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Proposal on the Alignment and Compatibility between

S-201 and S-125

# Summary

This paper, in combination with China's research and data experimental production in S-201 “Aids to Navigation (AtoN) Information Product Specification" (Ed2.0.0) and S-125 "Marine Aids to Navigation (AtoN) Product Specification" (Ed1.0.0), puts forward suggestions for the alignment and compatibility of S-201 and S-125 through comparative analysis of the two documents, so as to jointly promote the application practice of AtoN information data product specifications.

## Purpose of the document

This paper is intended to provide input for the 21st session of the Aids to Navigation Requirements and Management (ARM) Committee to promote the compatibility and update of IALA S-201 and IHO S-125 regarding the AtoN information product specifications, and to jointly advance the application of S-201 and S-125 into practical production fields.

## Related documents

1. IALA ARM Committee Work Programme 2025-2027
2. ARM20-12.1 ARM20 Meeting Report
3. C02-19.1 Report of the 2nd session of the IALA Council
4. C02-12.1.1.1 S-125 Ed1.0.0 (S-125 Marine Aids to Navigation (AtoN) Product Specification)
5. C02-10.6.1.1 S-201 Ed2.0.0 (S-201 IALA Aids to Navigation (AtoN) Information Product Specification)
6. C02-12.1.1 Liaison note to IHO NIPWG on development of S-125
7. C02-10.6.1 Report on S-200 Production Specification development (rev1)

# Background

The IALA ARM20 delivered the S-201 Edition 2.0.0 and provided member states ample time to study and give feedback to the working group to develop a mature version. In June 2025, S-201 Edition 2.0.0 was officially approved and released at the 2nd session of the IALA Council, becoming IALA’s first product specification to reach Edition 2.0.0, and the first non-IHO developed S-100 series standard to reach this version level, entering into the operational production phase. S-125 Edition 1.0.0 was officially completed and submitted to IHO, requesting the initiation of the formal adoption process to be included into the S-100 series. At the same time, the testing bed was conducted to ensure the interoperability with systems such as ECDIS and VTS. The update of the supporting document was also completed. *G1106 Guidelines for Developing IALA S-200 Series Product Specifications* Edition 3.0 was released, aligning with IHO S-100 Edition 5.2.0, introducing agile development processes and version management rules, and strengthening interoperability design and registration management mechanisms to provide methodology and template support for the continuous iteration of S-201/S-125 in future.

Considering that the S-100 Electronic Chart Display and Information System (ECDIS) will be legally used after January 1, 2026, and all new systems must comply with the International Maritime Organization's (IMO) new resolution (MSC.530(106)) on the performance standards of ECDIS since January 1, 2029, it is extremely significant to submit S-125 Edition 1.0.0 to the IHO GI Registry and carry out further modification in order to promote the application of S-125 to the practical production field.

According to the work plan of the ARM Committee, the ARM Committee WG2 (Information Services and Presentation Working Group) has been officially authorized to submit the final draft of S-125 Edition 1.0.0 before the 21st session of ARM Committee in October 2025 for simultaneous review by the IHO NIPWG. The ARM Committee will complete the joint test report on the interoperability catalog between S-125 and S-98 before the end of 2025 and submit it to ARM21 for review.

It is recognized that the development of product specifications is an iterative process with continuous improvement, the product specifications such as S-125 will be refined and improved during the current session, and the S-200 process will be continuously advanced to ensure the sound integration of various data across systems and institutions.

# Discussion

## Comparison Analysis of S-201 and S-125

The similarities and differences between IALA S-201 and IHO S-125 can be summarized as follows: they share the same technical lineage but serve different stages of the maritime life cycle.

1. Similarities

Both are built on the common technical foundation of IHO S-100 (Edition 5.2): the coordinate system is uniformly WGS84 and the data structure follows the ISO 19100 series. The exchange format of both is standardized as GML 3.2.1 and both are externally published through an “Exchange Set + CATALOG.XML.” Whether it is a lighthouse, a buoy, or a radar transponder, both specifications support the abstracting into a “structure-equipment” combination model and assigning a globally unique MRN identifier to ensure the data integration across systems and institutions.

1. Differences

In terms of purpose, they play roles as one back-end database and one front-end display screen: S-201 is an “encyclopedia” for AtoN management authorities, which contains detailed metadata of lantern models, battery specifications, mooring methods and maintenance plans, with a volume up to 50 MB. Its update cycle could be determined by the competent authority, aiming to let managers acknowledge the entire history of each AtoN.

