

Water Level Information for Surface Navigation Validation Checks

Edition 1.0.0 – May 2025

Aligned to S-104 Edition 2.0.0

IHO



International
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Published by the
International Hydrographic Organization
4b quai Antoine 1^{er}
Principauté de Monaco
Tel: (377) 93.10.81.00
Fax: (377) 93.10.81.40
info@iho.int
www.iho.int

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Document History

Changes to this Specification are coordinated by the IHO Tides, Water Level, and Currents Working Group S-104 Project Team. New editions will be made available via the IHO web site. Maintenance of the Specification shall conform to IHO Resolution 2/2007 (as amended).

Version Number	Date	Author/Editor	Purpose
0.1.0	2024-10-23	RM	Initial draft for S100 Validation Checks GitHub repository. Based on the 2023 “combined” checks from the S-104 PT, which are aligned to S-104 Edition 1.1.0 and S-111 Edition 1.2.0.
0.2.0	2024-12-09	RM	Extended conformance statement; revised maintenance clause; revised clause about other applicable checks; removed language in clause 1.1 about considering all checks as warnings.
1.0.0	2025-05-08	GS	Aligned to S-104 Edition 2.0.0; removed generic S-100 checks

Summary of Substantive Changes in Edition x.x

Bold references in the Clauses Affected column indicate the principal sections/clauses that are affected by the described change.

Change Summary	Clauses Affected
(To be populated for editions following Edition 1.0.0)	

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1 Introduction

This document specifies a set of checks that producers of S-104 Water Level Information for Surface Navigation validation tools must implement in their validation software. Validation software is used to ensure that S-104 data are compliant with the S-104 Product Specification. The initial list of checks for S-104 was compiled by the IHO S-104 Project Team of the IHO Tides, Water Level and Currents Working Group (TWCWG).

The checks listed in this document are product-specific. They supplement but do not replace the generic S-100 validation checks applicable to all S-100 products which are defined in a separate IHO publication (S-158:100 – Universal Hydrographic Model Validation Checks).

1.1 Scope

This document, designated as “S-158:104” by the IHO, specifies validation checks for data products conforming to Edition(s) 2.0.x of the S-104 (Water Level Information for Surface Navigation) Product Specification.

This document specifies product-specific validation checks for both S-104 datasets and exchange sets containing S-104 datasets.

The checks specified in this document supplement the checks described in Edition 1.0.0 of S-158:100 (Universal Hydrographic Data Model Validation Checks). Both sets of validation checks, those described in S-158:100 as well as those defined in S-158:104, must be applied to test the validity of S-104 datasets and exchange sets. For datasets and exchange sets intended for use on ECDIS, additional cross-product checks, defined in S-158:98, must also be applied.

The checks described are intended for production systems designed to produce S-104 datasets. The checks can be administered at any time during the production phase.

1.2 Conformance

This specification conforms to Edition 1.0.0 of IHO specification S-158 (Validation Checks – Introduction and Structure).

The validation checks described herein conform to Edition(s) 2.0.x of IHO Product Specification S-104 (Water Level Information for Surface Navigation).

Edition 1.0.0 is an Implementation version in accordance with IHO TR 2/2007 and there may be revisions issued by the Working Group prior to the Operational Edition 2.0.0 being published.

1.3 References

1.3.1 Normative references

S-98	<i>Data Product Interoperability in S-100 Navigation Systems, IHO Publication S-98, Edition 2.0.0, March 2025.</i>
S-100	<i>IHO Universal Hydrographic Data Model, Edition 5.2.0, June 2024</i>
S-104	<i>Water Level Information for Surface Navigation Product Specification, Edition 2.0.0, December 2024.</i>
S-158	<i>Validation Checks – Introduction and Structure, Edition 1.0.0, February 2025.</i>
S-158:100	<i>Universal Hydrographic Data Model Validation Checks, Edition 1.0.0, February 2025.</i>

1.3.2 Informative references

ISO 19157:2013	<i>Geographic information – Data Quality. As amended by Amendment 1, 2018</i>
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1.4 Terms, definitions and abbreviations

1.4.1 Terms and definitions

The terms and definitions listed in S-158 apply to this document. In addition, the following terms and definitions are used:

enumeration

a fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list

exterior

difference between the universe and the closure [ISO 19107]

NOTE The concept of exterior is applicable to both topological and geometric complexes

feature attribute

characteristic of a feature [ISO 19101]

NOTE: A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.

