

Viewing groups can be aggregated into Viewing Group Layers and Viewing Group Layer can be aggregated into Display Modes. Both aggregations are part of the portrayal catalogue

Items in the viewing group tables are arranged in numbered groups (for example, group 26230 consisting of the items pipeline area and cable area) which in turn are arranged in layers (for example, layer 26000 consisting of cautionary areas). The groups are arranged by IMO Category, in the sequence of INT 1; upper-case letters following group numbers correspond to symbolisation sections in INT 1.

Viewing groups from different IMO categories must not be combined under a single display selector.

### Viewing group layers

Table 11 shows the layers and numbering scheme for viewing groups. Groups for Mariner’s information are in *italics*.

The viewing groups in this table cover the “Basic” and “Other” products listed in clauses C-7.1.1 and C-7.1.2. Viewing groups for other S-100 products will be assigned later.

*[Note: How do viewing groups for S-100 products other than S-101 fit in this scheme? Alternatives: (1) Fit the other S-100 products into this numbering scheme. (2) Add another digit to the number (so it becomes 6 digits) and distribute the other products in the range 112000-199999, reserving ranges for information about the display, etc., similarly to the S-52 table. Provisionally, Alternative (1) has been adopted in the tables that follow.]*

| **DISPLAY BASE** | **STANDARD DISPLAY** | **OTHER INFORMATION** |
| --- | --- | --- |
| 00000–09999 reserved for administrative purposes | | |
| 10000 reserved  *40000 reserved* | 20000 reserved  *50000 reserved* | 30000 reserved  *60000 reserved* |
| 11000 A,B information about the chart display  *41000 tools* | 21000 A,B  51000 tools | 31000 A,B  *61000 tools* |
| 12000 C, D, E, F land features  *42000 own ship, planned route*  *S-421 planned route (Table 15)* | 22000 C, D, E, F  *52000 own ship etc.*  *S-421? track notations, past track (Table 16)* | 32000 C, D, E, F  *62000 own ship etc.* |
| 13000 H, I depths & currents  *43000 Mariners' features* | 23000 H,I  *53000 Mariners' features* | 33000 H,I  S-102 bathymetry  S-104 water levels  S-111 surface currents  *63000 Mariners' features* |
| 14000 J,K,L obstructions, pipelines  *44000 other vessels* | 24000 J,K,L  *54000 other vessels* | 34000 J,K,L  *64000 other vessels* |
| 15000 M traffic,routes  *45000 manufacturers' features* | 25000 M  *55000 manufacturers' features* | 35000 M  S-127 traffic routes  *65000 manufacturers’ features* |
| 16000 N special areas  *46000 Mariners' assignments* | 26000 N  *56000 Mariners' assignments* | 36000 N  S-122 protected areas  S-129 underkeel clearance areas  *66000 Mariners' assignments* |
| 17000 P,Q,R,S buoys, beacons, lights, radar  *47000 reserved for Mariners' information* | 27000 P,Q,R,S  *57000 reserved* | 37000 P,Q,R,S  *67000 reserved* |
| 18000 T,U services & small craft facilities  *48000 reserved for Mariners' information* | 28000 T,U  S-127 pilotage features  *58000 reserved* | 38000 T,U  S-123 radio services  *68000 reserved* |
| 19000–19999 reserved  *49000 49999 reserved* | 29000 29999 reserved  *59000 59999 reserved* | 39000 39999 reserved  *69000 69999 reserved* |
| 70000–70999 reserved  *71000–71999 reserved* | 72000–72999 reserved  *73000–73999 reserved* | 74000–74999 Weather and natural conditions[[3]](#footnote-3) (S‑412)  *75000–75999 reserved* |
| 76000–76999 reserved  *77000–77999 reserved* | 78000–78999 reserved  Navigational Warnings (S‑124)  *79000–79999 reserved* | 80000–80999 Navigational warnings (S‑124)  *81000–81999 reserved* |
| 82000–99999 reserved for future use | | |

Table 11 - Viewing group layers and numbering scheme

### Viewing groups for display base

The groupings in Table 12 list[[4]](#footnote-4) the contents of the Display Base. All features of this category should be permanently retained on the ECDIS display (subject to the application of interoperability when interoperability is activated). The definitive classifications can be found in the [documentation of portrayal catalogues? GI Registry?].

Features are S-101 features except where designated as being from other products.

| **Group** | **Contents** |
| --- | --- |
| RESERVED | |
| 10000-10999 | Reserved for chart information |
| A, B | CHART FURNITURE |
| *11000* | *Information about the Chart Display* |
| 11010 | cursor [symbol SY(CURSRA01)] |
| 11020 | na (not assigned) |
| 11030 | scalebar, latitude scale [SY(SCALEB10),SY( SCALEB11)] |
| 11040 | north arrow [SY(NORTHAR1)] |
| 11050 | no data [colour NODTA, AP(NODATA03)], unsurveyed (UNSARE), incompletely surveyed area |
| 11060 | Non-HO data boundary LC(NONHODAT) |
| C, D, E, F | TOPOGRAPHY AND INFRASTRUCTURE |
| 12000 | Land area |
| 12010 | land area (LANDARE) |
| 12200 | Dangers above water |
| 12210 | bridge (BRIDGE), pylon (PYLONS), overhead cable (CBLOHD), conveyor (CONVYR), overhead pipeline (PIPOHD), offshore platform (OFSPLF) |
| 12400 | Shoreline |
| 12410 | coastline (COALNE), ice shelf, glacier (ICEARE), shoreline construction (SLCONS), tie-up wall, dolphin (MORFAC), gate (GATCON, pile (PILPNT), crib, wellhead, ice boom (OBSTRN), floating dock (FLODOC), hulk (HULKES), pontoon (PONTON), oilboom (OILBAR), log boom (LOGPON), flood barrage (DAMCON, CATDAM=3) |
| 12420 | dock (DOCARE), lock (LOKBSN), canal (CANALS), river (RIVERS) |
| H, I | HYDROGRAPHY |
| 13000 | Safety Contour |
| 13010 | safety contour (from portrayal rule DEPCNT03) |
| 13020 | na |
| 13030 | depth area (DEPARE), dredged area (DRGARE), |
| J, K, L | SUBSEA FEATURES |
| 14000 | Dangers under water |
| 14010 | isolated underwater dangers in water deeper than the displayed safety contour (rocks, wrecks, obstructions, mooring cables from portrayal rule CableSubmarine) |
| M | TRACKS AND ROUTES |
| 15000-15999 | na (not assigned) |
| N | SPECIAL AREAS |
| 16000 16999 | na (not assigned) |
| P, Q, R, S | AIDS TO NAVIGATION |
| 17000-17999 | na (not assigned) |
| T, U | SERVICES |
| 18000 18999 | na (not assigned) |
| RESERVED |  |
| 19000-19999 | Reserved for chart information |

Table 12 - Viewing groups and their contents for Display Base (illustrative)

### Viewing groups for Standard Display

The groupings in Table 13 illustrate the contents of the Standard Display. Features are S-101 features except where designated as being from other products.

| **Group** | **Contents** |
| --- | --- |
| RESERVED |  |
| 20000 | Reserved for chart information |
| A, B | INFORMATION ABOUT THE CHART DISPLAY |
| 21000 | Information about the Chart Display |
| 21010 | Unknown feature (magenta question mark) (retained as failsafe) |
| 21020 | Generic Feature (NEWOBJ01) |
| 21030 | Chart scale boundary, overscale data [AP(OVERSCO1)] |
| 21040 | na |
| 21050 | na |
| 21060 | Place-holder for geographic names (LNDRGN, SEAARE) |
| C, D, E, F | NATURAL & MAN MADE FEATURES, PORT FEATURES |
| 22000 | Major Coastal Features |
| 22010 | Lake (LAKARE), sloping ground (SLOGRD), slope top (SLOTOP), dyke (DYKCON), causeway (CAUSWY), dam (DAMCON), |
| 22200 | Conspicuous landmarks: |
| 22210 | Radar conspicuous feature (any object with attribute CONRAD 1) |
| 22220 | Visually conspicuous feature (any object with attribute CONVIS 1) |
| 22230 | na |
| 22240 | Built up area (BUAARE) |
| H, I | DEPTHS, CURRENTS, etc. |
| 23000 | Depths |
| 23010 | Area of depth less than the safety contour (DIAMON01 pattern) |
| 23020 | na |
| 23030 | Swept area (SWPARE) |
| J, K, L | SEABED, OBSTRUCTIONS, PIPELINES |
| 24000 | Seabed dangers |
| 24010 | Mooring cables (MORFAC, CATMOR=6), (CBLSUB, CATCBL=6); tunnel on seabed (TUNNEL, BURDEP=0), sandwaves (SNDWAV) |
| M | TRAFFIC ROUTES |
| 25000 | Routes and Tracks |
| 25010 | Leading line, clearing line (NAVLNE), traffic lane (TSSLPT), deep water route (DWRTPT), traffic separation area (TSEZNE), traffic separation line (TSELNE), traffic roundabout (TSSRON), traffic crossing (TSSCRS), precautionary area (PRCARE), traffic separation scheme boundary (TSSBND), deep water route centre line (DWRTCL), two way route part (TWRTPT), inshore traffic zone (ISTZNE). |
| 25020 | Recommended track (RECTRC), recommended traffic lane (RCTLPT), recommended route centreline (RCRTCL) |
| 25030 | Ferry route (FERYRT) |
| 25040 | Radar line (RADLNE), limit of shore radar (RADRNG) |
| 25060 | Radio calling in point (RDOCAL) |
| N | SPECIAL AREAS |
| 26000 | Restricted and Cautionary Areas |
| 26010 | Restricted area (RESARE), both Navigational and Regulatory |
| 26020 | na |
| 26030 | na |
| 26040 | Submarine transit lane (SUBTLN), military practice area (MIPARE), sea plane landing area (SPLARE), offshore production area (OSPARE) |
| 26050 | Fairway (FAIRWY) |
| 26150 | Caution area (CTNARE) |
| 26200 | Information Areas. Protected Areas |
| 26210 | Fishing ground (FSHGRD), marine farm (MARCUL), Fishing Facility (FSHFAC) |
| 26220 | Anchorage area (ACHARE), anchor berth (ACHBRT) |
| 26230 | na |
| 26240 | Dumping ground (DMPGRD) |
| 26250 | Cargo transhipment (CTSARE), incineration (ICNARE) |
| 26260 | Archipelagic sea lane (ASLXIS, ARCSLN) |
| P, Q, R, S | BUOYS & BEACONS, LIGHTS, FOG SIGNALS, RADAR |
| 27000 | Buoys, Beacons, Topmarks, Lights, Fog Signals, AIS AtoNs |
| 27010 | Buoy (BOYxxx), light float (LITFLT), mooring buoy (MORFAC, CATMOR=7) |
| 27011 | Light vessel (LITVES) |
| 27020 | Beacon (BCNxxx) |
| 27025 | Daymark (DAYMAR) |
| 27030 | Distance mark (DISMAR) |
| 27040 | Direction of buoyage IALA buoyage regions (M\_NSYS) |
| 27050 | topmarks (TOPMAR) for paper chart symbols |
| 27060 | gridiron (GRIDRN) |
| 27070 | light (LIGHTS) |
| 27080 | fog signal (FOGSIG), retro-reflector (RETRFL) |
| 27200 | Radar |
| 27210 | racon (RTPBCN) |
| 27220 | na |
| 27230 | radar reflector (RADRFL) |
| 27240 | Physical and Virtual AIS Aids to Navigation |
| T, U | SERVICES & SMALL CRAFT FACILITIES |
| 28000 | Services |
| 28010 | pilot boarding place (PILBOP); Pilotage district |
| 28020 | signal station, traffic (SISTAT), signal station, warning (SISTAW) |
| 28030 | Vessel traffic service area |
| 28040 | S-127 pilotage features |
|  | NAVIGATIONAL WARNINGS |
| 78100 | Navigational warnings types [A, B, C] |
| 78110 | Navigational warnings types [D, E, F] |
| RESERVED |  |
| 29000 | reserved for chart information |

Table 13 - Viewing groups and their contents for Standard Display

### Viewing groups for other chart information

The groupings in Table 14 illustrate viewing group usage for other information. Features are S-101 features except where designated as being from other products.

| **Group** | **Contents** |
| --- | --- |
| RESERVED |  |
| 30000 | reserved for chart information |
| A, B | INFORMATION ABOUT THE CHART DISPLAY |
| 31000 | Information about the Chart Display |
| 31010 | Quality of Non-bathymetric data (M\_ACCY), Quality of survey (M\_SREL), Quality of Bathymetric Data (M\_QUAL) for ENC data |
| 31011 | symbol LOWACC01, identifying low accuracy data, applied to the spatial feature of point and area wrecks, rocks and obstructions and to point land areas |
| 31012 | Quality of Non-bathymetric data (M\_ACCY), Quality of survey (M\_SREL), Quality of Bathymetric Data (M\_QUAL) for non-ENC data |
| 31020 | Reserved (retained for backward compatibility in dual-fuel displays - was M\_NPUB in S-52) |
| 31021-31029 | Reserved for supplementary information in products other than S-101 |
| 31030 | Supplementary Information - S-101 feature InformationArea; NauticalInformation instances associated to S-101 features. |
| 31031 | Reserved for Additional Documents (referenced by fileReference attributes). |
| 31040 | DataCoverage |
| 31050 | na |
| 31060 | na |
| 31070 | na |
| 31080 | magnetic variation (MAGVAR), local magnetic anomaly (LOCMAG) |
| 31090 | UpdateInformation features |
| C, D, E, F | NATURAL & MAN MADE FEATURES, PORT FEATURES |
| 32000 | Natural Features |
| 32010 | dunes , hills (SLOGRD), ridge, clifftop (SLOTOP), contours and elevation (LNDELV) |
| 32020 | na |
| 32030 | trees , vegetation, mangrove (VEGATN), marsh (LNDRGN) |
| 32040 | na |
| 32050 | river (RIVERS) or lake (LAKARE); also rapids (RAPIDS), waterfall (WATFAL) |
| 32060 | Na |
| 32070 | tideway (TIDWAY) |
| 32080 | na |
| 32200 | Shore Structures |
| 32210 | na |
| 32220 | any of the following not classified as CONVIS=1 (conspicuous): landmark (LNDMRK), building (BUISGL), tank, silo, water tower (SILTNK), wall (FNCLNE), fort (FORSTC) |
| 32230 | na |
| 32240 | airport (AIRARE), runway (RUNWAY) |
| 32250 | railway (RAILWY), road (ROADWY), tunnel (TUNNEL), control point (CTRPNT) |
| 32260 | na |
| 32270 | quarry, refinery, power station, tank farm, wind farm, factory, timber yard (PRDARE) |
| 32280 | na |
| 32400 | Port Features |
| 32410 | harbour type (HRBFAC), customs check point (CHKPNT) [note: "small craft facilities" (SMCFAC) is in group 38210] |
| 32420 | na |
| 32430 | na |
| 32440 | berth number (BERTHS), mooring facility (such as bollard) (MORFAC), , gate (such as lock gate) (GATCON) , dry dock (DRYDOC), crane (CRANES) |
| 32450 | na |
| 32460 | na |
| H, I | DEPTHS, CURRENTS ETC |
| 33000 | Depths, Currents, Tide rips, etc |
| 33010 | Soundings (SOUNDG) |
| 33020 | depth contours (DEPCNT) other than the safety contour |
| 33021 | label for the safety contour |
| 33022 | label for contours other than the safety contour |
| 33030 | na |
| 33040 | water turbulence (WATTUR) |
| 33050 | reserved (retained for backward compatibility in dual-fuel displays) |
| 33060 | current and tidal stream information (CURENT, TS\_FEB, TS\_PAD) |
| 33100 | S-102 Bathymetry features |
| 33200 | S-104 Water level features |
| 33300 | S-111 Surface currents features |
| J, K, L | SEABED, OBSTRUCTIONS, PIPELINES |
| 34000 | Seabed Information: rocks, wrecks & obstructions, pipes & cables |
| 34010 | nature of seabed (SBDARE) |
| 34020 | spring (SPRING), sea weed (WEDKLP) |
| 34030 | Pipeline area (PIPARE), cable area (CBLARE) |
| 34040 | na |
| 34050 | rocks (UWTROC), wrecks (WRECKS), obstructions (OBSTRN), which are not a danger to own ship's navigation (these are all Display Base if a danger to own ship) |
| 34051 | non-dangerous rocks (UWTROC), wrecks (WRECKS) and obstructions (OBSTRN) which have a VALSOU attribute and are not a danger to own-ship’s navigation (these features are all Display Base if a danger to own-ship) |
| 34060 | na |
| 34070 | submarine cable (CBLSUB), submarine pipeline (PIPSOL) |
| M | TRAFFIC ROUTES |
| 35000 | Routes |
| 35010 | na |
| 35100 | S-127 Marine Traffic Management traffic routes & associated features |
| N | SPECIAL AREAS |
| 36000 | Administrative Areas, (by cursor enquiry) |
| 36010 | continental shelf (COSARE), |
| 36020 | harbour area (HRBARE) free port area (FRPARE), customs zone (CUSZNE) |
| 36030 | na |
| 36040 | fishery zone (FSHZNE) |
| 36050 | contiguous zone (CONZNE), exclusive economic zone (EXEZNE), national territorial area (NATARE), territorial sea (TESARE), territorial sea baseline (STSLNE), administration area (ADMARE) |
| 36100 | S-122 Marine Protected Areas features |
| 36200 | S-129 Underkeel Clearance features |
| P, Q, R, S | BUOYS & BEACONS, LIGHTS, FOG SIGNALS, RADAR |
| 37000-37999 | na |
| T, U | SERVICES & SMALL CRAFT FACILITIES |
| 38000 | Services |
| 38010 | radar station (RADSTA), radio station (RDOSTA) |
| 38020 | na |
| 38030 | coastguard station (CGUSTA), rescue station (RSCSTA) |
| 38200 | Small craft facilities |
| 38210 | small craft facilities (SMCFAC) |
| 38300 | S-123 Marine Radio Services features |
|  | WEATHER AND NATURAL CONDITIONS |
| 74100 | Weather hazards (S-412) |
| 74110 | Wave hazards (S-412) |
|  | NAVIGATIONAL WARNINGS |
| 80100 | Navigational warnings types [X, Y, Z] (S-124) |
| 80110 | Navigational warnings types [P, Q, R] (S-124) |
| 80200 | Navigational warnings (other) (S-124) |
| RESERVED |  |
| 39000 | reserved for chart information |

Table 14 - Viewing groups and their contents for other information

### Viewing groups for mariner’s and manufacturer’s information

Table 15–Table 18 illustrate the contents of viewing groups for mariner’s and manufacturer’s information. The “features” for these groups are not defined in the S-101 feature catalogue.

|  |  |
| --- | --- |
| **Groups** | **Contents** |
| RESERVED |  |
| 40000 | Reserved for Mariners’ information |
| TOOLS | |
| 41000-41999 | na |
| OWN SHIP, PLANNED ROUTES, PAST TRACKS | |
| 42000 | Own ship |
| 42010 | Own ship (ownship), symbol or scaled version, together with heading line, beam bearing line and course and speed vector |
| 42200 | Selected Planned Route |
| 42210 | legline (leglin, select 1), way points (waypnt, select 1) |
| 42220 | Course to make good for selected leglines |
| MARINERS' FEATURES | |
| 43000 | na |
| OTHER VESSELS | |
| 44000 | na |
| MANUFACTURERS' FEATURES | |
| 45000-45999 | Manufacturers’ Features |
| MARINERS' ASSIGNMENTS TO DISPLAY BASE | |
| 46000 46999 | Mariners' and manufacturers' features assigned to Display Base by the Mariner |
| RESERVED | |
| 47000-49999 | reserved for Mariners’ information |

Table 15 - Viewing groups and their contents for mariners' information - Display Base

|  |  |
| --- | --- |
| **Groups** | **Contents** |
| RESERVED | |
| 50000 | reserved for Mariners’ information |
| TOOLS | |
| 51000-51999 | na |
| OWN SHIP, PLANNED ROUTES, PAST TRACKS | |
| 52000 | Notations on Selected Planned Route |
| 52010 | wheel over line (wholin), selected route |
| 52020 | course to make good on leglines (leglin, select 1) of selected route |
| 52030 | planned position (pinpos), distance to go, and other notations on selected planned route |
| 52200 | Alternate Planned Route |
| 52210 | leglin (leglin, select 2), waypoint (waypnt, select 2) of alternate planned route |
| 52220 | na |
| 52230 | wheel over line (wholin), alternate route |
| 52240 | other notations, alternate route |
| 52400 | Past Track |
| 52410 | event (events) |
| 52420 | na |
| 52430 | primary past track (pastrk, catpst 1) |
| 52440 | notations on primary past track |
| 52450 | na |
| 52460 | secondary past track (pastrk catpst 2) |
| MARINERS' FEATURES | |
| 53000 | Mariners' features |
| 53010 | danger highlight (dnghlt) |
| 53030 | Mariners' information note (marnot catnot 1) |
| 53040 | Mariners' cautionary note (marnot catnot 2) |
| 53050 | Mariners' feature (marfea) |
| 53060 | na |
| 53070 | na |
| 53080 | tidal current observed (tidcur, catcur 2), tidal current predicted (tidcur, catcur 1) |
| OTHER VESSELS | |
| 54000 | Other Ships |
| 54010 | other ships (vessels) from radar |
| 54020 | notations on other ships (acqsta) |
| 54030 | other ships from other sources or undefined sources |

Table 16 - Viewing groups and their contents for mariners' information - Standard Display

|  |  |
| --- | --- |
| **Groups** | **Contents** |
| MANUFACTURERS' FEATURES | |
| 55000 | Manufacturers’ Features |
| 55010 | manufacturers' feature (mnufea, catnot 1) |
| 55020 | manufacturers' feature (mnufea, catnot 2) |
| MARINERS' ASSIGNMENTS TO STANDARD DISPLAY | |
| 56000-56999 | Mariners' and manufacturers' Features Assigned to Standard Display by the Mariner |
| RESERVED | |
| 57000-59999 | reserved for Mariners’ information |

Table 17 - Viewing groups and their contents for manufacturers' information - Standard Display

|  |  |
| --- | --- |
| **Groups** | **Contents** |
| RESERVED | |
| 60000 | reserved for Mariners’ information |
| TOOLS | |
| 61000 | Tools |
| 61010 | electronic bearing line (ebline), variable range marker (vrmark) |
| 61020 | na |
| 61030 | range rings (rngrng) |
| 61040 | cursor, style B (cursor, cursty2) |
| 61050 | cursor reference point (refpnt) |
| OWN SHIP, PLANNED ROUTES, PAST TRACKS | |
| 62000 | Position fixes |
| 62010 | position fix (positn) |
| 62020 | position line (poslin) |
| MARINERS' FEATURES | |
| 63000-63999 | na |
| OTHER VESSELS | |
| 64000-64999 | na |
| MANUFACTURERS' FEATURES | |
| 65000-65999 | Manufacturers’ Features |
| MARINERS' ASSIGNMENTS TO OTHER INFORMATION | |
| 66000 66999 | Mariners' and manufacturers' features assigned to other information by the Mariner |
| RESERVED | |
| 67000-69999 | reserved for Mariners’ information |

Table 18 - Viewing groups and their contents for mariners’ and manufacturers’ information - Other Information display category

### ECDIS viewing group implementation

For standardization of the ECDIS Human Machine Interface (HMI) and to facilitate generic training of Mariners as a minimum the following viewing group layers should be implemented to control display of charted features. An ECDIS may provide more display on/off controls than are available in this table, but OEM should use the viewing group layer names contained in this table. The viewing group names are derived from the IMO Performance Standards.

| **Viewing Group Layer** | **Name of viewing group layer in the ECDIS** | **Viewing groups included** |
| --- | --- | --- |
| 1 | Display Base | 10000–19999 |
| Standard Display | | |
| 2 | Drying line | 22010 |
| 3 | Buoys, beacons, aids to navigation | 21020, 22200–22240, 27000, 27010, 27011, 27020, 27025, 27040, 27050, 27070, 27080, 27200, 27210, 27230, 27240, 27030, 27060 |
| 3.1 | Buoys, beacons, structures | 21010, 21020, 22200–22240, 27000–27050, 27080, 27200–27230, 27030, 27060, 27240 |
| 3.2 | Lights | 27070 |
| 4 | Boundaries and limits | 23030, 26050, 26220, 26240, 26250 |
| 5 | Prohibited and restricted areas | 26000, 26010, 26040 |
| 6 | Chart scale boundaries | 21030 |
| 7 | Cautionary notes | 26150 |
| 8 | Ships’ routeing systems and ferry routes | 25010–25060 |
| 9 | Archipelagic sea lanes | 26260 |
| 10 | Miscellaneous | Switches on and off features in viewing groups 20000–29999 (other than the groups listed in layers 2–9 above) and features in mariners’ information viewing groups 50000–56999 |
| 10.1 | Mariners (Standard) | Switches on and off the mariners’ Standard Display information included in layer 10. |
| Other | | |
| 11 | Spot soundings | 33010 |
| 12 | Submarine cables and pipelines | 34030, 34070 |
| 13 | All isolated dangers | 34050, 34051 |
| 14 | Magnetic variation | 31080 |
| 15 | Depth contours | 33020 |
| 16 | Seabed | 34010, 34020, 33040 |
| 17 | Tidal | 33050, 33060 |
| 18 | Miscellaneous | Switches on and off features in viewing groups 30000–39999 (other than the groups listed in layers 11–17 above) and independent mariner selections (mariners’ tools) other than those listed in Table 20 (Mandatory and optional display functions). |
| 18.1 | Mariners (Other) | Switches on and off the mariners’ tools included in layer 18 |

Table 19 - Recommended set of viewing groups for ECDIS

For text groups see clause C-13.2.