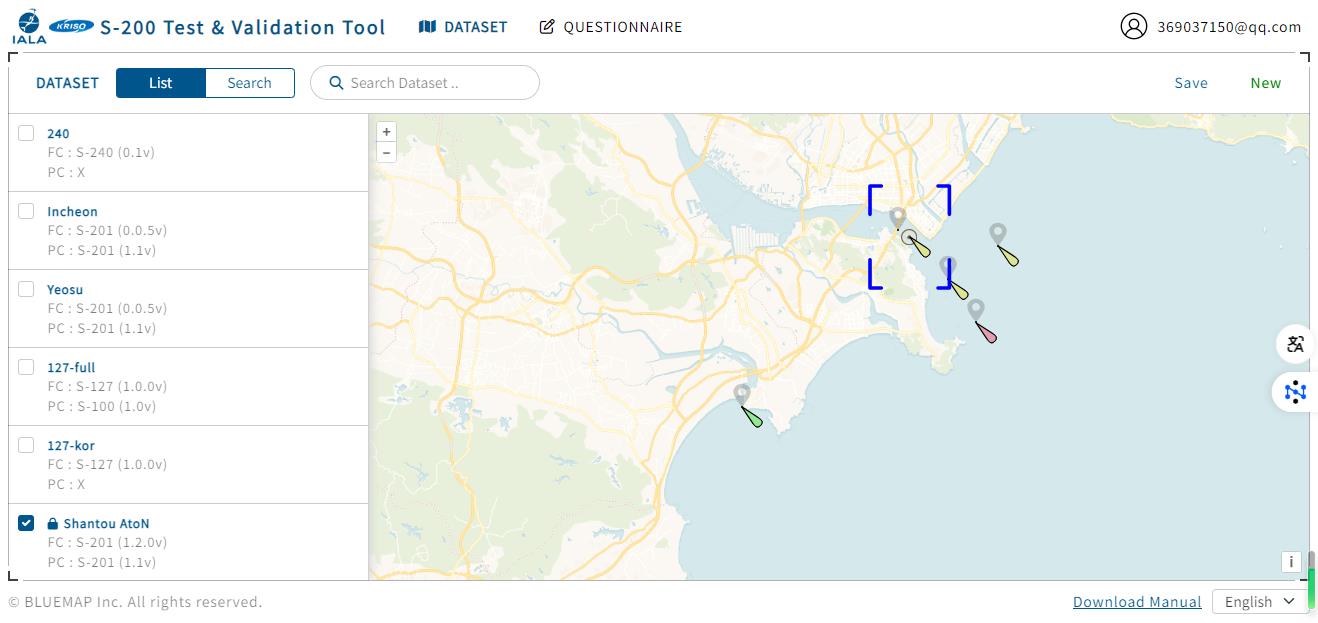
S-125 is a vector product specification, primarily used for encoding the attributes and status of AtoN. The AtoN dataset lists all AtoN and includes status information such as temporary changes, proposed changes, change announcements, and abnormal reports. The S-125 dataset is derived from the complete AtoN information and provides externally published information that can be used in ECDIS/ECS for the public. The S-125 AtoN data product is similar to a front-end display screen, functioning as a real-time AtoN table posted in the corner of the ECDIS. By extracting those elements directly related to navigation from S-201 and overlaying dynamic status of AtoN such as temporary extinguished, displacement, adjustment, and malfunction, S-125 provides a constantly available AtoN table on board to meet the regulatory requirements of the IMO SOLAS Chapter V .

Therefore, S-201 provides the answer of “What is this AtoN and what was it like in the past?”, while S-125 answers the question "Is this AtoN currently available and what will happen next?”. Both share the same data lineage but play complementary roles at the front and back end in the maritime information chain. In this regard, the alignment and compatibility between the two are of great importance.

## S-201 Data Information Products and Testing

Some features and attributes of AtoN and its related systems are internal management information, such as lantern models, energy allocation, and maintenance records. Therefore, it is necessary to consider the level setting and display rules of elements as much as possible in the specifications.

China has carried out the research and data application tests on S-201. For example, some AtoN information of Shantou Port in China was imported into the IALA S-200 TESTBED and the uploaded AtoN data was well displayed and could basically indicate the technical parameters of the AtoN. However, since the data categories in the S-201 product specification are numerous and the attributes are complicated, some detailed information needs to be further improved during the parameter configuration process in order to better serve the production field.