NOTE: A feature attribute type has a name, a data type and a domain associated to it. A feature attribute instance has an attribute value taken from the value domain of the feature attribute type.

NOTE: In a Feature Catalogue, a feature attribute may include a value domain but does not specify attribute values for feature instances.

EXAMPLE 1: A feature attribute named communication channel may have an attribute value VHF0007 which belongs to the data type text

EXAMPLE 2: A feature attribute named length may have an attribute value 82.4 which belongs to the data type real

multiplicity

specification of the number of possible occurrences of a property, or the number of allowable elements that may participate in a given relationship [ISO 19103]

EXAMPLES: 1..* (one to many); 1 (exactly one); 0..1 (zero or one)

1.4.2 Abbreviations

This Specification uses the abbreviated terms defined in S-158.

In addition, this Specification uses the following abbreviated terms:

DCF	Data Coding Format. Indicates the coverage type (see S-100 Part 10c clause 10c-10.1 – Data Coding Format). For S-104 Edition 2.0.0 the only coverage type is regular grids (DCF 2).
FDG	Feature Data Group. The values group specified in S-100 Part 10c and represented by Level 3 and Level 4 in S-104 Table 10-2 (Overview of an S-104 data product).
FIDS	Feature Information Dataset in “Group_F” - see S-100 Part 10c. See S-104 Table 10-2 (Overview of an S-104 data product) and clause 10.2.2.2.
FINST	Feature Instance. Instance of WaterLevel in S-104. Represents the WaterLevel.nn groups within the WaterLevel feature type group.
FTYPE	Feature Type. Represents the container group WaterLevel in S-104. See Level 1 of S-104 Table 10-2 (Overview of an S-104 data product).
FTYPE.N	Feature instance groups. “N” denotes the N-th Feature instance group in the dataset. See Level 2 of S-104 Table 10-2 (Overview of an S-104 data product).
FX	Feature code. The alphanumeric code for a feature type, as specified in the feature catalogue. For S-104 Edition 2.0.0 there is a single feature type, whose feature code is “WaterLevel”.

- <code>** The code for a particular attribute in the values record. Codes for attributes defined in the Product Specification can also be found in the feature catalogue as well as in Group_F in the HDF5 file. (Mismatched between the values record and the feature catalogue or Group_F are errors.)
- <name>** The name of an attribute. Can be found in the feature catalogue as well as Group_F in the HDF5 file.

1.4.3 Symbols

The symbols used in logical and spatial expressions are defined in S-158 clause 1.3.3 (Symbols).

1.5 Use of language

Within this document:

- “Must” indicates a mandatory requirement.
- “Should” indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
- “May” means “allowed to” or “could possibly”, and is not mandatory.

1.6 General description

S-158:104 is a specification describing product-specific validation checks for S-104 products. There are no data products based directly on this edition of S-158:104 and therefore no general information applicable to data products conforming to it.

The validation checks are intended for production systems designed to produce S-104 Water Level Information for Surface Navigation datasets. The checks can be administered at any time during the production phase.

1.7 Specification metadata and maintenance

1.7.1 Specification metadata

This information uniquely identifies this Specification and provides information about its creation and maintenance.

Title: Water Level Information for Surface Navigation Validation Checks

Version: 1.0.0

Date: 2025-05-08

Language: English

Classification: Unclassified

Contact: International Hydrographic Organization.
4 quai Antoine 1er,
B.P.445 MC 98011 MONACO CEDEX
Telephone: +377 93 10 81 00
B.P. 445 Fax: + 377 93 10 81 40
Email: info@iho.int

Role: Owner

URL: <https://registry.iho.int>

Identifier: S-158:104

Maintenance: Changes to this Specification are coordinated by the IHO S-104 Project Team of the IHO Tides, Water Level and Currents Working Group and made available via the

IHO Publications website. Maintenance of the Product Specification must conform to IHO Technical Resolution 2/2007 (revised 2010). For reporting issues which need correction, use the contact information.