## Mariners’ features

Mariners’ navigational features (C-10.1.2) are assigned to a “Mariners” category.

The display of Mariners’ features is independent of the ECDIS display category (Display Base, Standard and All Other).

## Display modes

The portrayal catalogue assigns every feature a display mode that is based on the IMO Display Categories (see IMO MSC.232(82) and clause C-10.3.1).

## Displaying ECDIS updates

The strategy for displaying ECDIS updates is derived from the IMO Performance Standard Circ.232(82). The citations below are to sections in that standard.

MSC.232(82) 4.5 Automatic and semi-automatic updates: these should be displayed in the same manner as ENC information, using standard colours and symbols.

MSC.232(82) 4.6 Manual updates: these should be displayed in standard colours and symbols and distinguished as described in the portrayal catalogue.

MSC.232(82) 4.8 The mariner should be able to display updates for review as described in C-10.8.1 and C-10.8.2.

### Automatic updates

The manufacturer must provide a means of distinguishing automatic updates. The S-101 feature catalogue provides encoders with an **UpdateInformation** feature that is used to represent a change to the information shown.

EXAMPLE: The ENC update contains updates to various features that adjoined the feature that was actually updated. In this case, the producer will use an **UpdateInformation** feature to indicate the actual feature that was affected and a brief description of the changes.

### Manual updates

The manual updates should be distinguishable from official information and its official updates.

## Display functions

Display functions are described in IMO MSC.232(82), MSC.252(83), MSC.1609, and clause C-9.3 of this document. Each of these functions has a display mode assigned but should only be shown in that display mode if the Mariner has decided to select this option. Listed below are the Mariner selectors that should be available in ECDIS, the name of the selector in the ECDIS GUI and a functional description in terms of S-101 information and viewing groups. The table is not a complete set of ECDIS user functions; there are a number of other Mariner selectors that can be included in ECDIS, listed in the cited IMO documents.

This table adds a user function for displaying information from additional products to the IMO list.

Context parameters associated with functions listed in Table 20 are given in clause C-19.1. Manufacturers may use other means of conveying settings for ECDIS functions to portrayal processing, but should note that some of the context parameters are used by the official IHO S-101 portrayal catalogue.

All ECDIS-capable products (i.e., S-100 compliance category 4) are expected to map the user functions/selectors to viewing groups, layers, and context parameters in their respective portrayal catalogues. The ECDIS user interface should combine the effects for all on-screen products, modifying the combination process as guided by the Scope column or equivalent settings.

EXAMPLE 1: Function applicable to all on-screen products: The display should switch to the same national language for all on-screen products when the National Language function is activated by the mariner.

EXAMPLE 2: Function applicable to S-101 only: The “Accuracy” selector displays accuracy symbols from only S-101 datasets. Accuracy from other S-100 data products is not displayed. This is the default action for this user function, manufacturers may allow switching to displaying accuracy for other data products by further or separate user action.

EXAMPLE 3: Function applicable to S-101 only, because no other product qualifies: The “Full light lines” selector displays full light sector lines for lights encoded in S-101. (There is no question of it applying to any other product, because S-101 is the only product that contains the relevant light features.)

| **Clause** | **ECDIS Implementation** | **Name of Selector in ECDIS** | **Function Description** | **Remarks** |
| --- | --- | --- | --- | --- |
| C-10.5.4 | Mandatory | Accuracy | Independent pattern selection of data quality (Quality of Bathymetric Data), viewing group 31010. Symbol LOWACC01, viewing group 31011 | According to MSC.1609 “Accuracy” is the function “To show accuracy related symbols”. |
| C-14.7 | Mandatory | Date dependent | Date Dependent Features – to turn on and off the display of temporal features by viewing a date range. |  |
| C-14.5.5 | Mandatory | Full light lines | Full Light Sector Lines | See Note 1 |
| C-14.7.2 | Mandatory | Highlight date dependent | Indication of date dependent features – to turn on and off the display of symbol CHDATD01 |  |
| C-10.5.4  C-14.10.1 | Mandatory | Highlight info | Additional Information - viewing group 31030 | See Notes 2 & 4 |
| C-10.5.4  C-14.10.1 | Mandatory | Highlight document | Additional Information - viewing group 31030 / 31031. | See Notes 2 & 4 |
| C-10.5.4  C-14.10.1 | Mandatory | Highlight overlay info | Additional information in products other than ENC - viewing group 31020-31029 |  |
| C-10.5.3  C-11.1  C-14.6.2 | Mandatory | Unknown | Unknown Features - to turn on the display of features in S-101 datasets which are not specified in the S-101 standard – viewing group 21010 |  |
| C-14.11 | Mandatory | Update review | Review of Updates – This function turns on colour highlighting for the S-101 **UpdateInformation** feature which have undergone modification in the process of the latest accepted correction. |  |
| C-14.8 | Mandatory | Scale min | Turn SCAMIN Off |  |
| C-14.9.5 | Mandatory | Shallow pattern | Shallow Water Pattern |  |
| C-14.5.4 | Mandatory | Shallow water dangers | Isolated Dangers in Shallow Water – to turn on the display of isolated danger features which are located in the unsafe waters - viewing group 24050 |  |
| C-10.5.4 | Optional | Contour label | Contour Labels – to turn on the display of contour labels (incl. label of safety contour) – viewing group 33021, 33022 | See Note 3 |
| C-14.5.2 | Optional | Four shades | Four Colour Depth Shades |  |
| C-14.10.2 | Optional | National language | National Language, text group 31 |  |
| C-19 | Mandatory | Paper chart / simplified symbols | Selection of Point symbol style | Context parameter |
| C-19.1 | Mandatory | Plain / Symbolized boundaries | Selection of Line symbol style | Context parameter |
| C-15.8.1 | Optional | Animation | Toggle animations | See Note 5 |

Table 20 - Mandatory and optional display functions

NOTES:

1. Assumes that S-101 or the equivalent is the only data product containing the relevant features. If in the future another product containing relevant features is introduced, this guidance may need to be revised to restrict the scope.
2. Other data products also have these attributes and features, but since turning that on may unduly overload the display, this selector is restricted to S-101.
3. S-102 contours are displayed only if a contour generated from S-102 data is available and S-102 is activated on the display.
4. “Highlight document” and “Highlight info” produce the same result because S-101 1.0.0 binds the attribute *information* only to information types, and the information types can have the information in either a *text* sub-attribute or an external file named by a *fileReference* attribute. Additional information for features is provided via an information association to **NauticalInformation**, which binds the attribute *information*. Distinguishing “highlight document” and “highlight info” would therefore involve a multi-level query. Manufacturers may implement such a query if desired; if implemented, viewing group 31031 must be used for “Highlight document”.
5. Animations will display only for products which have timelined data on the system, and should not be displayed in route monitoring mode.

# General Rules for Symbols and Text

## Symbol Specifications

All symbols are specified in the Portrayal Catalogue for the respective Product Specifications and are in the Scalable Vector Graphics (SVG) format.

Some feature classes do not have a symbol (For example, territorial sea). Such "no symbol" objects may be picked up by cursor interrogation of the area.

Should an "unknown feature" occur in the SENC which is not adequately defined or for which no symbol exists, its presence should be indicated on the display by a magenta "?" SY(QUESMRK1) with the IMO category "Standard Display".

Some features are symbolised differently depending on circumstances (for example the symbol for a contour depends on whether it is the safety contour).

## Guidelines for reproduction of lines, symbols and text

### Introduction (informative)

In a navigation system the viewing distance will be about 70 cm for route planning, but experience to date indicates that the viewing distance for important features during route monitoring may be several metres.

Human factors experts quote a minimum requirement that symbols and characters subtend 20 arc minutes at the observer’s eye. (For example, a symbol viewed from 70 cm for route planning should be about 4mm in size, 1.5 times the size of a normal chart symbol. Two times chart size is a good general rule.) Symbols and characters important for route monitoring may have to be significantly bigger.

For clear representation, symbols require a minimum number of screen units (pixels), depending on their complexity. A simple chart symbol of height 4mm should extend at least 13 pixels for a screen that just meets the current minimum standards for chart display size and resolution (clause C-22.1).

Symbol specifications in portrayal catalogues are designed for a display of the minimum physical requirements in clause C-22.1 and a nominal viewing distance of 1 metre(?). This assumption should be verified for each portrayal catalogue, and symbols scaled appropriately if necessary.

### Guidelines for size and resolution

Lines, symbols and text should be large enough that they can be easily interpreted at the operational viewing distance. Also, for clear representation, symbols require a minimum number of screen units (pixels), depending on their complexity. The ensuing requirements for size in absolute and pixel terms are described in this clause.

The minimum sizes for all symbols should be as shown in the portrayal catalogue.

Enough "picture units" (pixels) must be used to draw small features and symbols clearly and allow viewers to distinguish similar symbols. Symbols should therefore always be drawn with at least the same number of pixels as are required to draw the symbol at the size defined in the Portrayal Catalogue for the minimum resolution and minimum chart display area.

NOTE (informative): This requirement means the minimum height in pixels of a symbol is: (symbol height in mm) divided by the "pixel size" for the minimum size chart display (see clause C-22.1).

The text on the ECDIS should be readable from 1 metre[[5]](#footnote-5),[[6]](#footnote-6). Pending reconciliation of the two rules of thumb cited in S-52, this Annex adopts the IEC 60945 recommendation of a minimum character height of 3.5mm for a 1-metre viewing distance.

Since viewing conditions and anticipated viewing distances may vary between installations, manufacturers should provide for configuring ECDIS software for viewing distances on different bridges. Operating conditions (e.g., low illumination, bright daylight, etc.) may also need to be considered.

The CHKSYM01 symbol may be used for comparison; this symbol should measure 5mm×5mm when displayed at its nominal size (i.e., scaled to 100%), within the tolerance specified by the IEC testing standard (recommended tolerance: 1 physical pixel width in each of the X and Y dimensions).

Since the CHKSYM01 symbol is quite small for the purpose of on-site system configuration by ordinary users, manufacturers may use an enlarged version or an equivalent method for that purpose.

### Fonts

Sans serif, non-italic fonts should be used. The font should be plain and clearly readable. The computer 0 (‘slashed zero’) should not be used.

Because several appropriate commercial fonts are available, this document does not prescribe a specific font (except for soundings, for which the digits are specified as symbols in the portrayal catalogue). Manufacturers should make their own arrangements for the use of a font.

### Zooming

When the display scale is enlarged by zooming in, it should be possible to hold symbol size constant. The same applies to text. Symbol and text size should never be decreased when zooming out

## Mariner's options in symbols and linestyles

At large scale, it may be difficult to identify the area or see on which side of the boundary the area lies. The S-101 portrayal catalogue therefore provides, as a mariner's option, symbolised area boundary linestyles for use on large scale displays. These make the areas easier to figure out than the plain linestyles recommended for small scale displays, where symbolised lines would cause clutter. Two options are provided within the portrayal catalogue, to display either symbolised or plain area boundary linestyles.

The mariner should be given the option of selecting the buoy symbols and area boundary linestyles (plain or symbolised) that best fit the situation, without linkages. For example, boundary linestyle should be selectable independent of the choice of buoy symbol, and independent of the actual display scale.

## Display orientation

It should always be possible to display the chart north-up (IMO PS section 8.1), but other orientations are allowed.

Symbols and text should always be drawn screen-up, no matter what the orientation of the screen may be. Symbols which include “rotate” in the symbology instruction (For example, light flares) should be rotated with respect to the top of the screen. However symbols that are oriented according to an S-101 attribute such as ORIENT should be oriented with respect to true north.

If the display is oriented course-up, the orientation should not be altered too frequently, in order to avoid jitter from frequent rewriting of chart information.

The north arrow is always required on the display, as part of the IMO Performance Standards Display Base.

## Common text information attributes

Several product specifications use similar structures for feature names and information attributes. The following guidelines should be used when this document mentions displaying the “feature name” or “information” attributes.

### Feature names

Attribute “feature name” (*featureName*) is a complex attribute consisting of the mandatory sub-attribute “name” (the actual name of the feature) and sub-attributes “language” and “display name”. The sub-attribute “display name” is a boolean indicating which one of multiple instances (in the same feature) of the complex attribute *featureName* should be displayed. Only one instance of *featureName* attribute of a feature can have *displayName*=TRUE. Selecting which the *featureName* attribute should take into account the value of *displayName*, if present; if not, and if the NationalLanguage context parameter (clause C-19) is not set, the default name to display is one whose *language* attribute is coded as English (i.e., the ISO 639-2 alpha-3 code “eng”).

### Generic attribute “information”

Attribute “*information*” is a complex attribute consisting of the following sub-attributes:

* *fileLocator*: indicator for location of text within the file named by *fileReference*
* *fileReference*: name of text file
* *headline*: heading relevant to the content in co-attribute “text” or the file named by *fileReference* (specifically, the section indicated by *fileLocator*, if used). The length of “headline” will generally be much shorter than “text”.
* *language*: The language of the text or referenced file.
* *text*: A text string providing the information content.

At least one of “*fileReference*” or “*text*” must be populated (usually only one of the two).

If *headline* is populated, it can be used as needed by the manufacturer, for example as a short title in a collapsible sidebar, collapsible menu item, etc., or as a paragraph heading for the longer content in attribute text or the content of the file named by *fileReference*.

## Queries

ECDIS must be capable of performing spatial queries on ENC and other data during import and symbolisation. Spatial query is understood as possibility to inspect graphical position and numerical value of spatial coordinates associated with a charted feature. Spatial query could be available by means of cursor pick or as an independent function.

# Symbolising Vector Features - Areas, Curves, and Points

This clause describes the principles for symbolising features with area, curve, or point geometry.

## Areas

Areas can be identified both by filling or symbolising the area itself (displaying symbols in the interior) and by symbolising its boundary.

### Area fills

When areas are filled with a colour or a pattern the borders must be included in the fill as well. This generates an image without gaps between neighbouring areas. It is also important for a perfect fit of adjacent cells. If the borders of the area are to be distinguished from the area's fill, the borders have to be redrawn on top of the fill.

### Interior symbolisation

Interior symbolisation of area features may be by means of a centred symbol or a pattern created by repeating a symbol over the interior. The portrayal catalogue provides large transparent symbols for centred symbols and small symbols for pattern coverage. The following principles should be used for symbolisation of the interior of the area:

* Centred symbols are used where it is important to avoid clutter, particularly in traffic lanes. The symbol must be placed within the area.
* For a pattern of small symbols, the spacing between the symbols lies within the limits:

minimum distance apart: 2 cm.

maximum distance apart: 10 cm.

* It would be ideal to space the symbols further apart for a large area and closer together for a smaller area. However reliable symbolising is more important, and a constant fixed-space symbol pattern should be used.
* Pattern symbols need not line up exactly between datasets; and they need not stay in the same geographic position on re-draw.
* It should always be possible to identify an area by cursor picking on any point within the area.
* If the ECDIS offers a ship-centred display mode, the manufacturer should avoid overwriting between the ship symbol and a centred symbol for an area which wholly encloses the display (for example the traffic direction arrow (TSSLPT) in a very large traffic lane such as Dover Strait).

### Symbolising the area boundary

At large scales, area features may be clipped by the edges of the chart window, so that the entire area is not within the visible graphic and it becomes difficult for the mariner to discern on which side of a simple boundary the area lies. On the other hand, at small scales, complex area boundaries may add to screen clutter. To help clarify this situation, the portrayal catalogue includes two area rules for areas: (i) the "symbolised area boundaries" rules, using symbolised and "one-sided" versions of the boundary lines of important areas; this is for use at large scale as a mariner-optional alternative to (ii) the "plain area boundaries" rules, which use simple linestyle area boundaries; this will normally be preferred at smaller scales to avoid clutter.

Centred area symbols must also be used with symbolized boundaries to symbolize the case when the entire display window lies within an area.

The mariner must be given the option to select use of either plain or symbolized boundaries.

#### Complex linestyles

Complex linestyles are used to identify the area by means of symbols (or letters acting as symbols) which are embedded in the line, for example:

anchoring prohibited or restricted - LC(ACHRES51)

deep water route - LC(DWRUTE51)

#### One-sided complex linestyles

To identify the side of the boundary line on which the area lies, restricted areas use the traditional "T" linestyle of the paper chart, for example:

entry prohibited or restricted - LC(ENTRES51).

Other important areas use a boundary linestyle like the cold front on a weather map, for example:

waiting area - LC(CTYARE51)

fairway - LC(NAVARE51)

#### Simple linestyles

Dashed lines are generally used for area boundaries. In ECDIS, the dotted line is reserved for the danger line around foul areas, etc.

### Area colours

The colour magenta is used for important areas, grey for less important areas, for example:

traffic areas, caution areas – magenta (CHMGD)

harbour limits – grey (CHCRF)

## Curves

Curves that are not boundaries of area features may represent curve features, contours, or mariner tools. Curve features are generally represented by complex linestyles, combining a solid or dashed line with a symbol indicating the type of feature. Contours may have a numeric value embedded in the line at intervals.

## Points

Points are symbolised by drawing a symbol at the specified location. Text labels may be drawn at locations relative to the point by the portrayal rule using text derived from one or more feature attributes, or exceptionally at a location indicated by a **TextPlacement** cartographic feature associated to the point feature.

# Text and Graphics

## Text as part of the display

Text information should be used on the route monitoring display only when unavoidable, since it has to be written large to be readable and so causes clutter.

The complex attribute *featureName* has a Boolean sub-attribute *displayName*. When the ENC data is encoded with a *displayName* as TRUE then it is intended for that instance of *featureName* to be displayed on the ECDIS. This is intended to declutter much of the text display on an ECDIS. The other alternative *featureName*s must be able to be queried by the pick report.

Soundings are treated by the portrayal catalogue as symbols to ensure they are legible and correctly located.

In addition the following guidance should be used for text:

1. Text is normally coloured black, to give best readability under all light conditions.
2. Text should only be displayed when the feature it applies to is displayed.
3. Text should always have drawing priority 80-89, to ensure it is readable, independent of the feature it applies to.
4. The manufacturer should provide the capability to select “Important Text” and “Other Text”, and they may also provide further text groupings if they so wish.

The display of text must be controlled independently of the display of the feature it applies to and the Mariner must have full control over the display of text. All text is in the IMO Category “Other Information”.

## Text Groupings

Viewing groups for text are listed in Table 21.

NOTE: This table is useful information for implementations and should be available to implementors for completeness. It should also be kept updated with information pertaining to other product specifications. It is provided as part of this edition because there is at present no apparent provision for publishing it as a “living document”. Future editions may replace it by a reference to a “living document” in the IHO GI Registry or the IHO Web site. An alternative solution is to make it an S-101 appendix, but the same will have to be done for all product specifications which can be displayed on ECDIS.

| **Text Group Number** | **Text Group Description** | **S-101 Features and Attributes**  (attributes in lower case; indentation indicates attribute or sub-attribute) |
| --- | --- | --- |
| 00-10 | reserved for future assignment by IHO. |  |
| **IMPORTANTText** | | |
| 10 |  |  |
| 11 | Vertical Clearance of Fixed Spans | Span Fixed  vertical clearance fixed  vertical clearance value |
| Vertical Clearance of Open Spans | Span Opening  vertical clearance closed  vertical clearance value  vertical clearance open  vertical clearance value |
| Vertical Clearance of Overhead Cable | Cable Overhead  vertical clearance fixed  vertical clearance value  vertical clearance safe  vertical clearance value |
| Vertical Clearance of Overhead Pipeline | Pipeline Overhead  vertical clearance fixed  vertical clearance value |
| Vertical Clearance of Conveyor | Conveyer  vertical clearance fixed  vertical clearance value |
| Vertical Clearance of structures over navigable water | Building (with *in the water* = TRUE)  vertical clearance fixed  vertical clearance value |
| Wind Turbine (with *in the water* = TRUE)  vertical clearance fixed  vertical clearance value |
| Crane (with *in the water* = TRUE)  vertical clearance fixed  vertical clearance value |
| Bearing of Navline | Navigation Line  orientation  orientation value |
| Recommended Route | Recommended Route Centreline  orientation value |
| Deep Water Route Centreline Line | Deepwater Route Centreline  orientation value |
| Recommended Track | Recommended Track  orientation value |
| Name and Communications Channel of Radio Calling-In Point | Radio Calling In Point  feature name  communications channel |
| **Other Text** | | |
| 20 |  |  |
| 21 | Names for position reporting |  |
| Name or Number of Buoys | Buoy (all types)  feature name |
| Name or Number of Beacons | Beacon (all types)  feature name |
| Name or Number Daymarks | Daymark  feature name |
| Name or Number Light Vessel | Light Vessel  feature name |
| Name or Number Light Float | Light Float  feature name |
| Name or Number Offshore Platform | Offshore Platform  feature name |
| 22 | NA (Not Allocated) |  |
| 23 | Light Description String | (see C-14.10.4) |
| 24 | Note on chart data (INFORM) or nautical publication (TXTDSC) | information (attribute) |
| Nautical Information (Information type) |
| 25 | Nature of Seabed | Seabed Area  surface characteristics  nature of surface |
| 26 | Geographic Names | Anchorage Area  feature name |
| Bridge  feature name |
| Builtup Area  feature name |
| Building Single  feature name |
| Dock Area  feature name |
| Fairway  feature name |
| Landarea  feature name |
| Landmark  feature name |
| Land Region  feature name |
| Sea Area/Named Water Area  feature name |
| Tideway  feature name |
| Pilot Boarding Place  feature name |
| 27 | Value of Magnetic Variation | Magnetic Variation  value of magnetic variation |
| Value of Swept Depth | Swept Area  depth range minimum value |
| 28 | Height of Islet Or Land Feature | Land Area  height |
| 29 | Berth Number | Berths  feature name |
| Anchor Berth  feature name |
| 30 |  | NA |
| 31[[7]](#footnote-7) | National Language Text | feature name  language (other than English)  name |
| information  language  text or fileReference |
| 33 | Schedules | Service Hours |
| Non-standard Working Day |
| 34 | Organisations and Contacts | Contact Details |
| 35-49 | Reserved For IHO |  |
| 50-69 | Mariners' Text, Including Planned Speed etc. |  |
| 70-79 | Manufacturer’s Text |  |
| 80-99 | Future Requirements |  |

Table 21 - Viewing groups for text

## ECDIS Text Group Implementation

To enable the Mariner to make selections regarding the text visible in the chart display the ECDIS should use the individual text groups in Table 21 collected under distinct text group layers.

For standardization of the ECDIS user interface and to facilitate generic training of mariners, at least the following text group layers should be implemented to control the display of text:

1. Important text
2. Other text

“Important text” consists of the following :

* Communication channels for calling-in points.
* Vertical clearances for obstructions and structures over navigable water.
* Track or route orientations.

“Other text” consists of all other text.

Product specifications should conform to these definitions in their portrayal catalogues.

An ECDIS may provide more textual on/off controls than are available in this table, but manufacturers should use the names of text groups or layers contained in Table 21. Descriptive names may be combined but should be clearly indicative of the descriptive names in Table 21.

EXAMPLE: A manufacturer provides more detailed selections. The table has text group layer “Other text”. The manufacturer may subdivide this category into “names”, “light description” and “all other” (Table 22).

| **Text Group Layer** | **Name of Text group layer in the ECDIS** | **Text groups included** |
| --- | --- | --- |
| 1 | Important text | 11 |
| 2 | Other Text | 20-49, 0-10 |
| 2.1 | Names | 21, 26, 29 |
| 2.2 | Light description | 23 |
| 2.3 | All other | 0-10, 25, 27, 28, 32-49 |

Table 22 - Example of subdivision of “Other Text” layer to provide more detailed selections

## Abbreviations

The abbreviations listed below are to be used on the ECDIS display. The meanings of the abbreviations should be available to the Mariner through the pick report.

### Text abbreviations

The abbreviationsand format specifiers in Table 23 are used with text instructions. Format specifiers in the last column are a subset of C-language style format strings.

NOTE: The Lua print format specifiers are (as of Lua 5.1) a subset of the C-language specifiers (with one Lua-specific extension). For example, Lua 5.1 does not support the ‘l’ (length) modifier, but adds a ‘q’ option. See the Lua documentation for further details.

| **Abbreviations** | | **C-style format specifier** |
| --- | --- | --- |
| **Prefixes** | **Suffixes** |
| bn = beacon (INT1)  by = buoy  clr = overhead clearance  clr cl = clearance closed  clr op = clearance open  sf clr = safe clearance  No = number (INT1)  Plt = pilot  Prod = offshore production (INT1)  LtV = light vessel  Varn = magnetic variation  ch = communication channel  NMT = not more than “CLEARING BEARING”  NLT = not less than “CLEARING BEARING” | kn = knots (INT1)  deg = degrees | % = instruction follows  %s = text string  %d = integer number  %n.mf = floating point number with n characters (including the decimal), m of which come after the decimal point.  Zero padding is indicated by a ‘0’ preceding the ‘d’ or ‘n’. |

Table 23 - Abbreviations and format specifiers used with text instructions

EXAMPLE: The format specifier “%03.0f deg” printing an orientationValue of 60.1 produces the string “060 deg” (without quotes).

### Nature of seabed abbreviations

The following abbreviations are used for values of *natureOfSurface*:

| **Listed value** | | **ECDIS**  **Abbreviation** |
| --- | --- | --- |
| **Numeric code** | **Camel case code** |
| 1 | mud | M |
| 2 | clay | Cy |
| 3 | silt | Si |
| 4 | sand | S |
| 5 | stone | St |
| 6 | gravel | G |
| 7 | pebbles | P |
| 8 | cobbles | Cb |
| 9 | rock | R |
| 11 | lava | R |
| 14 | coral | Co |
| 17 | shells | Sh |
| 18 | boulder | R |

Table 24 - Abbreviations for *natureOfSurface* values

To reduce undue clutter in the ECDIS chart display, it is recommended that ECDIS manufacturers use the abbreviations of the *natureOfSurface* attribute.