***Figure 1 AtoNs in the S-200 Test & Validation Tool***

**1）Proposing to Add Multi-functional Devices of AtoN into Feature Catalogue**

With the advancement of technology and the increasing needs for marine environmental monitoring and forecasting, equipping AtoN with meteorological, hydrological, and other sensor devices can enable real-time acquisition of parameters such as maritime meteorology, hydrology, water quality, ecology, and dynamics. It would not only facilitate the transformation and upgrading of traditional AtoN but also promote the construction of multi-functional AtoN into a new era.

To achieve the embedding of multi-functional AtoN in ECDIS/ECS in a plug-and-play manner in future (e.g., the compound AtoN with AIS broadcasting, real-time meteorological and hydrological data, wireless communication, and drone landing platforms), it is essential to deconstruct the AtoN entity and create a S-125 subset for multi-functional AtoN. This subset would be used to describe the location, light characteristics, and status (normal/fault/displacement, etc.). Meteorological, hydrological, AIS messages, and other elements are incorporated into the product specification as independent switchable layers. An Exchange Set (including \*.000 and/+ CATALOG.XML)would be generated, allowing users to select via a “layer manager”:

☐ Display traditional buoy icons only (enabling the compatibility with old systems);

☐ Overlay the meteorological/hydrological data;

☐ Show the communication signal strength or real-time video thumbnails (when the AtoN is equipped with cameras);

etc.

Given that multi-functional AtoN collect a large amount of data and if the data interacted in real time, it is necessary to clarify the data validity period and version control mechanism to prevent the retention of expired data in ECDIS. Therefore, the introduction of a data expiration label (such as withdrawn, replaced, seasonal-off) would help coordinate the loading and update frequency of relevant data and support the life-cycle management.

**2)Proposing to Add BD-Related Attributes for Differential, Navigation, Positioning, and Other Features**

It is proposed to add BD-related attributes in S-201 , such as:

①FC 5.23 Horizontal Datum

Label: Beidou Horizontal Datum

Definition: The Beidou Horizontal Datum is a reference system used by the Beidou Navigation Satellite System to accurately determine the positions of points on the Earth's surface. It is based on the geocentric origin and uses the meter from the International System of Units (SI) as the length unit. It is consistent with the International Earth Rotation and Reference Systems Service (IERS) standards to ensure the high-precision positioning and interoperability globally.

②FC 5.59 Category of Radio Station

Label：Differential Beidou

Definition: A radio beacon transmitting DBD correction signals.

③FC 5.135 AtoN Commissioning, 5.136 AtoN Removal, 5.137 AtoN Replacement, 5.138 Fixed AtoN Change