## Additional information in text form

S-101 datasets encode uncategorised additional information in the complex attribute *information*, which is bound only to the information type **NauticalInformation** in S-101. Other data products may use the complex attribute *textContent*, which allows encoding of Internet information resources and descriptions of the sources from which the information is derived. The actual information may be encoded in the form of a text string or the name of a support file in text format that contains the information.

Additional information may be displayed in a hover box (see clause C-17.2.3). The size of the box should not be excessive in proportion to the chart window. The hover box should contain the following content, in order of precedence:

1. The content of the *headline* sub-attribute, if not empty or blank.
2. The content of the *text* sub-attribute, if not empty or blank.
3. Full or partial content of the file referenced by the *fileReference* sub-attribute, if any.

If all the information available in the text and referenced file cannot be contained in the hover box, an element should be added indicating the availability of more information than is displayed, and enabling the mariner to view all the information (for example, “…(more)” suffixed to partial content).

It is not necessary to display content derived from more than one of the sub-attributes *headline*, *text*, and *fileReference*. For example, displaying the headline with a link to access the other attributes will be sufficient.

S-100 5.0.0 allows several different formats for support files which may be suitable for displaying information in text form. S-101 (Ed. 1.0.0) restricts this set to text, HTML, and XML. Other specifications may use additional formats from those listed in S-100.

Rendering of additional text information should conform to the following rules:

* The displayed text must be formatted according to its format type (i.e., as plain text, rendered according to HTML format specified in the header, styled according to CSS style rules, etc.). This rule implicitly means that embedded markup (such as HTML <br> tags for line breaks) should not be displayed to the user in raw form.
* Any dynamic content (e.g., embedded Javascript, Flash, DHTML, etc.) should be ignored[[8]](#footnote-8).
* Any off-system links should be disabled8. The link should still be shown if it would normally be visible, but as an inactive element.
* Off-system resources should not be accessed9, but if the manufacturer has provided local copies, they may be used in place of off-site resources. (Note that this prevents accessing any CSS files not available on the local system.)
* Manufacturers should not attempt to display information encoded in *information* or *textContent* attributes, or the content of text support files, that is in any format other than plain text, HTML, or XML. Specifically, PDF files should not be opened. Instead the interface should show an indication of a file type that cannot be opened on the ECDIS, for example, the file type with a “not allowed” icon superimposed (Table 7). Clicking on this indication should provide an appropriate message to the user, for example “This file type cannot be displayed on an ECDIS, but may be readable on other systems.”

The optional sub-attribute *fileLocator* is intended to indicate the location of information relevant to the current feature within a larger file, and can be used to automatically position the text viewer at the correct place in a large file. Manufacturers should not assume that the content of *filelocator* will be human-readable. The content of *fileLocator* should be interpreted according to Table 25. If this attribute is present and the file is large enough to require scrolling of the text viewer window/panel, its use is encouraged, to save the mariner time in scrolling through possibly large amounts of text.

| **File Format** | **Interpretation of *fileLocator* content** |
| --- | --- |
| Text | Integer value of fileLocator: The offset of the start of the section relative to the beginning of the file (the first character in the file has offset 0). This can be used to position the view at a specific place in a long text document. |
| Text value of fileLocator: Section heading; clause heading or number; page number, etc. S-101 1.0.0 uses it this way. This cannot be used to position the view at the section, clause, page, etc. |
| HTML | HTML fragment identifier; this is the value of the *name* or *id* attribute of an HTML element in the file (as defined in the relevant HTML specification). Browsers can use this to position the viewer at a unique location in the document. |
| XML | XML fragment identifier as defined in the relevant specification, e.g., the value of an *xml:id* attribute of an element in the file. As in HTML, this identifies a unique |

Table 25 - Interpretation of *fileLocator* attribute

Additional information should be displayed in the current language of the display (the language sub-attribute of information is provided). If information in the current language is not encoded in the data, the English version should be displayed.

Final determination of the presentation type (hover box, side panel, etc.), the proper size of the presentation, its styling, and the arrangement and formatting of its content rests with the manufacturer. ECDIS manufacturers should provide appropriate solutions that enable text information to be displayed without affecting the night vision of the user.

For symbolisation representing the availability of additional information, see clause C-14.10.1.

## Graphics

S-101 datasets encode graphical information such as diagrams and photographs in the simple attribute *pictorialRepresentation*, which is bound only to the information type *NauticalInformation* in S-101. The *pictorialRepresentation* attribute contains the name of a support file in an allowed graphics format. Other data products may use the complex attribute *graphic*, which allows encoding descriptive information related to the picture, such as a caption, the date a photograph was taken, the aspect from which it was taken, etc. This is in addition to encoding the name of the picture file in *pictorialRepresentation*.

Pictorial information may be displayed in a hover box (see clause C-17.2.3) or side panel, or auxiliary display. If a hover box is used, its size should not be excessive in proportion to the chart window, and it should be distanced from own ship, planned track, alerts or indications by at least the track buffer distance. If these guidelines cannot be satisfied, a side panel or auxiliary display should be used. Expansion to the full size of the picture (or available display space in the picture side panel/auxiliary display, if smaller) should be allowed; whether the expanded picture is displayed over the chart window or in a side panel or elsewhere is left to manufacturer discretion. If a picture caption and aspect are available, they should also be displayed with the picture. Other information related to the picture should be accessible to the user via a “further information” link in or next to the hover box or panel.

ECDIS manufacturers should provide appropriate solutions that enable pictures to be displayed without affecting the night vision of the user.

Manufacturers should be prepared to handle pictures of resolution 800x800 pixels, in conformance with the guideline for picture files in S-101.

The availability of additional information in graphical format should be indicated by the same symbolisation as other supplementary information; see clause C-14.10.1.

# Miscellaneous Display Elements

This section describes additional display elements and special symbols and considerations for ENC data, including chart furniture, contours, mariners’ features, IMO-required elements, and presentation of updates. Cursor pick reports and information displays in off-graphic panels are described in clause C-17.

## Elements related to data and display scales

### ENC scale

The *minimumDisplayScale* and *maximumDisplayScale* of the ENC is the range of scales at which the ENC was designed to be displayed. It may not be the same as the scale of the source data. As required by IMO Performance Standards, section 6.1.1, an overscale indication should be shown whenever the mariner selects a display scale that is larger than *maximumDisplayScale* of a given **DataCoverage** and there is no other larger scale dataset within the mariners selected viewing scale.

### Overscale

Overscale is where the mariner has zoomed larger than the largest *maximumDisplayScale* of the ENC data that is shown in the mariner’s viewing window.

#### Overscale Indication

The overscale indication is intended to remind the mariner that the size of chart errors is magnified when they increases the display scale. A 1 mm error at *maximumDisplayScale* of 1/20,000 becomes a 1.3 mm error at a display scale of 1/15,000 and a 2 mm error at 1/10,000.

The overscale factor must be calculated as [denominator of the *maximumDisplayScale*] / [denominator of the mariners selected viewing scale], expressed as, for example "X1.3", or "X2" (using the figures in the example above.)

This must be indicated on the same screen as the chart display, and treated as display base. Use colour SCLBR.

This overscale indication is required by IMO Performance Standards (MSC.232(82)) whenever the display scale exceeds the compilation scale.

NOTE If the display is compiled from more than one ENC of the same *maximumDisplayScale*, and if the mariner deliberately chooses to zoom in so that the display scale exceeds the *maximumDisplayScale*, then only the "overscale indication" must be shown. The "overscale pattern" AP(OVERSC01) must not be shown

### Scale boundary

This shows where the *maximumDisplayScale* of the ENC data available changes. The ECDIS should warn the mariner of upcoming ENC scale change. Only the major changes in *maximumDisplayScale* resulting from the scale jumping more than three steps in *maximumDisplayScale*s should be shown. The steps are given in S-101.

The "chart scale boundaries", where the *maximumDisplayScale* of the data changes, must be symbolised on the ECDIS display by a simple linestyle LS(solid, 1, CHGRD). Alternatively linestyle LC(SCLBDYnn) may be used, with the double line (indicating better resolution) on the side of the larger scale data. The display priority is 35; over-radar; standard display; viewing group 21030.

When scale boundaries of smaller scale **DataCoverage** areas overlap larger scale **DataCoverage** areas, that portion of the scale boundary which intersects the larger scale **DataCoverage** area should not be visible.

### Overscale area at scale boundary

ECDIS displays all chart data at the same scale. In order to avoid leaving part of the display blank, the display may be rendered using data from multiple datasets. These datasets may contain DataCoverages with varying maximumDisplayScales.

The pattern AP(OVERSC01) must be used to indicate DataCoverage areas displayed {larger than, X2 or more larger than} the *maximumDisplayScale*; provided that the area was displayed automatically by the ECDIS in order to avoid leaving that portion of the display blank.

NOTE: This symbol applies only to the automatic overscaling performed by the ECDIS in matching ENCs at different *maximumDisplayScale*s. It should not be applied to an overscale display deliberately requested by the mariner, which should trigger the overscale indication required by IMO Performance Standard section 6.1.1.

A different overscale situation arises when the ship approaches a scale boundary from a larger to a smaller scale ENC, typically when leaving harbour. In combining data from the large scale and the small scale ENCs to generate a display at the larger scale, the ECDIS will have "grossly enlarged" the small scale data.

In addition to drawing the scale boundaries, the "grossly overscale" part of the display should be identified with pattern AP(OVERSC01), as illustrated. Its display priority is 35; over-radar; standard display; viewing group 21030.

In this context, "grossly enlarged" and "grossly overscale" should be taken to mean that the display scale is enlarged/overscale by X2 or more with respect to the *maximumDisplayScale*. For example, at the left edge of Figure 2 the display scale of 1/12,500 is X4 the *maximumDisplayScale* of 1/50,000, and so the overscale pattern is required.

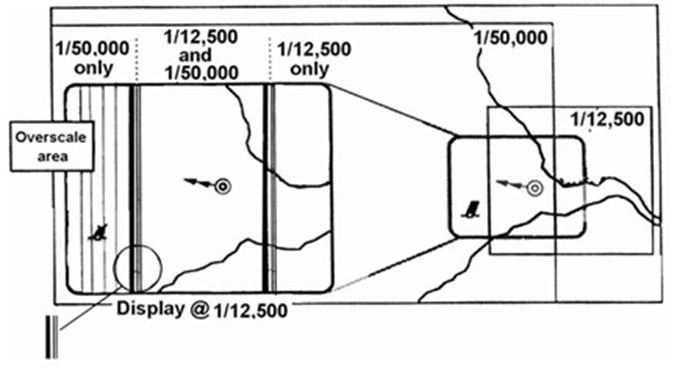


Figure 2 - Illustration of overscale display. The right hand side of the diagram shows the ENC layout with the screen window overlaid, and the left hand side is enlarged to show the ECDIS display on that screen.

Note that in this situation the pattern AP(OVERSC01) should only be shown on the area compiled from the smaller scale ENC. If the area from the larger scale ENC is also overscale, this should be indicated by the "overscale indication". The pattern AP(OVERSC01) should not be shown on the part of the display taken from the larger scale ENC. For example if the display scale of the situation in the data coverage diagram was 1/3,500 the area of compilation scale 1/12,500 would have an overscale indication of X 3.6 but would have no pattern AP(OVERSC01).

### Larger scale data available

As the mariner’s display window moves and begins to cover an ENC that is of a larger *maximumDisplayScale*, the ECDIS must indicate that larger scale data will shortly become available, as required by IMO Performance Standards.

## Graphical indexes

### Graphical indexes of ENCs

The system **must** be capable of displaying a graphical index of ENCs by maximum display scale.

Without cursor enquiry of the chart area it will not always be clear what *maximumDisplayScale* applies to a given part of a mixed source display. Display of S-101 requires a graphical index of the *maximumDisplayScale* of the data to clarify the situation. A graphical index of available S-101 data should be shown on demand.

The system should clearly indicate the product for which the graphical index is displayed. This may be done by any suitable means, such as displaying the product (e.g., “ENC Index” or other suitable terminology) in a transparent box in the corner of the display, or in a message area off the chart display area. This requirement applies even if the system is capable only of displaying a graphical index of ENCs.

Since the HO will not issue a data coverage diagram[[9]](#footnote-9), the ECDIS should compile a graphical index of the HO ENC data available, classified by *maximumDisplayScale*, and make it available to the mariner.

Only datasets actually installed on the system can be included in the graphical index. Discovery metadata from exchange catalogue files in exchange sets, or compilations derived from such exchange catalogue files, can be used if and only if the exchange sets have been validated[[10]](#footnote-10) to contain the claimed datasets (this will normally have been done when the exchange set is added to the system).

Listings in any general catalogue listing of datasets, for example S-128 (Catalogue of Nautical Products) information, must be used only for folio purposes.

### Graphical indexes of other S-100 products

The system **may** implement a capability for displaying graphical indexes of non-ENC data products by the maximum display scale.

If graphical indexes of other products are implemented, the mariner should be able to call up a graphical index of S-100 data products by maximum display scale on demand. Scale-independent products should be included in the index, treated as having *maximumDisplayScale*=1000 (i.e., the lower bound of the set of allowed display scale values for S-101 ENCs, corresponding to scale 1:1000).

The system should clearly indicate the product for which the graphical index is displayed in the same was as for ENCs.

If the system displays graphical indexes for different products simultaneously, the indexes should be distinguishable. For example, dataset extent boundaries in the graphical index may be designed so that the dataset boundaries for one product do not hide the dataset extents of another product; or, the system may provide a means of emphasizing the extents for a product selected by the mariner.

As for ENCs, the graphical index should be compiled from available datasets pending the availability of coverage diagrams or the equivalent in S-128 (Catalogue of Nautical Products), and only datasets actually installed on the system should be included in the graphical index. Listings in any general catalogue, for example S-128 (Catalogue of Nautical Products) information, must be used only for folio purposes.

## Limits of data

### Limit of HO S-101 data and data from non-HO sources

The limit of HO S-101 data on the graphical index defines the limit of HO ENC coverage.

The limit of HO S-101 data relative to “no data” areas need not be demarcated on the display. The appearance of the “No data” colour (NODTA) and fill pattern AP(NODATA03) (see C-14.3.3) will indicate the end of HO data.

If non-HO chart data is shown on the ECDIS display, its boundary should be demarcated by the linestyle LC(NONHODAT). The display priority is 35; over radar; display base; viewing group 11060. Note that the LC(NONHODAT) is a “one-sided” line and the boundary of the non-HO data must be drawn according to S-101 rules to ensure that the diagonal stroke of the line is on the non-HO data side of the line. The non-HO data boundary LC(NONHODAT) serves to separate ENC data from non-HO chart information.

### Limits of other S-100 product data

To reduce screen clutter, “no data” areas and “non-HO data” boundaries for products other than S-101 and S-57 ENCs should be depicted only when specifically called up by the mariner for a product, and then only if the product is actually displayed on the screen. The fill patterns and boundaries should indicate the product to which they apply, for example by mentioning the product in a corner or embedded in the line as for the graphical indexes (see C-14.2.1 and C-14.2.2).

For gridded data, the no-data area limits do not need to demarcate areas within the grid extent which are covered by fill values.

Implementing the depiction of limits for data other than S-101 and S-57 ENCs is optional.

NOTE: For some types of coverage products (for example gridded data), no-data areas may be easily distinguished by the lack of portrayal. Nevertheless, consistent treatment of products is recommended for the convenience of the mariner - either this clause should be implemented for all the non-ENC S-100 products, or for none of them.

### No data areas

The first action of the ECDIS display re-draw should be to cover the entire screen with the NODTA area colour fill and the AP(NODATA03) area pattern. These will remain to identify any area not subsequently covered by chart information as a no data area. The NODATA03 area pattern and NODTA colour fill are assigned drawing priority 0 (Table 10) and viewing group 11050 (Table 12).

An indication "refer to the official chart" is required if the display includes waters for which no ENC at appropriate scale exists.

If a scale boundary is shown on the display, the information in an overscale area should be identified, and should not be relied on.

An indication that the mariner must refer to the official chart should be given whenever line LC(NONHODAT) appears on the display, or whenever the display is comprised of other than ENC data.

## Data quality indicators

A bathymetric data quality indicator will cover the entire area of depth data or bathymetry for the ENC. This indicator is generated from the S-101 meta-feature **QualityOfBathymetricData** by a rule in the portrayal catalogue.

Other indicators of data quality (quality of non-bathymetric information, information about survey dates, positional uncertainty for non-bathymetric data, etc.) are derived from other quality meta-features in the S-101 dataset and may be displayed by turning on the appropriate viewing groups (Table 14) and/or by means of cursor queries (“pick reports”).

Quality indicators for other S-100 products may also be displayed by turning on the appropriate viewing layers (Table 14) and/or by means of cursor queries (“pick reports”) on (meta-)features describing data quality. Quality indicators for products other than S-101 and S-57 ENCs should be displayed only when specifically enabled or called up by the mariner.

## Special ECDIS chart symbols to identify unsafe depths

The ECDIS highlights four features that are important for safe navigation. These are the safety contour, depth shades, the safety depth and isolated dangers

### Safety Contour

The own-ship safety contour, selected by the mariner from among the contours in the SENC, is double-coded by a thick line and a prominent change in depth shade.

If the safety contour selected by the mariner is not available in the SENC, the ECDIS should default to next deeper contour and inform the mariner. If, when the ship moves onto a new chart, the safety contour previously in use is no longer available, the ECDIS should again select the next deeper contour, and inform the mariner.

If the mariner does not select a safety contour, the value should default to 30 m.

### Depth zone shades

Depth zone shades are defined by the safety contour and selected shallow and deep contours and the drying line.

The safety contour defines two depth zone shades and the drying line a third:

| **Depth zone** | **Description** | **Colour token** |
| --- | --- | --- |
| deep water | deeper than the safety contour | DEPDW |
| shallow water | shallower than the safety contour | DEPVS |
| intertidal area | area exposed at low water | DEPIT |

Table 26 - Depth zones determined by safety contour and drying line

A "depth less than safety contour" pattern is provided in the portrayal catalogue to reinforce the depth shade. It is optional for the manufacturer to provide this feature, but its inclusion is strongly recommended as a safety feature.

The mariner should be given the option of whether to use this pattern, by night or by day (although it is not strictly necessary by day when the shallow water can be clearly identified by the difference in depth shade).

It is recommended that the ECDIS should also allow the mariner the option of selecting a deep contour and a shallow contour from among the contours in the SENC, thus establishing the five depth zones in Table 27 below. The colour tokens and default values for the depth zones are also provided.

| **Depth Zone** | **Description** | **Colour token** | **Default value for zone** |
| --- | --- | --- | --- |
| deep water | deeper than the deep contour | DEPDW | deeper than 30 m (deep draught vessels) |
| medium-deep water | depths between the deep contour and the safety contour | DEPMD | own-ship safety contour to 30 m |
| medium-shallow | depths between the safety contour and the shallow contour | DEPMS | 2 m to the own-ship safety contour |
| very shallow water | depths between the shallow contour and zero metre contour | DEPVS | 0 to 2 m (defines waters accessible to small craft) |
| drying foreshore | intertidal area | DEPIT | exposed at low water (see S-101 DCEG for coding) |

Table 27 - Depth zones determined by safety/shallow/deep contours and drying line

### Safety Depth

The own-ship safety depth is intended as an aid when no appropriate safety contour is available in the SENC. Soundings equal to or less than the safety depth selected by the mariner are made more conspicuous than deeper soundings. A separate set of sounding figures is provided in the portrayal catalogue.

### Isolated dangers

Isolated dangers (small shoals, rocks, wrecks, obstructions) of depth less than the safety contour, and also lying within the 'safe' water defined by the safety contour, are highlighted by a special symbol. They are then put in IMO category “Display Base”.

Because the mariner may sometimes have to navigate in water shallower than a default safety contour, the mariner may also select to show isolated dangers in the 'unsafe' water between the displayed safety contour and the zero metre contour. These are placed in IMO category “Standard”.

### Full light sector lines

The radial leg-lines defining the light sectors are normally drawn to only 25mm from the light to avoid clutter (see continuation B). However, the mariner should be able to select “full light-sector lines” and have the leg-lines extended to the nominal range of the light (VALMAR).

## Other ECDIS symbols and their use

### Mariners Caution Notes

Point cautions and notes entered by the mariner and the manufacturer are distinguished by the colours orange and yellow respectively.

### Unknown feature

A magenta question mark ("?") marks the position of a feature which cannot be identified or for which there is no rule set in the portrayal catalogue.

### Change of horizontal (geodetic) datum

The use of non-WGS 84 data does not comply with IHO S-101, and the boundary at which the local geodetic datum changes is not symbolized by the portrayal catalogue.

### Manual chart correction

Small orange identifiers are used to distinguish hand-entered chart corrections, which are subject to human error, from corrections entered automatically by electronic means. The original chart feature should not be removed or altered.

### Manual corrections to non-ENC S-100 products

Manual corrections to other S-100 products are entered in the same way as chart corrections. They are not visually distinguished from manual chart corrections. However, for portrayal purposes they are treated as part of the appropriate product data rather than the S-101 data and are displayed or removed from the display along with the appropriate viewing groups from the relevant S-100 product.

### One-sided linestyle for boundaries

A one-sided linestyle is provided for use on large-scale displays to indicate the side of an area boundary on which the area lies, when only a part of the boundary can be seen on the display.

### Special identifiers

Identifiers are provided for low accuracy chart data and for ENC features which have additional information for cursor picking utilizing the S-101 information type **NauticalInformation** that is associated to the feature using the information association *additionalInformation*. The latter may cause clutter, and should only be displayed temporarily.

Similarly, special identifiers may also be provided for other S-100 products and should provide cursor pick functionality for any associated information type using any information association, since other products may use information types other than **NauticalInformation** and information associations other than *additionalInformation*. These identifiers should only be displayed on request by the user. The symbols for such identifiers are defined in the respective portrayal catalogues.

## Date-dependent features

There are a number of features within the Marine environment, which are seasonal, such as racing buoys. These features are only to be displayed over a certain period, S-101 uses the complex attribute *periodicDateRange* with the sub attributes *dateStart* and *dateEnd* to indicate the periodic nature of the feature. Other features, such as traffic separation schemes, use the complex attribute *fixedDateRange* with the sub attributes *dateStart* and *dateEnd* to indicate their introduction or removal. In order for the Mariner to receive important changes to traffic separation schemes before the event Hydrographic Offices are required to provide updates or new editions containing the alterations at least one month before they come into force. Any S-101 feature with one of the above complex attributes must not be displayed outside its effective dates unless requested by the Mariner.

### Display of date-dependent features by mariner-selected date

To provide the Mariner with effective route planning capabilities and for the look-ahead function during route monitoring ECDIS must display date dependent chart data based on a Mariner selected date or date range (start viewing date and end viewing date).

During route planning and monitoring the Mariner must be able to select a date or date range to display all date dependent chart features. The display of date dependent information is indicated by the symbol SY(CHDATD01).

All features for which any of the values for the complex attributes *periodicDateRange* and *fixedDateRange* are within the Mariner selected date range should be indicated using SY(CHDATD01)

EXAMPLE: A new traffic separation scheme is coming into effect on 01.01.2013, it has been encoded by the ENC producer using the attribute date start (DATSTA). The current date is 12.12.2012 and the Mariner is planning a route that will cross this area over the effective start period.

The ECDIS should be capable of providing the Mariner the ability to set the date the vessel will be in the area (02.01.2013) and the system should show the new traffic scheme.

### Highlighting of date-dependent features

The mariner should have the ability to turn on and off the highlighting of date dependent features.

### Indication of date adjustment

When viewing date or date range do not include the current date, the mariner must be informed by a permanent indication on the chart display that the date has been adjusted. The indication must begin with the text “Display Not Real Time” and the selected date or date range must be readily available. The format of the date should be: dd mmm yyyy = Day, Month, Year, for example; 28 Jan 2014.

The use of one of the following formats is recommended:

* Display Not Real Time – Display is based on date dd mmm yyyy
* Display Not Real Time – Display is based on viewing date range from dd mmm yyyy to dd mmm yyyy

## Scale-dependent features

To reduce screen clutter most features within ENC should carry the attribute *scaleMinimum* to specify the smallest display scale at which they should be drawn. At display scales smaller than *scaleMinimum* the feature must not be drawn. For example, a feature with a *scaleMinimum* value of 50,000, indicating a scale of 1/50,000, should not be drawn on an ECDIS display of 1/60,000.

ECDIS must provide the Mariner a selector to turn off the SCAMIN attribute to display all objects in the chart display.

## IMO presentation elements

In some cases S-101 does not provide a symbology instruction in the portrayal catalogue that specifies how to present a specific feature on the ECDIS screen. The reason is that such a feature cannot be clearly identified as an S-101 feature class or it appears to be illogical to include it to the Mariners' navigational feature classes.

The following presentation instructions are therefore provided in order to assist the manufacturer to set up a satisfactory and comprehensive ECDIS display.

### Scale bar and latitude scale

The IMO Performance Standards require an indication of scale and range as part of the Display Base. The display scale determines which should be used:

1. Case 1: for display scales larger than 1/90,000: always display the 1 mile scale bar provided in the portrayal catalogue
2. Case 2: for display scales at 1/90,000 or smaller: always display the 10 mile latitude scale provided in the portrayal catalogue.

The scale bar or latitude scale should always be drawn vertically at the left side of the chart display, just clear of the border of the display. The symbols and drawing parameters are described in Table 28.

The placement should be 3mm in from the border of the display. Make sure the symbol is properly sized by your software to represent 1 nautical mile at the scale of the display (for Case 1) or 10 nautical miles at the scale of the display (for Case 2).