Label：

• DBD station establishment

• DBD station removal

• DBD station temporary removal

• DBD out of service

• DBD operating properly

• DBD unreliable

④5.143 Positioning Equipment

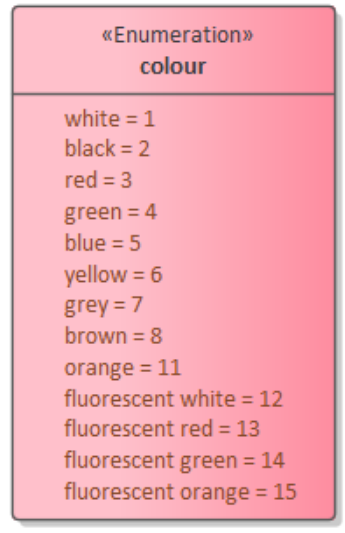
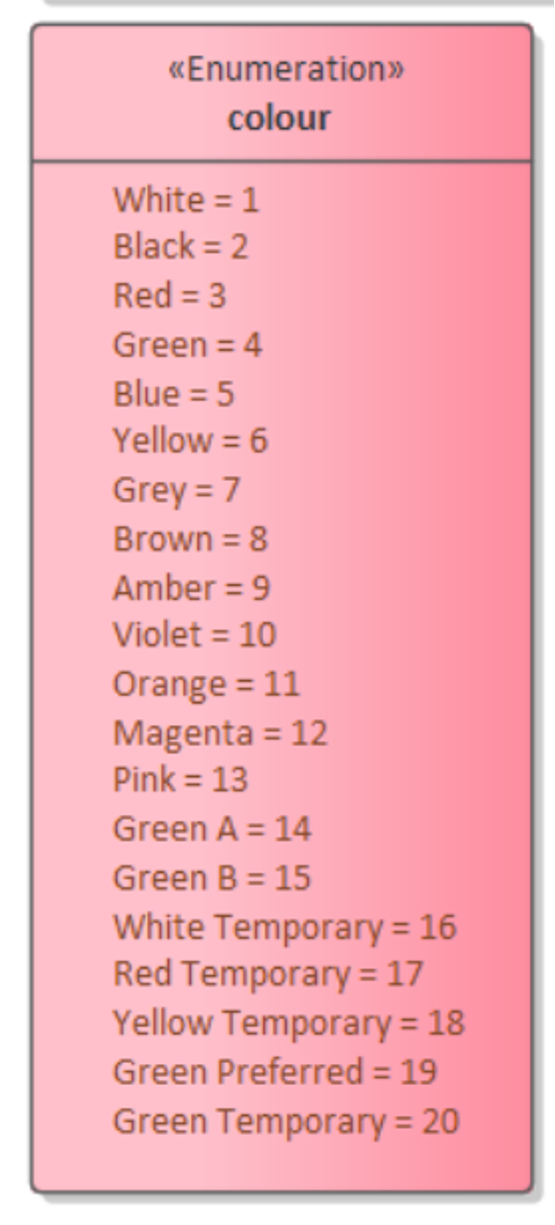
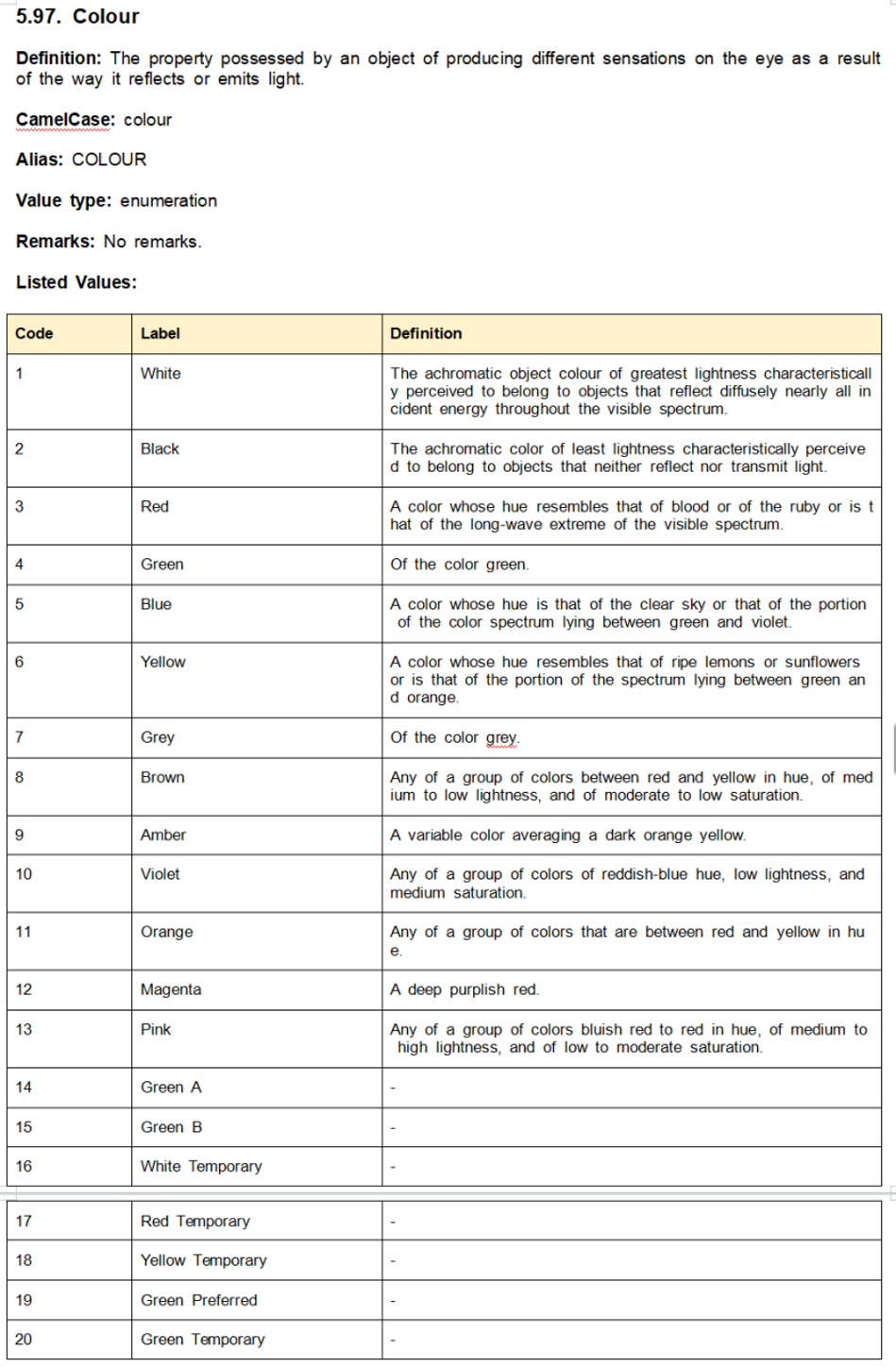
Label：BD Receiver (BeiDou Receiver)