The mariner should be able to remove any labels on the scales to avoid clutter.

| **Scale range** | **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- | --- |
| 1:89999 and larger scale | SCALEB10 | 90 | OverRADAR | Display base | 11030 |
| 1:90000 and smaller scale | SCALEB11 |

Table 28 - Scale bar presentation parameters

EXAMPLE 1: For *maximumDisplayScale* values larger than 1/90,000 (for example, a scale of 1/50,000) draw symbol 'SCALEB10' on the left side of the chart display, bottom justified and 3mm in from the border of the display. Make sure the symbol is properly sized by your software to represent 1 nautical mile (1852 m) at the scale of the display.

EXAMPLE 2: For display scales of 1/90,000 or smaller (for example, 1/250,000) use symbol 'SCALEB11', similarly located, and scaled to represent 10 miles at the scale of the display.

IEC define a requirement for indicating the location at which the scale is calculated under certain circumstances, as follows:

If the displayed area together with the used projection is such that scale is not uniform over the displayed area then the scale bar (more than 5% difference in uniformity for all directions or displayed area is over latitude 70º) or latitude scale (more than 5% difference in uniformity for latitude direction or displayed area is over latitude 70º) shall indicate the scale either at own ship location or at the centre of the displayed area. In such case a permanent indication “at own ship” or “at centre” shall be close to the scale bar or latitude scale. [IEC 61174:2015].

### North arrow

The IMO Performance Standard requires a north arrow as part of the Display Base. The north arrow should always be shown at the top left corner of the chart display, just clear of the scale bar or latitude scale.

Note: Polar projections do not use a north arrow.

IEC define requirements for placment under specified circumstances, as follows:

If the displayed area together with used projection is such that direction of the north is not uniform over the displayed area (more than 20º difference in uniformity or displayed area is over latitude 70º) then the North Arrow shall indicate the direction of North either at own ship location or at the centre of the displayed area. In such case a permanent indication “at own ship” or “at centre” shall be close to the North Arrow. [IEC 61174:2015]

Use symbol 'NORTHAR1' to indicate true north. Place it in the top left corner of the chart display, on the inner side of the scalebar. Rotate the symbol to true north if the display is other than north up, and make sure it is clear of the scalebar even if the latter extends the full height of the display.

The symbols and drawing parameters for the north arrow are described in Table 29.

| **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- |
| NORTHAR1 | 90 | OverRADAR | Display base | 11040 |

Table 29 - North arrow presentation parameters

### Graticule

If the ECDIS shows a graticule (listed in “other information” in IMO Performance Standards (MSC.232(82)) the lines should be one unit wide and use the colour token CHBLK.

### Display mode

The ECDIS manufacturer should provide the indication of display mode required in the display base by IMO Performance Standards (MSC.232(82)).

### Shallow water pattern

When the entire water area on the ECDIS display is of less depth than the safety contour, it is not possible for the mariner to easily detect this problem. The issue is exacerbated when the ECDIS is set to night mode due to the small differences between the depth area shades in the ECDIS chart display. Therefore S-101 provides a faint lattice pattern DIAMOND1 to distinguish shallow water.

The mariner must be provided with a selection to turn the shallow water pattern on or off from within the ECDIS.

| **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- |
| DIAMOND1 | 35 | UnderRADAR | Standard | 23010 |

Table 30 - Shallow water pattern presentation parameters

### Black level adjustment symbol

Unless the brightness and contrast controls of the monitor, are properly adjusted there is a danger that information may be lost from the chart display, particularly at night. Symbol BLKADJ is provided for checking correct adjustment and for re-adjusting as necessary. It should be available for call-up by the Mariner as required.

### Detection and notification of navigational hazards

The IMO Performance Standard for ECDIS MSC.232(82) clauses, 11.3.5 Route planning states;

An indication should also be given if the mariner plans a route closer than a user-specified distance from a point feature, such as a fixed or floating aid to navigation or isolated danger.

Clause 11.4.6 Route monitoring states;

An indication should be given to the mariner if, continuing on its present course and speed, over a specified time or distance set by the mariner, own ship will pass closer than a user-specified distance from a danger (For example, obstruction, wreck, rock) that is shallower than the mariner's safety contour or an aid to navigation.

The following table lists the features and their attributes that satisfy the conditions above and should precipitate an indication within the ECDIS. The point, curve or surface should be graphically indicated using the appropriate portrayal rule for the notional “INDHLT” feature. “INDHLT” is not an S-101 feature class, but a feature that should be created by the ECDIS.

| **Features** | **Condition (if any)** | **Geometric primitive** |
| --- | --- | --- |
| *S-101 Features* | | |
| BeaconCardinal |  | POINT |
| BeaconIsolatedDanger |  | POINT |
| BeaconLateral |  | POINT |
| BeaconSafeWater |  | POINT |
| BeaconSpecialPurpose |  | POINT |
| BuoyCardinal |  | POINT |
| BuoyInstallation |  | POINT |
| BuoyIsolatedDanger |  | POINT |
| BuoyLateral |  | POINT |
| BuoySafeWater |  | POINT |
| BuoySpecialPurpose |  | POINT |
| SpanOpening |  | POINT, CURVE, SURFACE |
| CableOverhead |  | LINE |
| Daymark |  | POINT |
| PipelineOverhead |  | CURVE |
| Conveyor |  | CURVE, AREA |
| MooringFacility |  | POINT,CURVE, SURFACE |
| VirtualAISAidToNavigation |  | POINT |
| PhysicalAISAidToNavigation |  | POINT |
| FishingFacility |  | POINT,CURVE, SURFACE |
| IceArea |  | SURFACE |
| LightFloat |  | POINT |
| LightVessel |  | POINT |
| LandArea |  | POINT, CURVE |
| LogPond |  | POINT, SURFACE |
| OffshoreOilPlatform |  | POINT, SURFACE |
| OilBarrier |  | CURVE |
| PilePoint |  | POINT |
| Pylons |  | POINT, SURFACE |
| Obstruction | defaultClearanceDepth < safety contour value | POINT,CURVE, SURFACE |
| UnderwaterRock | defaultClearanceDepth < safety contour value | POINT |
| Wrecks | defaultClearanceDepth < safety contour value | POINT, SURFACE |
| Sounding | ZCOO subfield < safety contour value | POINTSET |
| (Other product specifications TBD - perhaps some S-411 Sea Ice features?) | | |
| (TBD) |  |  |

Table 31 - Navigational hazard features

The safety contour value is set by the user; in the absence of a user setting, its default value should be 30m.

For curve and surface features, the highlight should indicate the intersection between the ship’s look-ahead buffer (computed using speed, course, look-ahead time and cross-track deviation) and the feature.

Figure 3 depicts indication highlights for points, curves, and surfaces.



Figure 3 - Examples of indication highlights

### Detection of areas for which special conditions exist

The IMO Performance Standard for ECDIS MSC.232(82) clause 11.3.5 Route Planning states;

An indication should be given if the mariner plans a route closer than a user-specified distance from the boundary of a prohibited area or a geographic area for which special conditions exist.

Clause 11.4.4 Route Monitoring states;

ECDIS should give an alarm or indication, as selected by the mariner, if, within a specified time set by the mariner, own ship will cross the boundary of a prohibited area or area for which special conditions exist.

The IMO Performance Standard Appendix 4 specifies the following areas which ECDIS should detect and provide an alert or indication.

* Traffic separation zone
* Inshore traffic zone
* Restricted area
* Caution area
* Offshore production area
* Areas to be avoided
* Military practice area
* Seaplane landing area
* Submarine transit lane
* Anchorage area
* Marine farm/aquaculture
* PSSA (Particularly Sensitive Sea Area)

The following table provides an authoritative map between the areas identified within the IMO Performance standard for ECDIS and S-101 features, their attributes and geometric primitives. The point, curve or surface features should be graphically indicated using the appropriate style for “INDHLT”.

| **IMO Special condition** | **Feature** | **Attribute** | **Geometry** |
| --- | --- | --- | --- |
| S-101 Features | | | |
| Traffic separation zone | TrafficSeparationZone |  | SURFACE |
| Inshore traffic zone | InshoreTrafficZone |  | SURFACE |
| Restricted area | RestrictedArea (Navigational, Regulatory) | restriction != 14 and categoryOfRestrictedArea != 28 | SURFACE |
| Caution area | CautionArea |  | SURFACE, POINT |
| Offshore production area | OffshoreProductionArea |  | SURFACE |
| Areas to be avoided | RestrictedArea | restriction = 14 | SURFACE |
| Military practice area | MilitaryPracticeArea |  | SURFACE, POINT |
| Seaplane landing area | SeaplaneLandingArea |  | SURFACE, POINT |
| Submarine transit lane | SubmarineTransitLane |  | SURFACE |
| Anchorage area | AnchorageArea |  | SURFACE, POINT |
| Marine farm/aquaculture | MarineFarmCulture |  | SURFACE, CURVE, POINT |
| PSSA (Particularly Sensitive Sea Area) | RestrictedArea  (Navigational, Regulatory) | categoryOfRestrictedArea = 28 | SURFACE |
| S-122 Features | | | |
| PSSA | Marine Protected Area | categoryOfRestrictedArea = 28 | SURFACE |
| Areas to be avoided | RestrictedArea  (Navigational, Regulatory) | restriction != 14 and categoryOfRestrictedArea != 28 | SURFACE |

Table 32 - Features for IMO special condition areas

### Visualisation of the safety contour

The safety contour is defined as an edge between safe and unsafe skin of the earth features from S-101.

### Detection of safety contour

The IMO Performance Standard for ECDIS MSC.232(82) clause 11.3.4 Route Planning states;

An indication is required if the Mariner plans a route across an own ship's safety contour.

Clause 11.4.3 Route Monitoring states;

ECDIS should give an alarm if the ship, within a specified time set by the Mariner, is going to cross the safety contour.

The following table specifies the features, conditions and geometry that constitute the safety contour and should therefore be used when raising the safety contour alarm.

| **Feature** | **Condition** | **Geometry** |
| --- | --- | --- |
| S-101 Features | | |
| DepthArea | DEPARE03[[11]](#footnote-11) “UNSAFE=TRUE” | SURFACE |
| DredgedArea | DEPARE039 “UNSAFE=TRUE” | SURFACE |
| FloatingDock | - | CURVE, SURFACE |
| Hulkes | - | POINT, SURFACE |
| LandArea | - | POINT, CURVE, SURFACE |
| Pontoon | - | CURVE, SURFACE |
| UnsurveyedArea | - | SURFACE |
| ShorelineConstruction | - | POINT, CURVE, SURFACE |
| S-129 Features | | |
| UnderkeelClearance‌NonNavigableArea |  | SURFACE |
| UnderkeelClearance‌‌AlmostNonNavigableArea |  | SURFACE |

Table 33 - Features for safety contour determination

The point, line or surface should be graphically indicated using the presentation named as “DNGHLT” in the portrayal catalogue, as depicted in Figure 4.



Figure 4 - Examples of danger highlights in ECDIS

### Range indicator

The IMO Performance Standards require an indication of scale and range as part of the Display Base. ECDIS should implement this as an emphasized marker on the course and speed made good vector (see IEC 62288).

### Detection of route-based conditions

The IMO Performance Standard requires that:

An alarm should be given by ECDIS when the ship reaches a specified time or distance, set by the mariner, in advance of a critical point on the planned route. [MSC.232(82) 11.4.9]

Critical points on the planned route are defined in S-421(?) When the ship arrives within the mariner-specified time or distance of the point, the system shall generate an alarm. [Further details TBD - this should be specified either here or in S-421.]

The IMO Performance Standard requires that:

An alarm should be given when the specified cross track limit for deviation from the planned route is exceeded. [MSC.232(82) 11.4.5.]

[Details TBD - should be specified either here or in S-421.]

## Hydrographic Office specified display features

### Supplementary information

Additional chart content in S-101 is encoded using the information type **NauticalInformation**. This information type is associated to S-101 features suing the information association, *additionalInformation*. The information type **NauticalInformation** carries attributes that must be discoverable by means of a hover box or user query (pick report).

The pivot point of SY(INFORM01) should be placed at the position of a point feature, at the midpoint of a line feature, or at the centre of a Surface feature. SY(INFORM01) is intended as a temporary overlay. The presentation parameters for this symbol are provided in Table 34.

| **Symbol** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- |
| INFORM01 | 85 | OverRADAR | Other | 31030 |

Table 34 - Additional information symbol presentation parameters

Schedules and contact information may also be encoded in datasets and should also use the same symbol. They are encoded using the information types **ServiceHours**, **NonstandardWorkingDay**, and **ContactDetails**, associated to features using the *additionalInformation* information association.

Other data products may also link regulations and specifications of vessel/cargo characteristics to features in their own feature catalogues. Such supplementary information should also be indicated using the supplementary information symbol. The names of the associations are defined in the respective product specifications; in general, any information association in a feature instance should be treated as a link to additional information for display purposes on ECDIS.

Display or suppression of supplementary information symbols should be under mariner control (see MSC.1609 App. 2 Table 2).

Presentation of the content of **NauticalInformation** is described in clause C-13.5. Presentation of pictorial content is described in C-13.6. Presentation for the content of schedules and contact information is described in C-17.5.

### Display in languages other than English

In S-101, information in national languages may be encoded using the complex attributes *featureName* and *information*. A sub-attribute of the complex attribute is *language*, which will enable the hydrographic office to note that the text is in the national language in addition to English. Information contained in the secondary *featureName* or *information* can be encoded in a number of formats and many IHO member states encode such fields in their data. National language information is not covered by the ECDIS Performance Standard, however, it is strongly recommended that OEMs support all text formats contained in the national language attributes and files.

The complex attributes *sectorInformation* (in sector light features) and *shapeInformation* (buoy, beacon, light float and daymark features), which are also used in S-101, may also contain information in national languages and have a corresponding *language* attribute populated. They should be treated similarly to *featureName* and *information* for the purpose of displaying information in national languages.

Other data products may encode a *language* attribute in the complex attribute *textContent* or an information type (e.g., **ContactDetails**), to indicate that the information in that instance of the complex attribute or information type is encoded in a national language. These instances should be treated in the same way as *featureName* or *information* attributes for the purpose of displaying information in national languages.

Information encoded in national languages, whether in complex attribute, information type, or feature, should have a corresponding English version in the dataset. Manufacturers and mariners are invited to bring the absence of a default to the attention of the dataset producer.

### ECDIS Legend

The ECDIS chart legend containing the following elements should be available for display at the position selected by the Mariner. Table 35 indicates which ENC data elements should be used.

| **ECDIS Legend Item** | **Values** |
| --- | --- |
| Units for depth | AXUM subfield in the CSAX field |
| Units for height | AXUM subfield in the CSAX field |
| Note: Units for depth and height: although the ENC Product Specification of S-101 does not allow any other than metric depths and heights, these two elements should be stated for clarity for the Mariner | |
| Scale of display | Selected by mariner. (The default display scale is defined by *maximumDisplayScale*, in the ENC discovery metadata in the exchange catalogue file.)  **DataCoverage** meta-features in S-101 datasets also have a *maximumDisplayScale* attribute; use this as the default if it differs from the value in metadata for the entire displayed area. |
| Data quality indicator | (a) *verticalUncertainty.uncertaintyFixed* (*SOUACC*) attribute of the **Quality Of Bathymetric Data** (M\_QUAL) meta-feature.  (b) *horizontalPositionUncertainty.uncertaintyfixed* (*POSACC*) attribute of the **Quality Of Nonbathymetric Data** (M\_ACCY) meta-feature if available. |
| Note: Due to the way quality is encoded in the ENC, both values (a and b) should be used. | |
| Sounding/vertical datum | The *soundingDatum* and *verticalDatum* fields of the dataset discovery metadata in the exchange catalogue, or the *verticalDatum* attribute of the **SoundingDatum** feature and **VerticalDatum** feature when available.  (*verticalDatum* attributes of individual features should not be used for the legend.) |
| Horizontal datum | WGS84 |
| Value of safety depth | Selected by Mariner. Default is 30 metres. |
| Value of safety contour | Selected by Mariner. Default is 30 metres. |
| Note: If the Mariner has selected a contour that is not available in the ENC and the ECDIS displays a default contour, both the contour selected and the contour displayed should be quoted. | |
| Magnetic variation | **MagneticVariation** (MAGVAR) feature, attributes:  *referenceYearForMagneticVariation (RYRMGV)*,  *valueofAnnualChangeInMagneticVariation (VALACM)*,  and *valueOfMagneticVariation (VALMAG)*  Item should be displayed as: VALMAG RYRMGV (VALACM)  For example, 4°15W 1990 (8’E) |
| Date and number of latest update affecting chart datasets currently in use. | ISDT and UPDN subfields of the DSID field of the last update dataset applied. |
| Edition number and date of the ENC. | EDTN and UADT subfields of the DSID field of the current base issue of the ENC dataset.  NOTE: Where are these mapped in S-101, Are these now found in the XML metadata or do these map to the following:  DSRD and DSED |
| Chart projection | Projection used for the ECDIS display (For example, oblique azimuthal). This should be appropriate to the scale and latitude of the data in use. |

Table 35 - Legend elements

The list above is the minimum that should be available, but the complete list need not always be shown. Individual items may be picked by the mariner for display for a period; examples are magnetic variation, data quality for depths, etc.

### Light description text strings

This clause defines the syntax, layout and map of the S-101 attributes to the ECDIS text string.

To produce textual light descriptions in ECDIS, the ECDIS system should use an abbreviated form of the S-101 attributes of the light feature in a particular order. The number next to the attribute in the list below denotes the order in which the ECDIS should use the attribute in the light description text string. The overall structure is given below:

1. category of light
2. light characteristic
3. signal group
4. colour
5. signal period
6. height
7. value of nominal range
8. status

NOTE: *lightCharacteristic*, *signalGroup*, and *signalPeriod* are part of the *rhythmOfLight* complex attribute.

The following tables define the map between the ENC attribute values and the required ECDIS textual output.

The values of the enumeration attributes *categoryOfLight*, *lightCharacteristic*, and *status* should be represented by abbreviations, as specified in Table 36 below. Values not listed in this table are not represented in the light description string.

| **Attribute** | **ENC Input** | | **ECDIS output** |
| --- | --- | --- | --- |
| **Code** | **Label** | **Abbreviation** |
| category of light | 1 | directional function | Dir |
| 5 | aero light | Aero |
| light characteristic | 1 | fixed | F |
| 2 | flashing | Fl |
| 3 | long-flashing | LFl |
| 4 | quick-flashing | Q |
| 5 | very quick-flashing | VQ |
| 6 | continuous ultra quick-flashing | UQ |
| 7 | Isophased | Iso |
| 8 | occulting | Oc |
| 11 | interrupted ultra quick-flashing | IUQ |
| 12 | Morse | Mo |
| 13 | fixed and flash | FFl |
| 14 | flash and long-flash | Fl+LFl |
| 15 | occulting and flash | OcFl |
| 16 | fixed and long-flash | FLFl |
| 17 | occulting alternating | AlOc |
| 18 | long-flash alternating | AlLFl |
| 19 | flash alternating | AlFl |
| 25 | quick-flash plus long-flash | Q+LFl |
| 26 | very quick-flash plus long-flash | VQ+LFl |
| 27 | ultra quick-flash plus long-flash | UQ+LFl |
| 28 | alternating | Al |
| 29 | fixed and alternating flashing | AlF Fl |
| status | 2 | occasional | occas |
| 7 | temporary | temp |
| 8 | private | priv |
| 11 | extinguished | exting |
| 17 | un-watched | U |

Table 36 - Abbreviations in light description string for enumerated attributes

Units of measure should be suffixed to the values of *signalPeriod*, *height*, and *valueOfNominalRange* as specified in Table 37 below:

| **S-101 Attribute** | **Description** | **Units of Measure** |
| --- | --- | --- |
| signal period | Seconds | s |
| height | Metres | m |
| value of nominal range | Miles | M |

Table 37 - Units of measure suffixes

When the signal group value is set to or includes “()” and/or “(1)” there is no requirement for this component (“()” or “(1)”) to be populated in the light description text. Only when the signal group value differs from the above mentioned values should the value be output on the ECDIS screen. This follows the paper chart convention.

The default presentation for each of the numeric values of *signal period*, *height* and *value of nominal range* is without using decimals. If the value of the attribute has a non-zero decimal part then the value is displayed to one decimal place.

EXAMPLE: Given light features with the attributes in Table 38:

| **Feature attribute** | **LIGHTS A** | **LIGHTS B** |
| --- | --- | --- |
| Light Characteristic | 2: flashing | 26: very quick-flash plus long-flash |
| Signal Group | (1) | (5)() |
| Colour | White | White |
| Signal Period | 30 | 15 |
| Height | 7 | 7 |
| Value of Nominal Range | 10 | 10 |

Table 38 - Example of attribute values for light description string

The ECDIS should display the lights textual descriptions as follows:

For LIGHTS A: **FL W 30s7m10M**

For LIGHTS B: **VQ(5)+LFl W 15s7m10M**

## Displaying manual and automatic updates and added information

### Manual update

Manual updates of ENC information should be displayed using the same symbology as ENC information and should be distinguished from ENC information as described in the following clauses.

#### Added feature (manual)

Point feature: superimpose SY(CHCRID01)

Line feature: overwrite with line LC(CHCRID01)

Surface feature: overwrite area boundary with line LC(CHCRID01) and superimpose SY(CHCRID01) on any centred symbol.

#### Deleted feature (manual)

The feature should remain on the display and should be marked as follows:

Point feature: Superimpose SY(CHCRDEL1)

Line feature: Overwrite with line LC(CHCRDEL1) (do not remove the original line)

Surface feature: Overwrite area boundary with line LC(CHCRDEL1) and superimpose SY(CHCRDEL1) on any centred symbol.

#### Moved feature (manual)

As for deleted feature, followed by added feature.

#### Modified feature (manual)

There are three cases, which are treated as follows:

1. If the only modification is an addition (for example, an existing buoy has a retro-reflector added with no other change):

superimpose SY(CHCRID01) or LC(CHCRID01)

1. If the only modification is a deletion of a part (for example, an area has a «fishing prohibited» restriction removed), then this creates both a change and a deletion and both should be symbolized:

Point: superimpose SY(CHCRID01) and SY(CHCRDEL1)

Line: overwrite with LC(CHCRID01) and LC(CHCRDEL1)

Area: overwrite the boundary with LC(CHCRID01) and LC(CHCRDEL1) and also superimpose SY(CHCRID01) and SY(CHCRDEL1) on any centred symbol.

1. If the modification is an addition and a deletion then it is handled as in (b) above.

A deleted feature should appear on the display only when its IMO category and viewing group are displayed.

A manually updated feature must be capable of the same performance in feature selection, response to cursor-picking, etc., as an ENC feature. In addition, it should provide updating information (identification and source of update, when and by whom entered, etc.) on cursor picking.

### Identifying automatic chart corrections on demand

The ECDIS manufacturer should provide a means of identifying chart corrections to the SENC on demand by the Mariner.

On mariner demand automatic chart corrections of ENC information should be highlighted as described in the following sub-clauses.

#### Added Feature (automatic)

Point object: Superimpose SY(CHRVID01).

Line object: Overwrite with line LC(CHRVID02).

Area object: Overwrite area boundary with line LC(CHRVID02) and superimpose SY(CHRVID01) on any centred symbol.

#### Deleted Feature (automatic)

Point object: Superimpose SY(CHRVDEL1).

Line object: Overwrite with line LC(CHRVDEL2) (do not remove the original line).

Area object: Overwrite area boundary with line LC(CHRVDEL2) and superimpose SY(CHRVDEL1) on any centred symbol.

#### Moved Feature (automatic)

As for deleted feature, followed by added feature.

#### Modified Feature (automatic)

Point: Superimpose SY(CHRVID01) and SY(CHRVDEL1).

Line: Overwrite with LC(CHRVID02) and LC(CHRVDEL2).

Area: Overwrite the boundary with LC(CHRVID02) and LC(CHRVDEL2) and also superimpose SY(CHRVID01) and SY(CHRVDEL1) on any centred symbol.

#### Non-HO (Non-ENC) Chart Information

Limited non-HO data added to existing HO ENC data to augment the chart information must be distinguished from the HO-ENC information as follows:

Point object: Superimpose SY(CHCRID01).

Line object: Overwrite with line LC(CHCRID01).

Area object: Overwrite area boundary with line LC(CHCRID01) and superimpose SY(CHCRID01) on any centred symbol.

#### Information about automatic updates

S-101 defines an **UpdateInformation** feature to describe automatic updates and corrections. A single instance of **UpdateInformation** may spatially cover multiple spatially dispersed ENC features. **UpdateInformation** may also be associated with one or more features using the *updatedInformation* association to indicate features affected by the update. An **UpdateInformation** feature can be either a point, curve or surface, and contains a description what has been updated. The presentation parameters are described in Table 39.

| **Primitive** | **Symbol/Style** | **Drawing priority** | **Display plane** | **Display category** | **Viewing group** |
| --- | --- | --- | --- | --- | --- |
| Point | ? | ? | ? | Other | 31090 |
| Curve | LS(solid,1,CHGRD)? |
| Area | LS(solid,1,CHGRD)? |

Table 39 - Presentation parameters for UpdateInformation feature

### Updating non-official chart information

Limited non-official data added to existing official ENC data to augment the chart information should be distinguished from the official information as follows:

Point feature: superimpose SY(CHCRID01)

Line feature: overwrite with line LC(CHCRID01)

Area feature: overwrite area boundary with line LC(CHCRID01) and superimpose SY(CHCRID01) on any centred symbol.

Non-official data should be distinguished from manually updated chart information, which uses the same identifiers, by cursor picking.

Non-official chart information may be updated by any systematic procedure. A record of updates should be maintained.

The mariner should be able to remove all non-official chart information if the need should arise.

### Other non-official data

Non-official data must be distinguished from manually updated chart information, which uses the same identifiers, by cursor picking.