## Suggestions for the Improvement of the IHO S-125

The graphical results of S-125 are displayed on ECDIS, electronic charts, or VTS systems and are suitable for data sharing and exchange among maritime authorities, ports, and shipping companies. For elements that need to be displayed in future electronic charts and elements that may bring changes to navigation safety, it is necessary to consider the incorporation of them into the product specification and the formulation of display rules as much as possible, and ensure the alignment and compatibility. For example:

**1） Proposing to Solve the Issue of Inconsistent Color Assignment between S-125 and S-201**

S-125 has not yet published a Feature Catalogue (FC). The FC available in the document is that of S-201. In the Product Specification (PS) of S-125, the color assignments are as follows: fluorescent white = 12, fluorescent red = 13, fluorescent green = 14 and fluorescent orange = 15. These colors neither have corresponding values in the S-201 product specification nor included in FC of the IHO S-101 Electronic Chart Product Specification. Thus it is recommended to harmonize these color assignments with those in S-201 and IHO S-101.

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***Figure 2 Inconsistent Color Assignment between S-125 and S-201***

**2)Suggesting to Add BD-Related Attributes for Differential, Positioning, and Other Features**

It is suggested to add BD-related attributes in S-125 Product Specification (Figure 7. AtoN Change Details Enumeration), such as:

• DBD station establishment

• DBD station removal

• DBD station temporary removal

• DBD out of service

• DBD operating properly

• DBD unreliable

**3）Other Suggestions-to Update Abbreviations**

The following abbreviations has appeared in the relevant sections of the S-125 product specification. It is recommended to list them in Section 3.2.

EPSG European Petroleum Survey Group (see Section 8.1)

GI Geospatial Information (see Section 11.5)

DSDL Document Schema Definition Languages (see Section 2.2)

MRN Maritime Resource Name (see Section 10.8)

## Suggestions for the alignment and compatibility of S-201 and S-125

S-201 focuses more on the physical attributes of AtoN, such as height, color, light characteristics, installation, and maintenance requirements, and is suitable for the design, manufacture, and maintenance of AtoN. S-125 is a standard specifically for the exchange of maritime AtoN data, defining the structure, encoding, and transmission formats of data. It focuses on how to exchange these data among different systems and how to encode these data into digital formats for the usage in electronic charts or VTS systems. It is suitable for data sharing and exchange among maritime authorities, ports, and shipping companies, with specific requirements for data transmission protocols. In future, it is suggested that:

1)Maintaining Attention to IALA's Correspondence with IHO on S-125: Remaining concern on the liaison note submitted by IALA to IHO regarding S-125 and maintaining a positive attitude towards feedback. Following up on the corresponding document revisions and continuously assessing the integration progress of S-201/S-125. Establishing a shared Feature Catalogue to ensure the consistency of elements and attributes between S-201 and S-125 to avoid semantic ambiguity.

2) Clarifying S-125 as a Subset of S-101: Clearly defining that S-125 is a subset of S-101 by only adding status information, without repeating geometric or static attributes, and supplementing with "status changes, announcements, temporary/seasonal information" , in order to avoid duplication with S-101 (ENC). Developing the symbology and interoperability mechanisms to display S-125 status symbols as an overlay or interleave on S-101 ENC.

3)Jointly Developing S-125 Portrayal Catalogue by IHO and IALA: Working together with IALA to develop S-125 portrayal catalogue and incorporate them into the S-98 interoperability catalogue. Establishing regional data coordination mechanisms to prevent redundant broadcasting between S-124 and S-125.

4)Encouraging the Submission of National Pilot Experiences: Encouraging member states to submit national pilot experiences through their national hydrographic offices to IHO and IALA, further to form the best practice reports.

# References

1. S-100 IHO S-100 Universal Hydrographic Data Model
2. S-97 IHO Guidelines for Creating S-100 Product Specifications
3. S-101 IHO Electronic Navigational Chart (ENC) Product Specification

# Action requested of the Committee

The Committee is requested to:

1. consider the proposal in section 3; and
2. take actions as appropriate.