See clause C-10.1.3 for information on how to symbolize other cases of non-HO data appearing on the ECDIS display.

Non-official chart information may be updated by any systematic procedure. A record of updates must be maintained.

The Mariner must be able to remove all non-HO chart information if the need should arise.

## Contours from datasets other than S-101

Whether algorithms for determining contours from bathymetry, water levels, etc., should be implemented on the ECDIS is undetermined at this time. It is possible that the relevant data products will include contours in (or with) datasets delivered to ECDIS. If contours are appropriate but unavailable in the dataset, manufacturers may devise their own methods for creating contours, but should not substitute the results for contours determined from S-101 ENCs.

Contours computed from other datasets may be displayed as “Other information” in the IMO categorisation, but should be clearly distinguishable from the contours derived from S-101 ENC data. The default method for distinguishing such contours is to use a linestyle with one or both of the following characteristics:

* A line colour that is clearly distinguishable from the colours used for safety, shallow, and deep contours, coastlines, tracks and routes.
* A complex linestyle with embedded or offset symbology identifying the data product (in terms understandable by mariners) or otherwise sufficient to distinguish the contour from safety, shallow, and deep contours, coastlines, tracks and routes.

A distinguishable colour is recommended even if the other characteristic is also used.

The effect on display clutter should be taken into account if display on the navigation window during route monitoring and collision avoidance is anticipated.

# Coverages and Time Series

Coverage and time series features are encoded in the HDF5 format (S-100 Part 10c). S-100 provides for the following types of coverage and time series data:

* Gridded data with different types of spatial grid coverages;
* Triangulated irregular network (TIN) data;
* Data at a set of discrete fixed points;
* Data at a set of moving platforms;
* Time series data at a set of fixed points.

Gridded data will specify either continuous or discrete[[12]](#footnote-12) interpolation between grid points. Data for discrete fixed points, moving platform, and time series at fixed points is intrinsically discrete.

A single data product may contain features of more than one spatial type. For example, the S-102 data model includes a coverage feature of gridded spatial type for depths and a point set feature for overriding values in the gridded features at particular points.

## Discrete coverages

Discrete gridded data is portrayed by placing the appropriate symbol(s) at each grid point that is populated with actual data (grid points where the “data” consists of the fill value or land mask value are not portrayed). The symbols and their portrayal parameters such as size, transparency, and colour tokens are specified in the portrayal catalogue for the data product.

Cursor queries within the extent of a grid should produce a pick report displaying the attributes and values at the grid data points. The neighbourhood for cursor query should correspond to the visual effects of the portrayal, for example:

* A box of dimensions one-half the grid spacing along each axis.
* The same value and geometry (box, circle, etc.) as for point features in the ENC.

Thinning for display at a smaller scale should also be taken into account, and the result should include data from {only visible grid points? all data points within the range of the query, including hidden points? leave it to the manufacturer?}.

In the absence of a prescription in the product specification for how the neighbourhood is to be determined, manufacturers may use any suitable method of their own devising.

Discrete coverages of other types (e.g., multipoints) may be portrayed similarly, by placing the appropriate symbol(s) at each point populated with actual data. Cursor queries should use the same neighbourhoods as cursor queries on ENC point features. As for grids, manufacturers can devise their own methods for determining the neighbourhood in the absence of a method described in the product specification. Thinning, if any, should also be taken into account.

## Continuous coverages

Continuous coverage data can be depicted using a sun-illuminated or static (flat) representation of the dataset. A sun-illuminated depiction requires the entry of a sun azimuth and corresponding altitude angle (or elevation angle). Examples are provided in Table 40. Figure 5 shows the difference between a sun-illuminated and static (flat) surface.

|  |  |  |
| --- | --- | --- |
| **Attribute** | **Value** | |
| **Sun-illuminated** | **Flat surface** |
| Sun Azimuth | 315° | 0° |
| Sun Altitude Angle | 45° | 0° |

Table 40 - Typical sun azimuth and elevation values for sun-illuminated portrayal (S-102)

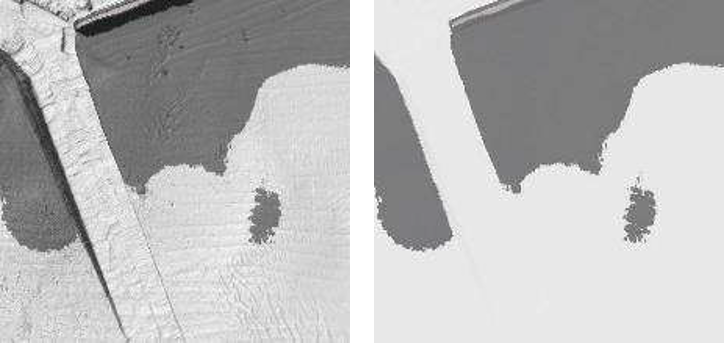


Figure 5 - Illustration of sun-illuminated shading (L) and flat shading (R). (From S-102 2.0.0.)

ECDIS in route monitoring mode should allow sun-illuminated shading only on a side panel or a display separate from the main navigation screen.

Cursor queries within the extent of a continuous coverage feature should produce a pick report displaying the attributes and values at the location of the cursor query. The interpolation method specified in the product specification should be applied.

In the absence of a prescription in the product specification for the values to be returned for a cursor query, manufacturers may determine the values using any suitable method of their own devising, consistent with the requirements of this clause.

Data from any point overrides within a given neighbourhood of the query location must also be returned. The neighbourhood should be as defined in the product specification, or, if the product specification does not define it, the same method as for discrete coverages.

## Contours from continuous coverages

The addition of S-102 datasets enhances the mariner’s ability to render and display, using colours, higher resolution depth zoning directly from the gridded data in S-102.

At time of ingest a display system should delineate navigational depth zones by comparing the depth layer of the S-102 dataset to the mariner defined vessel draft or default safety contour. Navigational depth zones so delineated should be stored on the system for faster retrieval.

## Transparency

The symbol transparency must be adjusted according to the background chart/image used.

## Scaling of symbols

The size of a symbol used for discrete coverages may be scaled in proportion to an attribute value (such as current speed). If scaling is used for a data product, the scaling algorithm must be defined in the product specification. Allowances should be made to (a) display a small symbol even if the attribute value approaches to near zero and (b) enforce a maximum size.

## Thinning

When gridded data is portrayed using discrete symbols at each data point, the effects of scaling the display must be considered. A high-resolution display (that is, zooming in) of regularly gridded data display produces a lower density of data in the visual field. Recommendations in the product specification as to whether spatial interpolation may be used to estimate data values at locations between grid points or point coverage locations must be followed.

Displaying at a low resolution (that is, zooming out) increases the density of symbols in the visual field. However, by applying a thinning algorithm, the number of symbols may be reduced.

This specification requires only that a thinning algorithm be applied to reduce symbol density when the display is scaled. Manufacturers may use the algorithms described below or other algorithms of their own devising.

### Thinning algorithms (informative)

#### Regularly gridded data

Let the grid cell’s diagonal for the unthinned grid at the current display scale be given by *D* mm. Note that *D* is dependent on the dataset and the characteristics of the viewing monitor. If every *nth* cell is displayed, the displayed spacing is *nD*. Next, suppose the maximum dimension of the largest scaled symbol in the displayed field is *Lsmax* mm. Then the ratio *R* of the maximum symbol dimension to the displayed grid spacing is constrained to be less than a prescribed maximum value, *Rmax*. A typical value for *Rmax* can be taken to be 0.5. (Given that on a navigation display there may be point features from other products within the extent of the grid, *Rmax=0.5* may be too high for practical use; the optimal value of *Rmax* is left to manufacturer determination, and may be different for different products, depending on the shape of the symbol.) Then the following inequality must be satisfied for the thinned grid:

If the above inequality cannot be met with increment *n* equal to 1, then a new value for *n* is computed by the following formula:

Where *fix()* is a function that returns the truncated integer value of its argument. For plotting, arrows at every *nth* column and every *nth* row are drawn, making sure that the row and column with the maximum-size symbol is drawn. The value of *n* must be calculated by the system. It also requires identifying a “seed point,” a grid point with the maximum-size symbol from which counting starts. Designating this seed point as *(x0, y0)*, the grid points where symbols are drawn are given by:

This algorithm assumes the grid spacing can be represented by its cell diagonal. It can be adapted to allow for symbols that are aligned parallel to grid axes or for rectangular cells.

The figures below illustrate the use of this algorithm. Figure 6 depicts a grid coverage feature symbolised by arrows of dimensions varying according to the value of an attribute at the grid point. Figure 7 depicts the same data thinned with *Rmax* = 0.5 (outline-only arrows are suppressed). Figure 8 depicts the thinning of the same data with *Rmax* = 0.33. The nominal[[13]](#footnote-13) dimensions and parameters for the three cases are:

Grid spacing at the display scale (*D*): 36mm (grid diagonal)

Scaling of symbols by data attribute values at grid points produced symbols of four sizes (arrow length):

* L0 = 30.4mm = *Lsmax*
* L1 = 17.7mm
* L2 = 16.2mm
* L3 = 12.7mm



Figure 6 - Grid without thinning

For *Rmax* = 0.5, with *n* = 1, the value of *R* is greater than *Rmax*:

Applying the formula for computing *n*:

Counting in row-major order from the grid origin *(0,0)*, the first symbol of size *Lsmax* is located at *(1,1)*. Denoting this point as the seed point *(x0, y0)*, the only grid points where symbols are displayed are:

The results are depicted in Figure 7.



Figure 7 - Grid thinned with *Rmax* = 0.5

For *Rmax* = 0.33, the formula for *n* yields:

and

The results are shown in Figure 8.



Figure 8 - Grid thinned with *Rmax* = 0.33

The algorithm may hide significant characteristics of the data; for example, counting displayable rows and columns starting with the first instance of a maximised symbol may suppress significant information in nearby grid points and produce the wrong overall impression. In Figure 7, row 2 would be suppressed even if all the data points in that row are of the same size as the symbol at (1,1) — this would suppress more data points with scaled-up symbols, which may represent data of more significance to the mariner.

Grid diagonal as a measure of cell spacing is more suitable for grids where cell dimensions along both axes are approximately equal in display units (i.e., in millimetres at the display scale); if there are significant differences, the *D* and *Rmax* parameters will need to be different for the two axes.

Execution of this algorithm would be faster if the grid coordinates of the seed point *(x0, y0)* are known in advance, either encoded by the producer as instance metadata, or calculated when the dataset is ingested into the system. S-100 does not yet provide a standard way of encoding this information.

Manufaturers may extend or adapt this algorithm in various ways, for example:

* Adapt *Rmax* to the shape and proportions of the symbol (i.e., its perceived effect on the display).
* For grids with cells whose dimensions in display units are very different along different axes, use different *D* and *Rmax* parameters for the two axes, giving different values of *n* for different axes.
* Pre-compute and cache the scale values where *n* changes, so that suppression or revelation of symbols can be determined by the scale of the display.
* Adapt the determination of the seed point to show as many significant values as possible.

In order to avoid confusing the mariner, reasonable consideration should be given to generally maintaining the regular appearance of the grid coverage, though some irregularity is probably unavoidable with greater thinning.

#### Irregularly gridded data

Thinning of irregularly-spaced symbols is more difficult. For each on-screen point the distance to all other on-screen points would have to be calculated, so that the closest point can be determined. The size and maximum dimension of the symbols at the point and its nearest point would be compared for overlap. If overlap occurred, one of the symbols would be eliminated. This procedure would be carried out for all on-screen points, keeping track of which points and their symbols had been eliminated.

An alternate solution would be to reduce the reference height of the symbol at its nomimal size or increase the reference values at which symbols are scaled. Caution may be needed with this approach to avoid giving the user the wrong impression about magnitudes of data values as the display is zoomed.

Another method, based on the assumption that non-regularly spaced data values are ordered in a nearly random manner, would be to reduce the number of symbols by plotting only every *nth* vector. This method would require that the value of *n* be entered by the user.

## Temporal variation

The metadata variables related to time are *dateTimeOfFirstRecord*, *dateTimeOfLastRecord*, *timeRecordInterval*, *numberOfTimes, timeIntervalIndex, timePoint, startDateTime,* and *endDateTime* (see S-100 Tables10c-12 and 10c-19). The time selected for display (that is, past/present/future) will typically not correspond exactly to the timestamp (metadata variable *timePoint*) of the input data. For a correct display, the ECDIS will have to select the correct data.

For data with only a single timed record (where the timestamp of the earliest value equals that of the latest value) such as real-time data, the data values are displayed only if the display time is later than the timestamp and the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example 5 minutes). For a single record, the variable *timeRecordInterval* can be used to set the discrimination interval.

For data with multiple times, if the selected display time is later than the first timestamp and earlier than the last timestamp, or the selected display time is in the interval [*startDateTime,* *endDateTime]*, then the closest but immediately preceding values in the data are displayed. However, if the selected display time is earlier than the first timestamp, or outside the interval [*startDateTime*, *endDateTime*] then the data is not displayed. If the selected time is later than the last timestamp or after *endDateTime*, then data values at that time are displayed only if the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example the value of the variable *timeRecordInterval*).

Some data change rapidly, so more-or-less continual revision or updating of such data is essential. For real-time observations, new values are periodically collected (e.g., on the order of once every 5 minutes).

For a forecast, the entire field may be created one or more times per day.

New issues of real-time observations or forecasts may not be considered as new editions, but as new datasets. New datasets may be distinguished by a unique datetime in the file name.

New editions may be encountered in predicted time series data.

Other data, such as tidal atlas or harmonic constant data are updated much less often, typically on an annual basis.

The system should check for the availability of new data at a frequency that matches the update frequency.

## Animations of coverage and time series data

If timelined data is available, it may be possible for manufacturers to program display of animations from available data. Timelined data may be available in various forms, for example, a time series feature, a collection of timestamped features representing the evolution of the same phenomenon over time, or a sequence of timestamped datasets representing the same information for a spatial location over time.

Before developing an animation, manufacturers should consider how closely it represents physical reality over time, and whether it contributes to mariners’ understanding of the phenomenon as it relates to ship operations. For example, surface currents can change relatively quickly over time and space and an animation of surface currents derived from 6-hourly datasets may misrepresent reality during a short-period animation (e.g., frames at 6-minute intervals).

In general, product specifications dealing with coverage data will address the suitability of their data for animation or interpolation either directly or indirectly. For example, the S-111 product specification recommends against spatial or temporal interpolation of surface current data (and declares the interpolation type as “discrete” for its gridded data features). In case of doubt, manufacturers should contact the organisation responsible for the product specification to discuss the matter.

### Display of animations

Animations of S-100-based datasets should not be displayed on the ECDIS when it is being operated for route monitoring or collision avoidance.

Animations of S-100-based datasets may be displayed at user request when the display is being operated in simulation or planning mode. The user should be able to turn display of animations on or off.

Animations of information other than S-100-based data, or of S-100-based data on displays playing other roles, should conform to the applicable rules and general principles in the relevant IMO performance standards or equivalent standards from another organisation.

### Accuracy of animations

Any interpolation in time or space needed for animations must conform to the nature of the coverage and any interpolation type that may be specified in the dataset. For example, animations of S-111 surface current data should not use spatial interpolation for any of the spatial types allowed in the S-111 product specification, because either the spatial type is inherently discrete (moving platforms, fixed stations) or declared to have interpolation type “discrete” in the S-111 product specification (regular and ungeorectified grids).

If the data cannot be temporally interpolated, the “frame rate” of animations may be limited by the temporal granularity of available information. For example, observations at 6-hourly intervals may not be usable for an animation speed representing 6-minute intervals.

In case of doubt, the organisation responsible for the product specification should be consulted.

## Legend

The legend, which is to be displayed as an option, must show the relationship between the symbol characteristics and data values, if one exists. The precise position of the legend if it appears on the monitor should be determined so as to minimize the obscuring of other important navigational information.

## Conflicting displays

Some product specifications may require that conflicting symbols be removed from the display. For example, S-111 states “When an S-111 dataset is displayed, symbols from the S-101 ECDIS nautical charting suite, in the area where the new data is displayed, must not be displayed. Such symbols include those for tidal stream tables (plus their points and boundary areas), flood and ebb tide stream arrows and their values and boundary areas, and other symbols for rip currents, eddies, breakers, and non-tidal currents.”

In S-100 5.0.0 and earlier, implementing such requirements requires either customized processing (customized to the data product) or activation of interoperability (and that the interoperability catalogue contain an interoperability rule implementing the requirement).

# Colours

## General

In portrayal catalogues, colours are specified in one or both of CIE (Commission Internationale de l'Eclairage) or sRGB colour space coordinates[[14]](#footnote-14). CIE colour specifications use xy chromaticity coordinates and luminance L. The sRGB colour space (IEC 61966-2-1) defines colours in terms of the chromaticities of red, green, and blue primary colours.

The ECDIS colour scheme is based on specification of colour tokens and color conversion tolerances.

Note that these colour specifications apply to both the operational chart display (for route planning and route monitoring), and also to any text on the same screen as the chart display.

## Selection of colours (informative)

Since chart and navigation lines and symbols must show clearly against the background shades, the colour palettes were constructed by first selecting the background area shades and then selecting colours for lines and symbols that contrast with their background. In selecting foreground colours for point and line features, lines and symbols, the aim has been to highlight important information by giving it greater contrast with the background.

In order to accommodate the very large change in bridge lighting between bright sun and dark night, the colours switch from a light background with dark foreground details, which has been found to give the best contrast under bright sun, to a dark background with light foreground details by night. The night display has to be dim enough that it can be viewed without impairing the mariner's night vision. The Dusk table is also a black-background table, for optional use by day as well as at twilight.

The design of both colours and symbols has concentrated on ensuring that important chart and navigation features remain clearly visible under the extremes of bright sun and dark night viewing.

## The colour palettes

There are three colour palettes, all of which should be made available to the mariner. They are specified as part of the colour profile file(s) in the portrayal catalogues. They are as follows:

DAY The "Day" palette uses a white background as a result of a comparative test outdoors in bright sunlight which showed that a display background of maximum luminance gives the best contrast achievable under near-washout conditions. This conclusion has been confirmed by subsequent sea experience.

DUSK The "Dusk" colour palette is based on using a black background; this palette may also be used by day as a mariner's option.

NIGHT The “Night” colour palette is intended for nighttime use. At night the light emitted by the display must be strictly limited to avoid impairing night vision. In case the luminance needs to be further reduced, the "Night" colour palette may be augmented by a luminance-reducing neutral density filter which should have 8 times attenuation, designated (logarithmically) "0.9 ND". (This is a manufacturer's option.)

## Transparency

### Use of transparency (informative)

Transparent area colour fill is used for the following purposes:

1. so that the background colours, lines and symbols show through an area shade (for example, depth shades and contours should show through a traffic separation zone);
2. to reduce the prominence of a large symbol (for example, too prominent a centred anchorage area symbol would cause clutter on the display);

When interoperability processing is activated, interoperability rules should take precedence over the purposes above in case of conflict; but if transparency for the above purposes can be used without overriding an interoperability rule, it should be used.

### Methods for transparent fill

Transparent fill can be achieved by implementations in two ways:

1. with a given percentage of the pixels having the transparent fill colour (pseudo-transparency);
2. by mixing the fill and underlying colour at each pixel to give a continuous transparency change from 0% to 100%. This should be done in such a way that no appearance of colour or shape change occurs in any SENC feature on the display, at any intermediate transparency value. The underlying SENC information should remain distinguishable, except when the overlay colour approaches 100%.

Transparency (or “fill-opacity”) values for symbols, text, linestyles, and fills are specified in portrayal catalogues. Transparency can be specified as part of an SVG or XML symbol specification, in an instruction generated by a portrayal rule, or a stylesheet. SVG uses the second method above (“simple alpha compositing”) for its “opacity” property (see the SVG-Tiny specification [SVG-Tiny], which is the normative SVG specification for symbol definition in S-100).

Since transparency is a CSS property (“opacity”), CSS stylesheets can be used to set transparency (see clause C-8.2.7). The transparency method is the same as SVG. Dynamic changes to transparency by swapping CSS stylesheets are also possible. However, the CSS model imposes limitations which may constrain the utility of CSS for controlling transparency.

When method 1 and a 4 pixel group are used to achieve transparency then only the percentages 25%, 50% and 75% can be used for the transparency. For compatibility with both transparency methods only percentage values 25%, 50% and 75% for transparency should be used within portrayal catalogues.

The following explains the pseudo-transparency that can be achieved by method 1:

If an area of 2 by 2 pixels has to be filled with a transparent colour only 3, 2 or 1 pixel(s) of this area are tinted with the opaque fill colour while the remaining pixel(s) are tinted using the colour 'TRNSP' (= 100% transparent), which means the colour fill is not performed for these pixels. Figure 9 depicts the pixel fill sequence for each pixel group. Thus the colour of the underlying pixels still can be seen through. On a high-resolution screen the result will be very close to a real transparent fill.

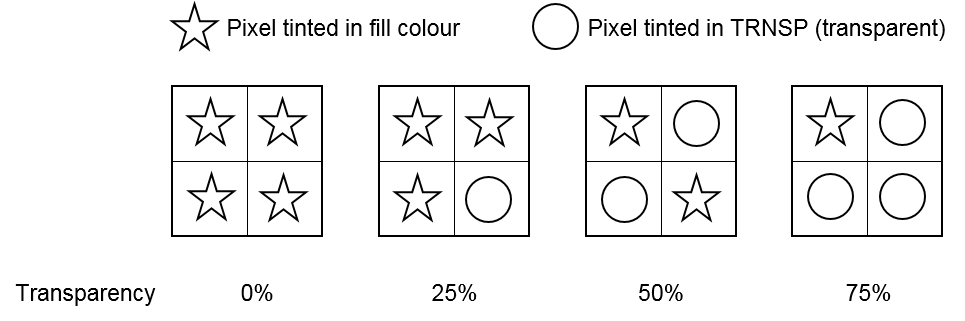


Figure 9 - Pseudo-transparency

## Colour assignment for navigation systems

### Introduction to colours (informative)

Since chart and navigation lines and symbols must show clearly against the background shades, the colour tables were constructed by first selecting the background area shades and then selecting colours for lines and symbols that contrast with their background. In selecting foreground colours for point and line features, lines and symbols, the aim has been to highlight important information by giving it greater contrast with the background.

In order to accommodate the very large change in bridge lighting between bright sun and dark night , the colours switch from a light background with dark foreground details , which has been found to give the best contrast under bright sun, to a dark background with light foreground details by night. The night display has to be dim enough that it can be viewed without impairing the mariner's night vision. The Dusk table is also a black-background table, for optional use by day as well as at twilight.

The design of both colours and symbols has concentrated on ensuring that important chart and navigation features remain clearly visible under the extremes of bright sun and dark night viewing.

### Colour assignments

The general colour assignment for navigation systems follows the guidance in clause 7-1 in Part 16A, reproduced below.

| **Colour** | **Usage** |
| --- | --- |
| black/white | (black by day / white by night) is used for critical navigation features which need highlighting by contrast against their background to give them adequate prominence. Examples are the own-ship symbol, dangerous soundings equal to or less than the safety depth, buoys, conspicuous objects on land etc. It is also used for text, which is less clear in any other colour. |
| white/black | (white by day / black by night) as a background area shade is used for deep, safe, water. |
| magenta | is used to highlight critically important features such as isolated dangers, traffic routes, anchorages; and for restricted areas, submarine cables, gas pipelines etc. It is also used for aids to navigation and services such as daymarks, racons, and pilot stations. |
| grey | is used for many features which are black on the paper chart. It is used with thick lines for critical physical objects such as bridges and overhead cables, and with thin lines for important but less critical physical features such as non-dangerous soundings, sandwaves, overfalls, water pipelines and fish farms. It is similarly used for chart features such as fairways, harbour areas, tidal information and for information about the chart such as quality of chart data, overscale areas, etc. |
| grey | as a background area shade is used with a prominent pattern for no-data areas. |
| blue | as a background area shade is used to distinguish depth zones. |
| blue | as foreground colour for AIS and VTS information; also reserved for future requirements. |
| green | is used for the radar image and synthetics, and for buoy and lights colours. |
| blue-green | is used for transferred ARPA. |
| yellow-green | ('moss-green') as a background area shade is used for the intertidal area between high and low waterlines. |
| yellow | is used as the manufacturer's colour; for the mariner's transparent colour fill; and for buoy and lights colours. |
| red | is used for the important planned route, for the mariner's danger highlight, and for buoy and lights colours. |
| orange | is the mariner's colour, for notes, chartwork, chart corrections. The scale bar, north arrow, and mariner's navigation objects such as EBLs and VRMs are also orange. |
| brown | as a background area shade is used for the land, and dark brown is used for features on land and in the intertidal area that do not have any strong significance for navigation. |

Table 41 - General colour assignments

## Colour tokens, profiles and palettes

Colour tokens and colour profiles should be registered in the Portrayal Register in the GI Registry prior to use in portrayal catalogues. The same colour tokens may be used by different data products. Product specifications should use the same colour tokens as S-101 for feature types and sub-types that are conceptually similar to S-101 feature types.

The colours in this section are specifically designed for chart display.

Table 42 lists colour tokens used in ECDIS displays and describes their roles and significance. This table is not a comprehensive list of colour tokens; see the colour profile files in the portrayal catalogues of individual products for the full list of colour tokens used by each product.

NOTE: This table is useful information for implementations and should be available to implementors for completeness. It should also be kept updated with information pertaining to other product specifications. It is provided as part of this edition because there is at present no apparent provision for publishing it as a “living document”. Future editions may replace it by a reference to a “living document” in the IHO GI Registry or the IHO Web site.

| **Token** | **Colour, day/night** | **Usage** | **Significance** |
| --- | --- | --- | --- |
| ***Colours for chart features*** | | | |
| CHBLK | black/grey | general | This selection of colours is used in general to design symbols and chart line features as well as fill styles. They are not used in cases where other colours are available for a special usage. |
| CHGRD | grey dominant | general |
| CHGRF | grey, faint | general |
| CHRED | red | general |
| CHGRN | green | general |
| CHYLW | yellow | general |
| CHMGD | magenta, dominant | general |
| CHMGF | magenta, faint | general |
| CHBRN | brown | general |
| CHWHT | white | general |
| OUTLW | black | symbol outline on sea area background | These colours are used to outline symbols depending on which background they are normally shown (water/land). |
| OUTLL | pale/dark brown | symbol outline on land area background |
| LITRD | red | red lights | Light symbols have their own colours to give the opportunity to influence their colour luminance individually. Yellow (LITYW) is used for white, yellow, orange and amber lights because it might be difficult to distinguish these colours from each other on a badly calibrated monitor. It also follows the tradition to show up white lights with a yellow flare or coloured arc. |
| LITGN | green | green lights |
| LITYW | yellow | white/yellow/orange/amber lights |
| ISDNG | magenta | isolated danger | Since the isolated danger symbol forms one of the most important items on the ECDIS screen, it is given a separate colour. |
| DNGHL | red | danger highlight | This colour is used for symbology that highlights Mariner selected dangers. The Mariner decides during route planning which features are highlighted by this colour. |
| TRFCD | magenta, dominant | traffic control features | Traffic separation schemes are complex chart features. The navigator is confronted with important elements of the schemes and with less important elements as well. TRFCD is used to distinguish important traffic routeing features. |
| TRFCF | magenta, faint | traffic control features |
| LANDA | brown | Land areas | This colour is used for land areas in general. |
| LANDF | brown | Landforms, land features | Landforms and land features are given a contrasting brown. |
| CSTLN | black/grey | Coastline, shoreline constructions | The coastline is a very important feature of the chart. If a radar image is combined with the chart picture it is required that coastline elements clearly show up on top of the green radar picture (see also RADHI/RADLO). To have full control over this combination under all conditions (day/night) a separate colour is reserved for coastline features. |
| SNDG1 | grey | deep soundings > safety depth | This colour is used for soundings that are deeper than the selected safety depth ("safe" soundings). |
| SNDG2 | black/white | shallow soundings <= safety depth |  |
| DEPSC | grey | safety contour | This colour is reserved for the selected safety contour. |
| DEPCN | grey | depth contours | All depth contours other than the safety contour should use this colour. |
| DEPDW | white/black | deeper than selected deep contour | These are depth shades. The depth zones are:   * DEPDW: areas deeper than the Mariner-selected deep contour; * DEPMD: areas between deep contour and the Mariner-selected safety contour; * DEPMS: areas between safety contour and the Mariner-selected shallow water contour; * DEPVS: areas between shallow water contour and the low water line (zero meter contour); * DEPIT: areas between zero meter contour and coastline (intertidal).   For route monitoring it may be desirable to distinguish only two water shades, plus DEPIT: deeper than own ship's safety contour and shallower than safety contour. In that case DEPDW and DEPVS should be used.  At night it may be difficult to distinguish between DEPMD and DEPDW. |
| DEPMD | pale/dark blue | safety contour to selected deep contour |
| DEPMS | light/medium blue | shallow contour to selected safety contour |
| DEPVS | medium/light blue | zero meter contour to shallow contour |
| DEPIT | yellow-green | high water line to zero meter contour |
| ***Radar image overlay colours*** | | | |
| RADHI | green | high intensity echo or single intensity echo | The radar image overlay can be generated by using either one intensity colour or a range of intensities. The colour for high echo intensity (RADHI) should be used where only one intensity is used. If you prefer to show more than one echo intensity or fading target trails, the corresponding colour intensities should be interpolated between the colour for high echo intensity (RADHI) and the colour for low echo intensity (RADLO).  Optionally, the manufacturer may vary the radar green overlay by making it transparent. |
| RADLO | green | low intensity echo & target trail |
| ARPAT | green, dashed | ARPA, target symbols & information | used for ARPA targets and information tagged on them |
| ***Mariners’ and navigation information colours*** | | | |
| SCLBR | orange | scalebar | Used to generate the scalebar |
| CHCOR | orange | chart corrections | Hand entered chart corrections are marked by the colour |
| NINFO | orange | Navigators Notes | Mariners' notes of any form (Symbols, Text) are generated using the colour |
| ADINF | yellow | Mariners' transparent area fill and manufacturers' points and lines |  |
| ***Ships symbol and planned route*** | | | |
| SHIPS | black/white | own ship, Course & Speed Made Good vector |  |
| PSTRK | black/white | Past Track |  |
| SYTRK | grey | Secondary Track |  |
| PLRTE | red | planned route & notations |  |
| APLRT | orange | alternate planned route |  |
| ***Other colours*** | | | |
| RESBL | blue | AIS features and symbols |  |
| RESGR | grey | reserved for line features & screened areas |  |
| BKAJ1 | black | black level test symbol background |  |
| BKAJ2 | grey | black level test symbol foreground |  |
| TRNSP | 100% transparent | transparent | This means a 100% "transparent" colour. This is not a "real" colour since it is invisible. Every pixel on the screen, which has the colour value 0 shows up as 100% transparent. In case the pixel was already painted with another (visible, for example black) colour this colour is not overwritten by the transparent colour. In case the pixel was cleared before or not yet painted the "background" colour shows up (contrast to NODTA). |
| NODTA | grey | Areas without chart data | This colour shows up on every pixel on the screen, which is neither covered by chart features nor covered by other elements of the ECDIS display (for example radar overlay, user interface). Thus, it can also be called the "empty background colour" (contrast to TRNSP). |
| CURSR | orange | Cursor | In most graphic systems the cursor is treated as an item that can be handled completely independent from the graphic of the chart area. Therefore the cursor is given its own colour and it is kept separately from the other sections of the colour scheme. The cursor colour is also used by variable range marker (VRM), electronic bearing line (EBL), parallel indexing lines and other tools to perform absolute and relative measurements in the chart. |
|  |  |  | [To be added - significant colour tokens for other “important” data products, taken from the product specifications, if they are defined there.] |

Table 42 - Significance of colour tokens for ECDIS displays

The active colour palette detemines the colour coordinates assigned to colour tokens in any particular display. Colour palettes for day, night, and dusk viewing conditions are required for S-101 and any other S-100 product intended for viewing on the navigation display.

# Cursor Pick Reports and Displays in Interface Panels

ECDIS must be capable of performing spatial queries on ENC and other data during import and symbolisation. Spatial query is understood as possibility to inspect graphical position and numerical value of spatial coordinates associated with a charted feature. Spatial query could be available as by means of cursor pick or as an independent function.

## Cursor pick rules

The rules below must be applied to all ECDIS cursor pick reports.

1. Full feature and attribute names should be displayed.
2. Listed value names should be displayed.
3. There should not be any padding of attribute values, for example, a height of 10 metres should not be padded to 10.000000 metres as this could potentially confuse or mislead the Mariner.
4. Units of measure should be included after all attribute values which are weights or measures.
5. Cursor enquiry should extend to include both information associations and feature associations, including aggregations and compositions, which may link to information types or features that carry additional information such as a *featureName*.
6. Dates should be given in the form “Day Month Year” DD-MMM-YYYY.

Month abbreviations should be: JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC.

1. The pick report should only return information about the visible features on the ECDIS display. If the viewing group is turned on all features even no symbol features without visible presentation within that viewing group are available via the cursor pick report.
2. Cursor enquiry should extend to the uncertainty of the spatial object, including attributes *quality of horizontal measurement*, *vertical uncertainty*, and *horizontal position uncertainty* from an associated *Spatial Quality* information type.
3. The pick report should indicate the data product from which the information is extracted. Descriptive data product names or abbreviations as should be preferred if possible (e.g., “ENC” or “Electronic Navigational Chart”, not “S-101”). The Dataset Identification in the Product Specification and dataset discovery metadata in the exchange catalogue should contain this information.

Data from different products and viewing groups should be organized to facilitate navigation through complex reports in a manner logically consistent with the layering of products and groups on the screen.

## Pick report descriptions

A plain language explanation of each symbol is included in the portrayal catalogue. This gives the mariner quick and understandable information which is not always obvious from the feature class and attribute information. The manufacturer should always provide explanations to the Mariner in response to a cursor pick on the symbol.

Attribute values provided in addition to the above explanation should be connected to their meaning, and the definitions should also be available. The definitions should be included in the XML feature catalogues for the data products.

### User defined cursor pick parameters

The mariner should be able to configure the content displayed in the pick report.

### Sorting order of results

A general cursor enquiry should be sorted by the drawing priority of the feature as defined in the portrayal catalogue. When the drawing priority of features is equal, the geometric primitive will be used to order the information, points followed by curves and finally surfaces.

Data from different products and viewing groups should be organized to facilitate navigation through complex reports in a manner logically consistent with the layering of products and groups on the screen.

### Hover-over function

OEMs may wish to include hover-over functions for Mariners to access important charted feature details without having to select a pick report. If this function is implemented within an ECDIS, the Mariner should be able to configure the system to turn hover-over functionality on and off.

The hover-over function should only be used on the following features and for the symbols SY(INFORM01) and SY(CHDATD01). Table 43 lists the features that should provide hover functionality. (Features are from S-101 unless otherwise indicated.)

| Features | Feature Type |
| --- | --- |
| Lights | LightsAllAround |
| LightsSectored |
| LightFogDetector |
| LightAirObstruction |
| Beacon, cardinal | BeaconCardinal |
| Beacon, isolated danger | BeaconIsolatedDanger |
| Beacon, lateral | BeaconLateral |
| Beacon, safe water | BeaconSafeWater |
| Beacon, special purpose/general | BeaconSpecialPurpose |
| Buoy, cardinal | BuoyCardinal |
| Buoy, installation | BuoyInstallation |
| Buoy, isolated danger | BuoyIsolatedDanger |
| Buoy, lateral | BuoyLateral |
| Buoy, safe water | BuoySafeWater |
| Buoy, special purpose/general | BuoySpecialPurpose |
| Landmarks | Landmark |

Table 43 - Features with hover-over functionality

### Unknown attributes

When the ECDIS encounters an unknown attribute not present in the product’s feature catalogue its value should be available via the ECDIS cursor pick.

## Cursor queries on coverage data

Cursor queries on continuous gridded coverage data should report the coverage feature’s data values corresponding to the spatial location indicated by the cursor query. The data values reported should be those at the nearest data point for discrete coverages, or interpolated values for continuous coverages.

For discrete coverages, the data point from which the result is reported should be highlighted. Highlighting grid data points is not required for continuous coverages.

Depictions of results may be customized by the product specification or manufacturer, provided important information in other parts of the display is not obscured. For example, time series information may be depicted using a graph.

See clauses C-15.1 and C-15.2 for more information on methods and rules for cursor queries on coverage features.

## Tidal stream data panels

When a **TidalStreamPanelData** feature is encoded within ENC, the data from the attributes should be formatted for display in the ECDIS cursor pick report. Table 44 shows the template that should be used for displaying the values. (The “Hours” values should be the actual values in the *timeRelativeToTide* attribute.)

|  |  |  |  |
| --- | --- | --- | --- |
| Tidal Station: (station name) | | | |
| Tidal Station Identifier: (station number) | | Data From: (data product, from dataset metadata) | |
|  | Hours | Direction of stream (degrees) | Rates at spring tide (knots) |
| Before | -6 |  |  |
| -5 |  |  |
| -4 |  |  |
| -3 |  |  |
| -2 |  |  |
| -1 |  |  |
| (reference tide) | 0 |  |  |
| After | +1 |  |  |
| +2 |  |  |
| +3 |  |  |
| +4 |  |  |
| +5 |  |  |
| +6 |  |  |

Table 44 - Template for tidal stream values

Table 45 below relates an exemplary S-101 Tidal Stream Panel Data feature and its attributes to its display. S-101 has modelled the tidal stream panel data as a series of complex attributes. Complex attributes are in italics and encoded values are in blue text.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tide Stream Panel Data (feature)** | | | | **Example of ECDIS depiction** |
| Station name | | PLYMOUTH (DEVONPORT) | |  |
| Station number | | 0014 | |
| *Tide stream panel values* | | | |
| Reference tide | high water | | |
| Reference tide type | springs | | |
| *Tide stream value* | *Orientation* | Orientation Value | 113 |
| Time relative to tide | | -6 |
| speed maximum | | 0.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 332 |
| Time relative to tide | | -5 |
| speed maximum | | 0.6 |
| *Tide stream value* | *Orientation* | Orientation Value | 331 |
| Time relative to tide | | -4 |
| speed maximum | | 1.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 342 |
| Time relative to tide | | -3 |
| speed maximum | | 1.0 |
| *Tide stream value* | *Orientation* | Orientation Value | 347 |
| Time relative to tide | | -2 |
| speed maximum | | 0.7 |
| *Tide stream value* | *Orientation* | Orientation Value | 333 |
| Time relative to tide | | -1 |
| speed maximum | | 0.5 |
| *Tide stream value* | *Orientation* | Orientation Value | 317 |
| Time relative to tide | | 0 |
| speed maximum | | 0.3 |
| *Tide stream value* | *Orientation* | Orientation Value | 178 |
| Time relative to tide | | 1 |
| speed maximum | | 0.3 |
| *Tide stream value* | *Orientation* | Orientation Value | 146 |
| Time relative to tide | | 2 |
| speed maximum | | 0.6 |
| *Tide stream value* | *Orientation* | Orientation Value | 140 |
| Time relative to tide | | 3 |
| speed maximum | | 1.0 |
| *Tide stream value* | *Orientation* | Orientation Value | 143 |
| Time relative to tide | | 4 |
| speed maximum | | 1.1 |
| *Tide stream value* | *Orientation* | Orientation Value | 143 |
| Time relative to tide | | 5 |
| speed maximum | | 0.8 |
| *Tide stream value* | *Orientation* | Orientation Value | 138 |
| Time relative to tide | | 6 |
| speed maximum | | 0.3 |

Table 45 - Example of tidal stream panel data and its ECDIS display

## Schedules, contact Information, and vessel characteristics

[Templates to be developed.]

## Special pick report formats

Some product specifications may require or suggest specific layout and contents for pick reports (examples are shown in Figure 10). Since there is at present no generic format for defining such custom pick reports, manufacturers will need to develop their own solutions.

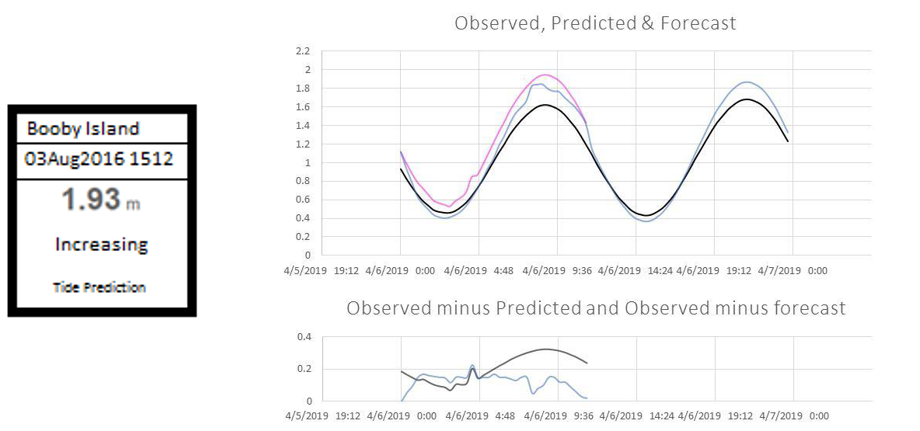


Figure 10 - Examples of special formats: Water level at a station (L) and graphic showing time series of water level data (R)

# Alerts and Indications

IMO Resolution MSC.232(82) states in 11.3 and 11.4 and their sub paragraphs how an ECDIS should respond to risk of crossing, dangers, prohibited areas or areas with special conditions. Appendix 4 and Appendix 5 of the same resolution provide details about the areas for which an ECDIS should detect incursions and provide an alert or indication.

All product specifications which are intended for navigation should specify any feature combinations that match one or more of the areas for which alarm or indication should be given to ensure there is a harmonized implementation of alarms and indications in navigational products. Such specification could be done using a machine-readable alerts and indication catalogue.

Clauses C-14.9.7 and C-14.9.8 list the features to which close approaches should cause alerts or indications. C-14.9.10 lists the conditions and geometry that constitute the safety contour and should therefore be used when raising the safety contour alarm. The alerts in this table are from MSC 232(82) and IEC 61174. Radar, AIS and sensor/system malfunction alerts are not included (struck through).

| **Implementing Clause** | **Alert or indication** | **Description** | **Reference** |
| --- | --- | --- | --- |
| C-14.9.10 | Alarm | Crossing safety contour | MSC.232(82) 11.4.3 |
| C-14.9.8 | Alarm or Indication | Area with special conditions | MSC.232(82) 11.4.4 |
| C-14.9.12  (S-421?) | Alarm | Deviation from route | MSC.232(82) 11.4.5 |
| ~~N/A~~ | ~~Alarm~~ | ~~Positioning system failure~~ | ~~MSC.232(82) 11.4.8~~ |
| C-14.9.12  S-421(?) | Alarm | Approach to critical point | MSC.232(82) 11.4.9 |
| TBD | Alarm | Different geodetic datum | MSC.232(82) 11.4.10 |
| ~~N/A~~ | ~~Alarm or Indication~~ | ~~Malfunction of ECDIS~~ | ~~MSC.232(82) 13.2~~ |
| C-14.5.1 | Indication | Default safety contour | MSC.232(82) 5.8.3 |
| C-14.1.2 | Indication | Information overscale | MSC.232(82) 6.1.1 |
| C-14.1.5 | Indication | Larger scale ENC available | MSC.232(82) 6.1.2 |
| N/A | Indication | Different reference system | MSC.232(82) 7.3 |
| C-14.3.3 | Indication | No ENC available | MSC.232(82) 8.5 |
| C-10.3.1  C-10.1.4 | Indication | Customized display | MSC.232(82) 10.5 |
| C-14.9.10 | Indication | Route planning across safety contour | MSC.232(82) 11.3.4 |
| C-14.9.8 | Indication | Route planning across specified area | MSC.232(82) 11.3.5 |
| C-14.9.7 | Indication | Crossing a danger in route  monitoring mode | MSC.232(82) 11.4.6 |
| ~~N/A?~~ | ~~Indication~~ | ~~System test failure~~ | ~~MSC.232(82) 13.1~~ |
|  | Indication | Route close to point object | MSC.232(82) 11.3.5 |
| C-10.1.3 | Indication | Chart display includes non-official data | C-10.1.3 (this Annex)  IEC 61174 4.8 |
| N/A | Warning | Outside anchor watch area | IEC 61174 4.6.6 |
| C-10.1.3  TBD (note 2) | Permanent Indication | SENC data from non-HO source is in use and presentation is different from IHO | IEC 61174 4.8 |
| TBD | Permanent Indication | Off state of route planning across safety contour, prohibited areas and hazards indication | IEC 61174 4.10.2.1 |
| TBD | Permanent Indication | Off state of safety contour, prohibited area and hazard indication in route monitoring | IEC 61174 4.10.3 |
| N/A | Permanent Indication | Chart scale is not uniform over the displayed area | IEC 61174 5.2.1  C-14.9.1 |
| C-14.7.3 | Permanent Indication | Viewing date or date range does not include current date | IEC 61174 |
| N/A | Permanent Indication | Chart orientation is not uniform over the displayed area | IEC 61174 5.8.1  C-14.9.2 |
| C-23.3.2  (note 3) | Permanent Indication | Out of sequence update | C-23.3.2 |
| ~~N/A~~ | ~~Alarm~~ | ~~CPA/TCPA~~ | ~~IEC 61174 4.6.2.3, 4.6.6~~ |
| ~~N/A~~ | ~~Warning~~ | ~~Lost target~~ | ~~IEC 61174 4.6.2.3, 4.6.7~~ |

Table 46 - Alerts and their implementing clauses

NOTES:

1) N/A (Not Applicable) for the implementing clause means implementing the alert does not involve conditions or queries on features or datasets.

2) IEC 61174 4.8 apparently conflicts with the statement in C-10.1.3: “If the manufacturer should add non-official information to the SENC it should be symbolised in the same way as official chart information.”

3) According to this Annex it would be rejected and never appear on the display.

# Use of Context Parameters

The Portrayal Register in the GI registry contains a list of predefined context parameters used in S-100 portrayal catalogues. Manufacturers may add additional parameters, but should not change the names, roles, or data types or predefined parameters, or substitute other parameters of the same scope.

The portrayal catalogue for a product contains the set of known parameters which may be used in the portrayal processing for that product. This set may be different for different products[[15]](#footnote-15). Context parameters are used for passing portrayal-related configuration information and user settings to portrayal processing, and the values of context parameters may therefore be changed by user functions, including those defined in the IMO performance standards, in this document, or manufacturers’ custom user functions.

In order to be able to use the official portrayal catalogue for a data product, manufacturers must implement all the context parameters listed in the portrayal catalogue. The context parameters used in a portrayal catalogue are listed in the **<context>…</context>** section of the portrayal catalogue XML file.

## Context parameters for ECDIS functionality

The following parameters are used in the S-101 portrayal catalogue for implementing mandatory and optional ECDIS functionality mandated by the IMO performance standards, listed in Table 20 (Clause C-10.9). Since they are used by rules in the IHO portrayal catalogue for S-101, they should be implemented without change by manufacturers in order to maintain compatibility with the IHO portrayal catalogue for S-101.

| **Parameter** | **ECDIS user function** |
| --- | --- |
| ? | Accuracy |
| ? | Date dependent |
| Full sectors | Full light lines |
| ? | Highlight date dependent |
| ? | Highlight info |
| ? | Highlight document |
| ? | Unknown |
| ? | Update review |
| Ignore scamin | Scale min |
| Shallow pattern | Shallow pattern |
| Show isolated dangers in shallow waters | Shallow water dangers |
| ? | Contour label |
| Two shades(?) | Four shades |
| National language | National language |
| Simplified points | Paper chart / simplified symbols |
| Plain boundaries | Plain / Symbolized boundaries |
| Deep contour |  |
| Radar overlay |  |
| Safety contour |  |
| Safety depth |  |
| Shallow contour |  |
| Two shades |  |

Table 47 - Cross-reference between context parameters and ECDIS user function

Table 47 provides more complete details about known parameters, product specification(s) which use them, and configuration or user setting information they convey to portrayal processing.

NOTE: This table collects information that can be gathered from individual product specifications, the IMO specifications, and the IHO GI Portrayal Register, but is not currently presented in complete form anywhere. It should be kept updated as product specifications are published and revised. It is temporarily provided in this document because there is no provision at present for publishing it as a “living document”. Future editions of this document may replace it by a reference to a “living document” in the IHO GI Registry or the IHO Web site. [If this matrix is retained, it will probably become large enough that it should be turned into a spreadsheet and placed on the IHO Web site or GI registry, and maintained as a separate document.]

| **Parameter** | **Definition** | **Source** | | | | | | | | | | | | **Datatype** | **Default** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IMO Perf. Stds. citation** | **S-98** | **S-101** | **S-102** | **S-104** | **S-111** | **S-122, S-123, S-127** | **S-124** | **S-129** | **S-412, S-413, S-414** | **S-421** | **(citation in this document)** |
| Deep contour | Selected deep water contour (meters) |  | -- | O | ? | ? | -- | -- | -- | ? | -- | -- |  | Double | 30 |
| Full sectors | Show full light sectors |  | -- |  | -- | -- | -- | -- | -- | -- | -- | -- |  | Boolean | true |
| Ignore scamin | Ignore the scaleMinimum attribute |  | -- |  | -- | -- | -- | -- | -- | -- | -- | -- |  | Boolean | false |
| National language | Selects which language to use for text (ISO 639-3/T alpha3 code) |  | M | M | M | M | M | M | M | M | M | M |  | String | eng |
| Plain boundaries | simplify portrayal of lines |  | -- | M | -- | -- | -- | ? | -- | -- | -- | -- |  | Boolean | false |
| Radar overlay | Tells the portrayal whether a RADAR sweep is displayed or not |  | M? | M | M? | M? | M? | M? | M? | M? | M? | M? |  | Boolean | true |
| Safety contour | Selected safety contour (meters) |  | -- | M | ? | ? | -- | -- | -- | ? | -- | -- |  | Double | 2 |
| Safety depth | Selected safety depth (meters) |  | -- | M | ? | ? | -- | -- | -- | ? | -- | -- |  | Double | 30 |
| Shallow contour | Selected shallow water contour (meters) |  | -- | O | ? | ? | -- | -- | -- | ? | -- | -- |  | Double | 30 |
| Shallow pattern | Show the shallow diamond pattern in shallow water |  | -- | M | -- | -- | -- | -- | -- | -- | -- | -- |  | Boolean | false |
| Show isolated dangers‌‌ in shallow waters | Show isolated dangers in shallow waters |  | -- | M | -- | -- | -- | -- | -- | ? | -- | -- |  | Boolean | false |
| Simplified points | Simplify portrayal of point symbols |  | -- | M | ? | ? | ? | ? | -- | ? | ? | ? |  | Boolean | true |
| Two shades | Show two depth shades only, safe vs unsafe |  | -- | M | ? | -- | -- | -- | -- | -- | -- | -- |  | Boolean | true |
| Interoperability on | Whether interoperability is turned on |  | M | -- | -- | -- | -- | -- | -- | -- | -- | -- | C-9.3 | Boolean | false |
| Interoperability level | The interoperability level selected or last set by the user |  | M | -- | -- | -- | -- | -- | -- | -- | -- | -- | C-9.3 | Integer | 0 |
| Selected Interoperability Catalogue | Identifies the interoperability catalogue selected by the mariner |  | M | -- | -- | -- | -- | -- | -- | -- | -- | -- | C-9.3 | String | (identifier of IHO Interop. Cat.) |
| Predefined combination | Identifies the predefined combination selected by the mariner |  | M | -- | -- | -- | -- | -- | -- | -- | -- | -- | C-9.3 | String | (none) |
| (other context parameters for functions and settings in MSC.1609 and Table 20 - Mandatory and optional display functions?) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 48 - Context parameters matrix

M: Mandatory

O: Optional

--: not required

x.y: Clause/Section X.Y

# Dual-fuel systems

Dual-fuel systems are systems that use both older (pre-S-100) and newer (S-100) data products that contain the same type of information (for example, S-57 and S-101 ENCs).

All stakeholders should anticipate a transition period during which new S-100 formats increasingly replace older formats.

A dual-fuel ECDIS must be able to handle both S-57 and S-101 ENCs during the transition period.

## Display of data available in both new and legacy formats

In general, systems should give newer formats priority over the older formats, and utilise data from the older format only when there is no coverage of the new format data at an appropriate scale (i.e., when the display scale is out of the scale bounds in dataset metadata).

S-101 ENC data should always be given priority over S-57 ENC data when both S-101 and S-57 ENCs provide data coverage at the current display scale.

The question of handling simultaneous display of data in old and new formats is still to be addressed by the IHO at the time this draft is being written. In the interim, systems should:

1. Indicate when the screen is displaying older-format data.
2. Indicate the boundary between new and old-format datasets if both new and old formats are being simultaneously displayed (one part of the screen is displaying new-format data and another old-format data).
3. Anticipate that the portrayal of newer formats aligns with the portrayal of the older formats during the transition period, so that dual fuel systems will not show significant differences in portrayal of what is essentially the same data in different formats or between different regions where S‑100 adoptions are occurring at different paces.

## Display of additional information layers

The display of additional information layers is generally driven by mariner need. The interoperability catalogue concept for ECDIS (see S-100 5.0.0 Part 16 and S-98) is based on using S-101 ENCs as the base layer. Therefore, in areas without S-101 ENC data, manufacturers and data producers should expect additional information layers to be displayed as overlays over S-57 ENC data.

The converse is also allowed - data in legacy formats may be displayed as overlays over S-101 data.

In both cases, the applicable requirements in IMO performance standards must still be met, especially requirements about not degrading the route monitoring display.

## Concurrent applicability of S-52 and S-57

Dual-fuel systems should continue to use the principles defined in S-57 and S-52 for the presentation of chart data that conforms to S-57 instead of S-101. The principles in S-101 and this Annex should be concurrently applied where S-101 data is displayed. This includes the case where one part of the chart window has S-101 data as the chart layer and another has S-57 data as the chart layer - S57/S-52 apply to the portion where S-57 data is the chart layer and S-101 and this Annex apply where S-101 data is the chart layer.

Overlays of S-100-based non-ENC data over S-57 chart data are left to manufacturer discretion, pending development of guidance by the IHO. Where S-100-based non-ENC datasets are overlaid over S-57 data, they should be treated as “additional information” in the sense of MSC.232(82), including the requirement to avoid degrading the display of ENC information. Activation of the new functionalities described in this Annex for screen regions where S-100 data is overlaid over S-57 ENCs is left to manufacturer discretion, pending the development of guidance by the IHO. For example, S-98 interoperability need not be implemented in the absence of an S-101 base layer, but graphical indexes can still be displayed for non-ENC S-100 products and thinning for an S-111 (Surface Currents) grid can still be applied even if it overlays S-57 data.

MSC.232(82) and other applicable IMO standards continue to apply to the “S-57 portion” of the display, and, in the absence of updated IMO standards specifically for S-100-based data, also to the “S-101 portion” of the display. The IEC standards should continue to be used for testing, with necessary extensions to tests for the “S-101 portion” of the display, pending IEC update of the IEC standards for S-100-based displays and this Annex.

This Annex is designed to allow such integrated displays. Note in particular:

* The IMO functions continue to be used. This Annex describes their applicability to S-100-based data and defines additional functions for S-100-based data. Any additional functions that apply only to S-100-data should be deactivated for S-57 data.
* The IMO display categories and viewing groups for S-57 data are carried over into this Annex and include the same feature information for each group as in S-52.
* Where S-101 changed S-57 modelling, the replacement features have been assigned to the same viewing group as before.
* Features that are wholly new in S-101 compared to S-57 are assigned to new viewing groups.
* Features from new non-S-101 data products are assigned to new viewing groups.
* The principles for chart furniture and miscellaneous display elements (scale boundaries, limits of data, safety contour, depth zones, update identification, legend, etc.) are the same in S-52 and this Annex.
* Additional functionalities such as graphical indexes, data quality indication, etc., are independent of the legacy/modernised nature of the information. To minimise clutter and maximise compatibility with legacy data, the functionalities for modernised data are defined so they can act on/with only ENC data in the first place, and on/with other S-100-based data only upon additional or different operator action. For example, the graphical indexes requirement (clause C-14.2) is separated into sub-requirements, one for ENCs and the other for other S-100-based products.
* The names of colour tokens are the same. (Future versions of this Annex may add additional colour tokens, but should retain the S-52 set.)

Note that some things required for complete compatibility of S-57/S-52 and S-101 presentations cannot be controlled in this Annex, depending as they do on the harmonisation of portrayal catalogues with S-52 symbology, colour tables, and lookup tables. Among these are the shapes and dimensions of symbols and the colour coordinates assigned to colour tokens.

# Type approval considerations

Manufacturers, type-approval authorities, and above all mariners, are always encouraged to contact the IHO over any improvements, criticisms, questions or comments that they may have about the ECDIS display, in order that the specifications can be kept effective and up to date.

## Minor deviations from registered symbols

It is expected that the manufacturers of navigational equipment and software are in constant contact with users. To allow for fast response to suggestions for improvement to the portrayal. The following criteria shall serve as a guide for judging whether any symbolization on a system which is visibly different from the symbolization provided by the portrayal catalogue of a product specification and as demonstrated by the relevant Test Data Set print-outs is still compliant. The symbolization used:

1. should be the same in general shape and size as the portrayal catalogue version;
2. should be clear and sharp so that there is no uncertainty over meaning;
3. should be close enough to the portrayal catalogue version to avoid ambiguity in meaning between that model and any other model of similar systems;
4. should use only the colours as specified in the portrayal catalogue;
5. should comply with the various considerations of scientific design described in the portrayal catalogue;
6. should comply with the priority of prominence on the display in proportion to importance to safety of navigation which is built into the portrayal catalogue, and
7. should avoid any increase in clutter.

Any symbolization which does not meet these criteria is not compliant.

The type-approval authority is strongly encouraged to contact the organisation responsible for the product specification in question, in any case of uncertainty over differences in symbolization, ideally attaching graphics to illustrate the situation. The responsible organisation should give the reason for the particular symbolization on the relevant Test Data Plots, and should comment on any perceived advantages or disadvantages of the manufacturer's version, with reasons.

# Specifications for the display screen

## Physical display requirements

The requirements for the main graphic display are:

Size: minimum effective size of the area for chart display: 270 x 270 mm.

Resolution: minimum lines per mm (L) given by L=864/s, where s is the smaller dimension of the chart display area. (e.g. for the minimum chart area, s=270 mm, the resolution L = 864/270 = 3.20 lines per mm, giving a "picture unit" size of 0.312 mm)

Colours: 64

The specifications above permit a chart display whose minimum resolution (lines/mm) may vary depending on the size of the display. Maintaining a clearly readable chart display under this flexibility imposes certain requirements on the display software, which are described in clause C-11.2.

Information should be displayed in the ECDIS on one or more physical screens, which may be divided into more than one chart display. Information may be displayed automatically, on demand or as a result of mariner's selection.

The physical size of the screen(s) should be appropriate to viewing conditions. Larger screens may be more suitable for situations where the operational viewing distance is higher, because the larger physical area of the display offsets the reduction of on-screen geographical extent that is caused by the greater zoom levels and symbol sizes necessitated by greater viewing distances.

Redraw during route monitoring to follow the ship's progress, including scale changes due to change in the scale of the chart information, should take less than 5 seconds. Demands by the mariner that cannot be predicted by the ECDIS, such as draw at a different scale or in a different area may take more than 5 seconds. In the latter case:

* the mariner should be informed;
* the display should continue route monitoring until the new information is ready to draw within 5 seconds.

## Colour reproduction

Absolute accuracy in colour reproduction is not required but relative colour fidelity is important. To ensure clear contrast between colour-coded features the display screen should be calibrated before use, and this calibration should as far as possible be maintained while in service. If this is not done, lines, symbols, and area shades may become indistinct, and information may then be lost or become misleading.

## Display requirements for colours

*[Content is from the following sections of S-52 6.1.1:*

*4.1 General*

*4.2 Colour Assignment: Content directly under this S-52 heading is now in C-16.2 (Selection of colours (informative) and will not be repeated here.]*

*4.2.2 Bright Sunlight or Night viewing - Use of filters, etc.*

*4.2.3 Display calibration and verification*

*4.2.4 Colour control; contrast and brightness controls*

*4.2.4.1 Effect of controls.*

*4.2.4.2. Use of the controls.*

*4.2.4.3. Initial setting of the controls.*

*4.2.4.4. Re-adjustment of the controls.*

*4.2.4.5. Setting the controls for route monitoring*

*Section 4.2.6 (The colour scheme - colour tokens) has been rewritten as “C-16.2” and section 4.2.7 (Transparency) is included as “C-16.4 Transparency” and those sections will not be repeated here.]*

### General

The ECDIS manufacturer can use any technology to build his display as long as his display fulfils the requirements of this specification. It is known that at least displays based on CRT, TFT or LCD can be made to fulfil the requirements of this standard.

The colours are specified in CIE (Commission Internationale de l'Eclairage) xy chromaticity coordinates and luminance L. CIE colour coordinates are used because any other colour specification, such as RGB, is specific to a particular monitor and so cannot be specified either in relative or in absolute terms. The ECDIS colour scheme based on specification of colour tokens and colour conversion tolerances and tests are described in C-22.4.1.

The Colour Profiles are in [TBD. In S-52 they are in the Presentation Library, Part I, Appendix A. The Colour Tables are also included in the .dai file of the digital Presentation Library.]

Note that these colour specifications apply to both the operational chart display (for route planning and route monitoring), and also to any text on the same screen as the chart display.

The colour tables have been carefully designed by perception specialists to give the maximum clarity and contrast between features on the display under all light conditions on the bridge.

### Bright Sunlight or Night viewing - Use of filters, etc.

The information-carrying capability of the ECDIS display is curtailed at the extremes of bright sunlight and night viewing. The reasons, and some remedies, are described in this section.

**Bright sun**. Some of the strong ambient light on the bridge is reflected off the back of the display screen face plate and arrives at the mariner's eye mixed with the light generated by the monitor which carries the image of the ECDIS display. This display image is further diluted by light entering the mariner's eye directly from the brightly-lit bridge. The effect is to make the display look washed out; contrast between features may be severely reduced. In the extreme case of sunlight shining directly on the screen, no information at all will be visible. In addition, reflections on the face of the monitor from objects close to the screen, particularly a mariner's white shirt, may mask parts of the display.

The ECDIS display should be situated where direct sunlight will not shine onto it, nor into the eyes of the mariner looking at it. A visor around the face of the screen may help. A filter may also help, (because it attenuates the sunlight twice, both when incident and when reflected, whereas the monitor image is attenuated only once). Low attenuation neutral density filters may be used, such as a 2 times attenuation filter designated (logarithmically) "0.3 ND". Polarised filters should be an advantage. Ideally, the bridge windows should have glare reducing glass and the inside of the bridge should have non-reflecting paint.

**Night**. The need to preserve night vision requires that the illumination from the screen be reduced to a lower level than is desirable from considerations of clear viewing. The light level from night colour tables is below that which provides full contrast capability. Consequently some area-fill colours are indistinguishable on the night display, as noted in section 3.2.2 (2), and colours of lines may be difficult to distinguish.

An additional problem for CRT type of monitor is that the R,G & B guns of the CRT may drop to the cut-off point at these very low DAC (digital to analog converter) voltages, particularly on an ageing CRT. Because good quality neutral filters reduce illumination without significantly affecting colour, and even tend to enhance contrast their use is recommended for the night display.

### Display calibration and verification

The ECDIS display should be calibrated initially in order to transform the CIE colour table coordinates to screen coordinates. The main components of the ECDIS display are the monitor and the image generator. Both the monitor and the image generator used to drive the ECDIS display can be calibrated together as a colour generating unit. Another alternative is to calibrate separately both the monitor and image generator.

The following international standards describe methods for calibration of a monitor’s RGB values to produce an output. Other methodologies may be followed, but the same verification test requirements apply regardless of method.

CIE 122-1996 Technical Report: The Relationship between Digital and Colorimetric Data for Computer-Controlled CRT Displays.

IEC 61966-3:2000 Multimedia systems and equipment -Colour measurement and management - Part 3: Equipment using cathode ray tubes, Edition 1.

IEC 61966-4:2000 Multimedia systems and equipment-Colour measurement and management - Part4: Equipment using liquid crystal display panels, Edition 1.

The ECDIS display calibration should be verified for type approval of all monitors as described in section X.X.

### Colour control; contrast and brightness controls

There are a variety of technologies available for monitors to be used for ECDIS display. Different technologies have different methods to control colour, contrast and brightness, but some basic rules apply for all of them.

#### Effect of controls.

The contrast control of a display generally shortens or extends the range of luminance available, making the display appear darker or brighter.

On the other hand, the brightness control shortens or extends the range of colour saturation available by adding white (which extends the range by making colours other than black less saturated), or subtracting white (colours become darker, more saturated.)

To the viewer, it has much the same apparent effect as contrast, but it achieves this by altering the colour contrast of the colour tables between foreground and background colours, and this may result in some features becoming harder to see, particularly at night. More importantly, making the night display more saturated may drop some dark colours below the cut-off point, into black, thus losing distinctions such as shallow versus deep water.

#### Use of the controls.

Colour tables are provided for day, dusk and night. The mariner should be provided with the control to make fine adjustments between these tables; the calibration position should be marked as a reference for this.

For a CRT type of monitor the brightness control should be pre-set, i.e. used only when essential, with provision to return to the calibrated setting. LCD and other monitor technologies have a variety of controls. The general principle is that all available controls should have a provision to return to the calibrated settings and that only appropriate controls should be made available for the mariner.

The ECDIS manual should carry a warning that careless use of the display controls may adversely affect the visibility of information on the display.

#### Initial setting of the controls.

The controls should be set up in preparation for initial calibration, and their positions marked at that time (e.g. by a detent) so that they are recoverable.

#### Re-adjustment of the controls.

In case the controls go out of adjustment in use, they may be re-adjusted onboard ship by means of the Colour Differentiation Test Diagram described in C-22.5 and provided by the IHO.

#### Setting the controls for route monitoring

The ECDIS display carries far more detail than a radar display, and requires correspondingly more attention to the correct selection of colour table and the correct adjustment of the controls.

This particularly affects the black-background displays, and is critically important at night, because all colours of the night table, particularly those for large areas, have to be set very dark to avoid loss of night vision, and if the control is turned down too far these colours will disappear into the black background. As a result, chart information will be lost.

The situation will be worse if one of the day tables is improperly dimmed for use at night, instead of switching to the night table.

It is important that the display be adapted to lighting conditions on the bridge by selecting the correct colour table: "Day" for bright sunlight; "Day” or "Dusk" for general daylight viewing; "Dusk" for twilight; and "Night" for the night-darkened bridge.

The controls should only be used for fine adjustment within the appropriate colour table.

To ensure that the controls are always set to a level above that at which information will be lost, the black-adjust symbol BLKADJ should be available to the mariner, treated as "Standard display", to be called up at any convenient point on the screen. The instructions for its use by the mariner should be incorporated in the "Users instructions" for the ECDIS.

Below is an example of instructions for a CRT type of Monitor:

1. First, set contrast to a maximum, brightness to a minimum. Look at the black-adjust symbol. Then either:

2A. If the centre square is not visible, turn up the brightness until it just appears.

or:

2B. If the centre square is clearly visible (with contrast at maximum, brightness at minimum), turn the contrast down until the inner square disappears, then turn contrast back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure).

The "black level" is now correctly set. If a brighter display is required use the contrast control, but it is better not to re-adjust the controls unless lighting conditions on the bridge change.

Note that the black-adjust symbol should be displayed to check that the inner square remains visible on the following occasions:

* every time that the brightness or contrast controls are adjusted,
* every time that the display is switched to the night colour table.

Below is an example of instruction for LCD type of Monitor. The LCD type of monitor used in this example has only one mariner control, which is called brilliance. Internally the monitor has also other controls available for service engineers. These internal controls include also controls named as contrast and brightness.

1. First, set brilliance to calibration position. Look at the black-adjust symbol.

Then either:

2A. If the centre square is not visible, turn up the brilliance until it just appears.

or:

2B. If the centre square is clearly visible, turn down the brilliance until the inner square disappears, then turn brilliance back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure).

The "black level" is now correctly set. If a brighter display is required use the brilliance control, but it is better not to re-adjust the controls unless lighting conditions on the bridge change.

Note that the black-adjust symbol should be displayed to check that the inner square remains visible on the following occasions:

- every time that the brightness or contrast controls are adjusted,

- every time that the display is switched to the night colour table.

It is recommended that the BLKADJ symbol be displayed automatically all the time that the night colour table is selected, with a mariner over-ride to remove it if necessary.

## Colour display capability

Colour displays should be capable of at least 256 luminance steps in each of red, green and blue.

For night performance it is essential that the hardware has a graphics card capable of giving "blacker than black", i.e. complete control of colour, and that the software can control that function.

For CRT type of monitor cathode (beam) current stabilisation is desirable, to prevent dark colours dropping below the cut-off point.

### Colour conversion tolerances and tests

#### Tolerances

The tolerances quoted below apply only to the process of converting CIE colour coordinates to RGB values, and so should be evaluated shortly after the ECDIS leaves the manufacturer's plant.

Considerable operational experience will be needed before it will be possible to state colour maintenance tolerances for ECDIS onboard ship.

The colour tables developed have been selected to ensure maximum colour discrimination between features. Colour discrimination depends on both the colour difference and the luminance difference between two colours. Colour science (as represented by the C.I.E. colour convention) has defined colour difference units ΔE\*. The ΔE\* metric is a measure of the overall discrimination (including both colour and luminance differences). As a metric for ECDIS colour accuracy, a measure of the discrimination in colour alone, excluding luminance differences has been defined as a subset of ΔE\* referred to as Δ(u\*,v\*).

Δ(u\*,v\*) = SQRT [ (u2\*-u1\*)2 + (v2\*-v1\*)2 ]

ΔE\* = SQRT [ (L2\*-L1\*) + (u2\*-u1\*)2 + (v2\*-v1\*)]

Calculations of L\*, u\*, and v\* must be made using as reference the chromaticity and luminance specified for the brightest white colour token in the respective colour table (Y0, u0, y0); where Y0 is the luminance in units of cd/m2. Note: this is not the brightest white of the monitor.

Note: “Δ” represents the Greek letter “Delta”, although it may appear differently on some computers.

The tolerances for the conversion of the colour tables from the CIE colours defined in these specifications to the actual RGB values for the ECDIS CRT are defined in three terms:

1. Overall discrimination between actual colours within the converted table: ΔE\*. This is to ensure that all the colours within the RGB table remain discriminably separate, i.e. that the relative colour distinctions have been maintained.

2. Colour discrimination differences between the defined and the actual values: Δ(u\*,v\*). This is to ensure that the actual RGB colours resulting from the conversion remain reasonably close to the CIE colours defined in the specifications, i.e. that the blues stay blue and the greens stay green.

3. Luminance differences between the defined values and the actual values: L. This is to ensure that the luminance remains the same within acceptable limits.

Note: The CIE L\*u\*v\* human perception colour model, which is the source of the tolerances described above, has not yet been evaluated at the low luminances of the night colour table, at which the less colour-sensitive rods of the eye take over from the daytime cones. Consequently these tolerances should not be applied to the night table, and for type-approval purposes they are restricted to the bright sun table.

Colour tolerance values:

1. The discrimination difference between any two colours displayed (except those with a tabular ΔE\* less than 20) should be not less than 10 ΔE\* units.

| **Token** | **Colour (x, y, L)** | **Token** | **Colour (x, y, L)** | **ΔE\*** |
| --- | --- | --- | --- | --- |
| DEPMD | (.27 .30 65)  pale blue | CHWHT  DEPDW  UIBCK | (.28 .31 80)  white | 11 |
| CHBRN | (.42 .45 30)  brown | ADINF | (.41, .47 35)  yellow | 14 |
| DEPMS | (.24 .26 55)  medium blue | DEPVS  UIAFD | (.22 .24 45)  medium blue | 17 |
| DEPMD | (.27 .30 65)  pale blue | CHGRF  NODTA  (S-52 Ed 3.3 colours have greater ΔE) | (.28 .31 45)  faint grey | 18 |

Table 49 - Tolerance exceptions

2. The difference between the colour displayed and the CIE colour defined in these specifications should be not greater than 16 Δ(u\*,v\*) units. If a monitor is independently tested, then the difference must not be greater than 8 Δ(u\*,v\*)units.

3. The luminance of the colour displayed should be within 20% of its specified value. Black is a special case and the luminance of it must not be greater than 0.52 cd/m² for bright sun colour table.

#### Instrumental calibration verification test

For CRT displays, an instrumental test to check that the results of the colour conversion calibration are within tolerance should be made by displaying the colours of the Day colour table (restricted to colour pairs of tabular ΔE\* greater than 20); measuring their CIE coordinates x,y and L; and applying a tolerance test. For LCD displays the instrumental test should be applied to all three colour tables.

Note that since the tolerance test is intended solely to check successful colour calibration, and not to test colour maintenance at sea, this test should be performed on the bench in the manufacturer's or type-approval authority's plant under normal conditions of temperature, humidity and vibration.

Manufacturers of ECDIS can choose between two different methods of colour calibration.

The first method is a test of a monitor as part of an integrated system. In this method both the monitor and the image generator parts of ECDIS display are tested together.

The second method is an independent test of the monitor. In this method the monitor and the image generator of ECDIS display are separately tested against a reference (i.e. the monitor is tested against a reference image generator and the image generator is tested against a reference monitor). The second method has tighter tolerance for displayed colour than the first method (see section X.X).

## Colour differentiation test diagram

A multi-purpose colour differentiation test diagram is illustrated in Figure 11. This consists of 20 squares each coloured with one of the 4 main background colour fills (such as shallow water blue), and each having a diagonal line in one of the six important foreground colours (such as mariner's orange). Each diagonal line is 2 pixels wide.

The diagram is in the form of an ENC and so can be displayed using any of the three colour palettes. This diagram is intended:

1. for use by the mariner to check and if necessary re-adjust the controls, particularly for use at night;
2. for use by the mariner to verify that an ageing display remains capable of providing the necessary colour differentiation;
3. for initial colour verification of the day, dusk and night colour tables.

Both the Colour Test Diagram and the instructions for its use (C-22.7) should be made available to the mariner.

In addition, a grey scale is described in C-22.7 for use by maintenance technicians in checking colour tracking in an ageing display.

The Colour Differentiation Test diagram is intended for use off-line. It is not needed during route monitoring.

Note that the Colour Differentiation Test Diagram will not be true to colour unless it is projected on a calibrated screen and is generated using the digital format provided by IHO, which correctly reproduces the colour tokens of the Presentation Library.

The colour differentiation diagram is required in "Day" and "Dusk" colours so that the Mariner can verify that the ECDIS display monitor has the colour differentiation capability needed to distinguish between the various colour-coded areas, lines and point symbols of the ECDIS display. Both diagrams will be provided online by the IHO and should be downloaded by manufacturers for supply with ECDIS software. The diagrams will not be true to colour unless they are projected on a calibrated monitor and are generated in a manner which correctly reproduces the colour tokens.

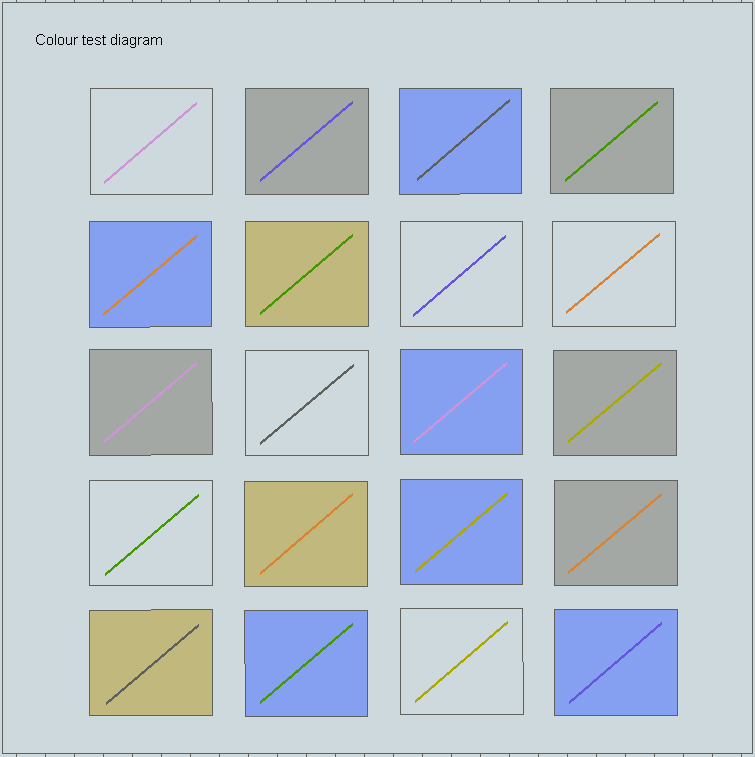


Figure 11 - Colour differentiation diagram - Day. For illustrative purposes only. The diagrams from the IHO web site should be downloaded for testing.

## ECDIS Chart 1

The IHO provides ECDIS Chart 1 in digital form, a graphical index of ECDIS symbols including both simplified and paper-chart point symbols, and also the symbolized lines and area boundary linestyles. This is intended to familiarize the mariner with the colour and symbol coding used by the ECDIS. The symbols are grouped according to INT1, which is familiar to the mariner, but are numbered with a look-up sheet, not labelled. Manufacturers should provide linking by cursor interrogation between the symbols and the explanations given in Chart 1.

Since product specifications for data products used on ECDIS will be updated at different times, there will be a supplementary “Chart 1” for each data product other than ENC that is intended for use on ECDIS.

The ECDIS Chart 1 and its supplements are intended for use off-line and in route planning. They are not needed during route monitoring, when the mariner can use cursor enquiry to find the meaning of symbols.

The ECDIS Chart 1 and its indexing list of symbol names and meanings arranged numerically, together with the colour differentiation test diagrams, are intended for the Mariner’s use. The use of the Colour Differentiation Test Diagrams is described in C-22.4.2. A separate plot of symbols arranged alphabetically and an indexing list of symbol names and meanings arranged alphabetically will be provided for the manufacturer’s use.

Note that because colour printing and copying is not completely true to the original, a hard-copy version of Chart 1 does not accurately represent the colour requirements of the IHO Colour and symbol Specifications.

In addition, symbol size may change in copying. To ensure correct size, all symbols illustrated must be scaled by the factor required to make symbol CHKSYM01 measure 5mm by 5mm.

## Use of ECDIS Chart 1 and Colour Test Diagram

### Specification for ECDIS Chart 1 and the Colour Test Diagram

#### Definition (for this specification only)

A Chart 1 dataset must be displayed so as to fill all of the standard ECDIS display area (that is, the minimum 270 x 270 mm chart area).

#### Description and purpose

The ECDIS Chart 1 and the Colour Differentiation Test are diagrams for use by the Mariner which are provided in the form of ENC-like files.

The ECDIS chart 1 is intended to familiarise the Mariner with the symbology used on ECDIS. The Mariner must be able to display each cell, and by cursor-pick get a read-out of the meaning of any symbol shown.

The Colour Differentiation Test diagram is intended for display using the day or dusk colour tables so that the Mariner can check that the ECDIS monitor is providing adequate colour performance. It is also used in type-approval testing. Instructions for its use are given in the sections below.

The ECDIS Chart 1 includes the CHKSYM which is intended for checking the correct size of the symbols during the type approval. The width and height of the CHKSYM is 5.0 mm.

The line width of the diagonal line in the Colour Differentiation Test diagram is specified as 0.6 mm wide (that is, 2 pixel wide with a monitor with 0.3 mm pixel pitch). The line width must be checked during the type approval.

#### Mode of use

These diagrams are supplementary features of the ECDIS, intended for use off-line or during route planning. Because they occupy the entire display they must not be used during route monitoring. If the Mariner needs to find the meaning of a symbol during route monitoring, he must use cursor-picking.

The operation of these diagrams is not subject to the draw-speed requirements of route monitoring.

#### Content and Encoding

[Add description after the datasets have been updated for S-100.]

#### Revisions

Revisions will be made by whole file replacement, that is by issuing a new edition.

#### Packaging

The data files may be downloaded from the IHO web site.

#### Presentation

The Chart 1 files are symbolized by the NEWOBJ portrayal rules triggered by the SYMINS attribute of the generic object NEWOBJ.

The README files give some specific Mariner settings, such as safety contour, that are required to give the correct display.

The ECDIS Chart 1 and Colour Test diagram cells must be displayed full-screen (meaning the “minimum standard” screen, 270 x 270 mm), that is at or larger than the compilation scale. Otherwise features such as centred symbols may not be correctly illustrated.

The Mariner must be able to cursor-pick on any symbol on the Chart 1 display and get a text read-out of the symbol meaning.

### Displaying the Colour Test Diagram

#### Introduction; providing the diagram

The colour generating capability of any type of display screen will deteriorate with age and the Colour Differentiation Test diagram is provided to enable the Mariner to verify that his display screen still retains the colour differentiation capability needed to distinguish between the various colour-coded areas, lines and point symbols of the ECDIS display.

The diagram will not be true to colour unless it is projected on a calibrated monitor and is generated using the ENC colour profiles.

Two methods of providing the diagram are:

1. Use the file labelled “C1WOO” containing the Colour Differentiation Test Diagram. This file must be drawn so that the extent of the imaginary chart data covers the entire ECDIS display. Because the file uses pseudo-cartographic objects it must be displayed using the special portrayal catalogue provided for the digital ECDIS Chart 1.
2. Use the graphics file illustrated in Figure 11 as a model. Based on this model, reproduce the same pattern of rectangles and lines on the screen, but present them in the correct colours using the colour tokens given in the S-101 colour profiles provided by IHO.

The diagram consists of twenty numbered squares extending over the whole of a 270 x 270 mm screen. Each square is coloured with one of the four main background area shades (such as shallow water blue, DEPVS), and each carries a two-pixel wide diagonal line in one of the important line or symbol foreground colours (such as planned route red, PLRTE). These are arranged as follows:

**Four main background colours:**

DEPVS (shallow water blue) squares 3, 5, 11, 15, 18, 20.

DEPDW (deep water, white or black) squares 1, 7, 8, 10, 13, 19.

LANDA (land colour) squares 6, 14, 17.

NODTA (no data shade: radar, navigation safety squares 2, 4, 9, 12, 16.

lines and chartwork must be visible on the

no-data part of a display)

**Six important foreground colours:**

DEPSC (safety contour grey) squares 3, 10, 17.

NINFO (orange, Mariner's information) squares 5, 8, 14, 16.

ADINF (yellow, manufacturer's information) squares 12, 15, 19.

TRFCD (magenta, traffic lanes and area boundaries) squares 1, 9, 11.

RADLO (the lower luminance radar green) squares 4, 6, 13, 18.

RESBL (blue, provisionally reserved for traffic info squares 2, 7, 20.

from transponder, VTS etc.)

Note: Remember that a TIFF, PDF or other source will not be true to colour unless it has been specifically modified to access the colour tokens and colour tables used by the ECDIS.

Although originally designed for use on CRTs, this test must be extended to LCD and other screens.

#### Test description

The dusk and night tables should be checked subjectively by means of the colour differentiation test diagram, which is provided as an S-101 file (.tif file diagrams must not be used for this purpose), as follows:

(1) The person carrying out the test should have passed the Isihara colour blindness test, or other test used to qualify bridge watchkeepers, and should adapt to night viewing for 10 minutes before checking the night display;

(2) The controls should be set to their calibrated settings;

(3) While the display is off, adjust the ambient light reflected from white paper positioned on the display screen to the following values:

Colour profile Light level

Day 200 cd/sq. m

Dusk 10 cd/sq. m

Night darkness (the ECDIS display is the predominant light source)

Preferably use natural daylight for the day table.

(4) Under each of the above conditions, display the appropriate colour differentiation test diagram for the colour profiles.

Select each table in turn and ensure that:

* each foreground diagonal line is clearly distinguished from its background;
* the foreground lines representing yellow, orange, magenta (purple), green, blue and grey may be clearly identified.

#### Using the diagram

The Colour Test must be applied on the day and dusk colour tables.

Before the Colour Test diagram is used, the black-adjust symbol SY(BLKADJ01) must be brought up on the screen and the contrast and brightness controls (or equivalent controls for an LCD) must be adjusted as follows:

1. First, set contrast to a maximum, brightness to a minimum. Look at the black-adjust symbol. Then either:

2A. If the centre square is not visible, turn up the brightness until it just appears;

OR:

2B. If the centre square is clearly visible (with contrast at maximum, brightness at minimum), turn the contrast down until the inner square disappears, then turn contrast back up until the inner square is just visible again.

(If the above adjustment is not successful, select a more appropriate colour table and repeat this procedure).

The "black level" is then correctly set. If a brighter display is required use the contrast control, but preferably do not adjust the controls unless lighting conditions on the bridge change.

The test consists of being able to distinguish the background colours and to pick out the like foreground colours, that is to say that squares 3, 5, 11, 15, 18 and 20 all have a shallow water blue background, and that squares 3, 10 and 17 have a grey line.

Note: The test above uses the black-adjust symbol for the purpose of a type approval test. The other purpose of the black-adjust symbol SY(BLKADJ01) is to allow the mariner to adjust the display for ambient illumination on the bridge of a ship. An ECDIS must have the black-adjust symbol displayed whenever the mariner is adjusting the display (that is, depending on the technology of the display brilliance, brightness, contrast, etc.), as required by C-22.3.

### Grey Scale

A grey scale may be used by service technicians to detect display ageing or other display performance issues.

Eight grey strips are recommended, spaced between the minimum and the maximum luminance for each of the five mandatory colour tables.

The bit levels or signal levels producing the grey levels are evenly spaced from the level producing white to the level producing black. In order to select the appropriate grey level from a large set of available grey levels, use one of the following models:

1. Bit Levels in Software: Given n levels of grey that can be displayed on a screen, with 0 for black and w = n - 1 for white. We want to select a subset of m levels that are as evenly spaced as possible. The interval between the n levels to create m levels is ΔV = w/(m-1), which may not be an integer. So, the levels to select are the (integer) values of Vi= int[(i-1) ΔV] for i = 1, 2, ..., m, or Vi= 0, int(ΔV), int(2ΔV), int(3ΔV), ..., int[(m-1) ΔV], with int[(m-1) ΔV] = w for white. For example, if there are n = 256 = 28 levels from which we select m = 8 levels, white is w = 255; the interval is ΔV = 36.4286, and the chosen levels are: 0, 36, 73,109, 146, 182, 219, 255.
2. Analog Signal Levels: For analog signals, if Vw is the white level and Vb is the black level, then for m levels the signal step size is ΔV = (Vw - Vb)/m and Vj= Vb + jΔV.

# Dataset Management

This clause covers dataset management on the ECDIS to the extent that it affects the user experience and portrayal processing.

## Multiple product versions and portrayal

The ECDIS must be able to carry and use multiple versions of the feature catalogue for a product. Catalogue management is based on the version number of the Product Specification and Catalogues. For example, the ECDIS will need to carry all valid catalogues that are used for datasets that have been produced from an earlier edition of a product specification; but may retire a superseded version after the last such dataset has been cancelled.

S-97 recommends that the versioning of product specifications follow the same rules as S-100, which uses a three-part version number (*Edition.Revision.Clarification*). The significance of each component is summarised below.

* Edition: New Editions introduce significant changes, such as the ability to support new functions or applications, or the introduction of new constructs or data types. New editions are indicated by incrementing the *Edition* component of the version number and resetting the other components to 0.
* Revision: Revisions introduce substantive semantic changes. Changes in a Revision ensure backward compatibility with previous versions within the same Edition. A Revision, for example, may introduce new features and attributes, but will not delete a feature or attribute. New revisions are indicated by incrementing the *Revision* component of the version number and resetting the *Clarification* component to 0.
* Clarification: Clarifications are non-substantive changes. Typically, Clarifications remove ambiguity; correct grammatical and spelling errors; amend or update cross references; and/or insert improved graphics, spelling, punctuation and grammar. Clarifications must not cause any substantive semantic changes. Changes in a Clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Clarifications are indicated by incrementing the Clarification component of the version number.

The consequences for portrayal are:

1. It should be possible to process datasets conforming to an earlier Revision within the same Edition, with the Feature and Portrayal Catalogues for the latest Revision in that Edition.
2. It should be possible to process datasets conforming to an earlier Revision or Clarification within the same Edition with the Feature and Portrayal Catalogues for the latest.
3. A Portrayal Catalogue for a new Clarification can always rely on earlier versions of the Feature Catalogue within the same Edition. (Note that an old Feature Catalogue cannot be relied on for processing the dataset for a newer Revision. That is OldDataset+OldFC+NewPC is processable, but NewDataset+OldFC+NewPC is not.)
4. It should be possible to process datasets conforming to a Clarification with the Feature and Portrayal Catalogues for an earlier Clarification within the same Edition and Revision.
5. The significance of changes to only a portrayal catalogue (without a concomitant change to the product specification or feature catalogue) can be more difficult to classify (as a new Edition, Revision, or Clarification), because in addition to data model semantics, human factors effects for user interfaces and IMO guidance about compatibility, text abbreviations, etc., must also be considered.

In classifying changes to portrayal catalogues alone, the principles in clause C-21 (pertaining to minor deviations from approved symbols) should be applied; if the changed presentation satisfies the criteria in C-21.1 for minor deviations from approved symbols, it can be classified as a clarification. In case of uncertainty the IHO and/or type approval authority should be consulted. This also applies to revisions planned by project teams.

## Dataset overlaps and gaps

### Overlaps and gaps in ENC coverage

There may be cases where ENCs in the same scale range overlap. Such may be the case at agreed adjoining producer data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used.

Where an overlap of two or more datasets exists the ECDIS must only display one dataset for the overlap area and provide a permanent and persisting indication “overlap”.

Similarly, there may cases be where gaps in ENC coverage exist.

Where gaps in ENC data of the same scale range exist, smaller scale data from the SENC may be used to fill the gap. If there is no smaller scale data available the gap must be filled with the no data area fill pattern.

### Overlaps and gaps in other data products

Overlaps in datasets of the same scale range in products other than the ENC should be indicated by a non-permanent indication “Overlap in ??? data” (where ??? is the abbreviation for the data product). If interoperability has been activated, the interoperability catalogue may have a rule to break the tie, in which case an indication is not needed.

Coverage gaps in products other than the ENC can be expected and should not be indicated.

## Guidance on updating S-100 datasets on ECDIS

### Introduction

In a previous edition (3rd Edition, December 1996), S-52 Appendix I provided guidance for the updating service and the ECDIS to support the updating of ENCs issued through a Regional ENC Coordinating Centre (RENC). Following an HSSC-requested review by the ENC Updating Working Group (EUWG), guidance related to ENC updates production by HOs and their distribution was mainly integrated into Edition 2.0.0 of IHO publication S-65 “ENC Production, Maintenance and Distribution Guidance” and Edition 3.0.0 of IHO Publication S-57 Appendix B.1, Annex A “Use of the Object Catalogue for ENC”. Beginning with Edition 4.0.0 (April 2012), S-52 Appendix I was limited to describing guidance for the processing of automatic and manual ENC updates by ECDIS.

The current editions of S-57 and S-65 continue to apply to the production and data delivery for S-57 ENC updates. S-52 Appendix I continues to apply to the processing of S-57 updates on ECDIS.

The guidance in S-52 Appendix I has been updated for S-100 datasets on ECDIS and is provided in clauses C-23.3.2–C-23.3.5 below. Except for C-23.3.5 (support file updates), which is a new requirement for support files, and the addition of language relating to authentication, the requirements are the same as S-52 6.1.1 with the language updated to include data products other than ENCs.

Some products may require or permit the use of data protection. Whether data protection has been applied to a dataset can be determined from the dataset discovery metadata in the exchange catalogue file (see S-100 Part 4a App.4a-D). Digital signatures and authentication are described in S-100 Part 15. The protection method is indicated in dataset discovery metadata (S-100 Part4a App.4a-D; it should also be documented in individual product specifications. At present there is only one method specified in S-100, which is described in Part 15. S-100 Part 15 should be referenced for authentication and integrity checks. S-63 may be used as a informative reference for information pertaining to authentication that is not currently in S-100 Part 15.

### General requirements

1. **Data Integrity**. The ECDIS should be able to process updates to S-100 data products without degradation of the information content of the dataset or dataset update. For example, all information regarding attributes, logical relationships, geometry, and topology must be accounted for.
2. **Verification of Application**. The ECDIS should provide a method to ensure that updates have been correctly applied to the SENC (or other appropriate database for products held outside the SENC). Those updates are either an official data product update integrated into the SENC display, an update to non-official products installed on the system, or temporary information that was entered manually.
3. **Integrated/Non-integrated Updates Distinction**. Updates should be clearly distinguishable on the display. Once accepted, integrated updates to ENCs should be indistinguishable from ENC data. Non-integrated updates (i.e., those entered manually) shall be distinguishable as described in clause C-14.11.1. Updates to non-ENC data shall be treated as described in C-10.1.3 and C-14.11.4.
4. **Storage Separation**. ECDIS should store all updates separately from the original datasets. However, such separate storage may utilize the same data storage device.
5. **Recall for Display**. It should be possible on demand to review previously installed updates.
6. **Compatibility**. Updates to S-100 products must comply with the applicable Product Specification.
7. **Non-interference**. ECDIS should be able to receive updates without interfering with its current operation.
8. **Log File**. ECDIS should keep a record of updates, including time of application and identification parameters described in the applicable Product Specification, through a log file. The log file should contain, for each update applied to or rejected by the SENC, the following information:

**.1** date and time of application/rejection;

**.2** complete and unique identification of update as described in the applicable Product Specification;

**.3** any anomalies encountered during application;

**.4** type of application: manual/automatic.

1. **Update out of sequence**. The ECDIS should warn the user when an update is applied out of sequence, terminate the update operation and restore the SENC as it was before the application of the update file.

NOTE (informative): Sequences are determined by the update and edition numbers, not by issue date and time. However, sequential updates should have issue date/time combinations that are consistent with the sequence of updates as determined by the update and edition numbers. Issue date/time are given in dataset discovery metadata in the exchange catalogue (see S-100 Part 4a App.4a-D). Note that time is optional. Note also that it is possible for the date/time for two or more consecutive updates to be the same - in fact for data that are frequently updated, such as water levels, the date will be the same for many consecutive datasets.

### Automatic Update

1. **Interface**
   1. **Fully Automatic Updates**. The ECDIS should be capable of being interfaced to an appropriate telecommunication network.
   2. **Semi-automatic Updates**. The ECDIS should be capable of receiving official updates in standard IHO format by CDROM and from any other interface or data storage media that are provided with the ECDIS for that purpose and through telecommunication.
2. **Reception of Updates**
   1. Update data shall be recorded automatically in the update storage of the ECDIS.
   2. The identification of the Issuing Authority of the update should be checked for conformance with the corresponding identifier of the dataset being updated.
   3. If any errors are detected from the receiving device, the reception procedure shall be terminated and the update flagged invalid in the record of updates. The user should be informed of the corruption.
3. **Sequence Check**. The following sequence number checks should be performed at the time of application, for sequential and cumulative updates:

.1 File extension of the update

.2 Update number of the update

.3 Update sequence number of the individual records in the update. Refer to the relevant Product Specification for details on how the sequence numbers are encoded in the update.

1. **Authentication and Integrity Check**. If the product specification uses data protection and therefore requires the use of digital signatures, the ECDIS should authenticate updates using the applicable procedures. The error codes for S-100 Part 15 data protection can be found in S-63 clause 11. In some cases (described in S-63 clause 11), updates that do not pass the authentication and integrity check should not be applied. The user should be informed of any authentication anomalies. Update authentication-related messages for the user may be combined or throttled to avoid flooding the user, but should all be logged in the log file.
2. **Consistency Check**. The mariner should be warned of any previous updates which have not been successfully applied.
3. **Geographic Applicability**. Updates not relating to a dataset within the set of datasets in the ECDIS may be discarded.
4. **Summary Report**. A summary report for each of the Issuing Authority's official update files should be given after completion of receipt containing at least:

**.1** identification of Issuing Authority;

**.2** Update numbers of the update files;

**.3** Dataset Identifiers of datasets affected;

**.4** Edition number and date of dataset involved;

**.5** Number of updates in the affected dataset.

1. **Review of ENC Updates**. It should be possible for the mariner to review the updates applied through displaying the SENC contents with the updates highlighted.
2. **Modification of Updates**. Rejection or amendment of an update by the mariner shall be achieved by the manual update method. The questionable update should be noted as an anomaly in the Log File (see clause C-23.3.2(h)).
3. **Formatted Non-integrated Updates**, for example a temporary military exercise area, will be processed as manual updates.

### Manual Update

1. **Keying and Symbology**. The ECDIS should enable manual entry of updates for non-integrated presentation on the display. A capacity should exist to enable the mariner to:

**.1** enter the update so it can be displayed as described in this Annex.

**.2** ensure all update text information relevant to the new condition and to the source of the update, as entered by the mariner, is recorded by the system for display on demand.

1. **Indications and Alarms**. The ECDIS should be capable of sensing indications and alarms related to non-integrated (manual) updates, just as it does for integrated Updates.
2. **Presentation**. Manual updates shall be displayed as described in this Annex, clause C-10.8.
3. **Text**. It should be possible to enter text into the ECDIS.
4. **Archiving of Manual Updates**. It should be possible to remove from the display any manual update. The removed update should be retained in the ECDIS for future review until commencement of the next voyage, but will not be otherwise displayed.

### Support file updates

When a feature pointing to a text, picture or application file is deleted or updated so that it no longer references the file, the ECDIS software should check to see whether any other feature references the same file, before that file is deleted.

## New editions, re-issues, and updates of datasets

The method for detecting whether a dataset is a new edition, re-issue, cancellation, termination, or update is described in the relevant product specification. The default treatment of each is described below; note that particular product specifications may override the default treatment.

* New edition - replace old edition and its updates with the new edition. Retention of the old edition should be as specified in the product specification. The information in clause C-15.7 about the use of new editions and re-issues for certain coverage data products should be kept in mind.
* Update - apply the update and retain for tracking purposes. See C-23.3.
* Re-issue - replace the original datasets and its updates up to the date of the issue with the reissued dataset. Retention of the old issue should be as specified in the product specification. The information in clause C-15.7 about the use of new editions and re-issues for certain coverage data products should be kept in mind.
* Cancellation - delete the cancelled dataset and its updates.
* Termination - delete the terminated dataset and its updates.

Keep in mind the guidance about updating support files (C-23.3.5) when replacing or deleting a dataset.

Appendix C-1 Relationship to S-52 (Informative)

**C-1.1 Relationship to S-52 provisions**

The table below describes the relationship between the operative clauses in S-52 and this Annex.

| **S-52 clause(s)** | **New clause(s)** | **Notes** |
| --- | --- | --- |
| 1. Introduction |  | Divided between Part 16A and this Annex |
| 1.2 Concept and Limitations of ECDIS | C-5.1 | Also in Part 16A |
| 2. Organising the Display | C-10 |  |
| 2.1 General Considerations |  |  |
| 2.1.1 Design Considerations |  |  |
| 2.1.2 The diversity and flexibility of ECDIS |  |  |
| 2.1.3 Colour discrimination… |  |  |
| 2.2 Operational Considerations |  |  |
| 2.3 Organising the Display |  |  |

Table C-1-1 - Relationship to S-52

1. The inclusion of S-411 as an S-100 data product is tentative. S-411 Edition 1.0 datasets are not in an S-100 data format (S-411 1.0.0, which was developed before the GML profile was added to S-100, specifies a GML format different from that in S-100 Part 10b) and the transition to an S-100 data format is undetermined at this time. Wherever S-411 is treated in this document as an S-100 product, its inclusion should be regarded as contingent on availability of “S-100 compliance category 4” S-411 Product Specification and datasets. [↑](#footnote-ref-1)
2. The discrete or continuous nature is also apparent from the metadata attributes *dataCodingFormat* and/or *intepolationType* (see S-100 Part 10c). Discrepancies between these attributes and portrayal catalogues should be reported to the data producer or the organisation responsible for the portrayal catalogue in question. [↑](#footnote-ref-2)
3. S-411, S-413, S-414, and perhaps parts of S-126 will be included in this layer when those specifications are more mature. [↑](#footnote-ref-3)
4. This table covers the Basic and Other products in C-7.1.1 and C-7.1.2. Note that portrayal catalogues might be revised to change assignments to viewing groups. [↑](#footnote-ref-4)
5. IEC 60945 as cited in S-52 specifies that character size in mm be not less than 3.5 x the viewing distance in metres. According to this criterion "readable from 1 metre” requires that characters be not less than 3.5 mm in size. A 3.5mm symbol or character subtends an angle of approximately 12 arc minutes at a distance of 1 metre. [↑](#footnote-ref-5)
6. The rule that symbols and characters should subtend an angle of not less than 20 arc minutes at the observer’s eye (mentioned in S-52) results in a minimum character height of 5.76mm for a 1 metre viewing distance. [↑](#footnote-ref-6)
7. National text is a supplementary option for ECDIS. If used, the style for Latin characters must be similar to the English text. Other characters should conform to the requirements in C-11.2.2 and C-11.2.3 as far as possible. [↑](#footnote-ref-7)
8. Because of potential usability and cybersecurity issues. Revised restrictions may be adopted after the IEC cybersecurity standard is complete. [↑](#footnote-ref-8)
9. Adoption of S-128 (Catalogue of Nautical Products) may change this situation. [↑](#footnote-ref-9)
10. Depending on implementation design, one-time validation upon installation, removal, or update of datasets on the system may suffice. [↑](#footnote-ref-10)
11. This is the portrayal rule DEPARE03 in the S-101 portrayal catalogue. [↑](#footnote-ref-11)
12. “Discrete interpolation” means no interpolation between data points. [↑](#footnote-ref-12)
13. Values are for hypothetical data and display, and the figures have been reduced for reproduction in this document. [↑](#footnote-ref-13)
14. CSS files use hex RGB to specify colours. Colour profile files in portrayal catalogues use CIE and decimal RGB. [↑](#footnote-ref-14)
15. For example, S-101 (ENC) requires the parameter “Safety Depth”, but S-123 (Marine Radio Services) does not encode any depth information and therefore cannot use “Safety Depth”, so it may not be listed in S-122 portrayal catalogues. [↑](#footnote-ref-15)