1.7.2 Specification maintenance

1.7.2.1 Introduction

Changes to S-158:104 will be released by the IHO as a New Edition, revision, or clarification.

The list of checks, which accompanies this document is considered part of this Specification and changes to it are considered changes to this Specification.

S-158:104 is not accompanied by separate artefacts such as an XML Schema, Feature or Portrayal Catalogue and therefore this clause does not address the question of changes to such derived artefacts.

1.7.2.2 New Edition

New Editions of S-158:104 include at least one of the following changes:

- introduce a new validation check (of any classification);
- remove an existing validation check (of any classification);
- change the classification of a validation check, whether upgrade (such as Error to Critical) or downgrade (such as Error to Warning);
- extend a validation check to include new features, conditions, etc., in a way that requires validation software manufacturers to change their software.

New Editions are likely to require validation software manufacturers to change their software or invalidate datasets which passed validation according to the previous Edition of S-158:104.

All cumulative revisions and clarifications must be included with the release of approved New Editions.

1.7.2.3 Revision

Revisions are defined as substantive semantic changes to S-158:104. Typically, revisions will change S-158:104 to correct factual errors or introduce necessary changes that have become evident as a result of practical experience or changing circumstances. Revisions include corrections of misinterpretations of S-100 or S-104, or extensions to checks that do not require changes to validation software..

A revision must not be classified as a clarification. All cumulative clarifications must be included with the release of approved revisions.

1.7.2.4 Clarification

Clarifications are changes to S-158:104 arising from non-substantive reasons.

Typically clarifications for non-substantive reasons remove ambiguity; correct grammatical and spelling errors; amend or update cross references; revise check messages or clarify check descriptions without requiring manufacturers to change their software.

1.7.2.5 Version numbers

The associated version control numbering to identify changes (n) to S-158:104 must be as follows:

New Editions denoted as **n.0.0**

Revisions denoted as n.**n.0**

Clarifications denoted as n.n.**n**

2 Check Structure

Check structure in S-158:104 includes the fields specified in S-158 plus the additional fields specified in Table 2-1.

[If S-158:104 omits the “Data Quality ...” column from the template (made optional at S-100 WG9) add a phrase to the previous sentence saying that column is omitted.]

Table 2-1 - Extensions to check structure

Column Name	Description
Prerequisites	Checks which must succeed (check condition evaluates to FALSE) before this check can be executed. Trivial prerequisites are omitted from this column (such as requiring the presence of an attribute before using it in a condition).
Terminate if failure	Whether failure of the check (the check condition evaluates to TRUE) will force termination of check processing before all validation checks can be executed. Valid values are TRUE, FALSE, or none (equivalent to FALSE). The HDF5 format is hierarchical and the validity or even the existence of certain parts of the dataset depends on structure or content required to be provided in the dataset. Validation checks for such fundamental structure or content have this field set to TRUE so that subsequent checks which depend on that structure or content are not unnecessarily attempted if the fundamental structure or content fails its own validation check. For example, checks on groups which are members of another group are not attempted if the container group is missing.
Context	Sets the context for a check, such as a particular coverage type (which is indicated by the value of an HDF5 attribute as specified in S-100), a group, or other element (e.g., an HDF5 array), or test the value of a metadata attribute.

Termination of check processing need not be immediate, but is recommended at the end of the validation phase during which the failure occurs. Validation phases are explained in clause 4.

3 Check Syntax

The check syntax conforms to the syntax and operators for product-specific checks described in S-158 clause 4.2.

4 Organisation

The list of validation checks for this edition of S-158:104 is available separately (see clause 9). The list of checks accompanies this specification and forms an integral part of it.

The numeric component of the check ID is a 4-digit number whose first digit indicates the phase to which the check belongs (see Table 4-1 below).

Table 4-1 - Division of product-specific checks into processing phases

Phase	Check Numbers	Name	Description
1	104_1xxx	Validate Dataset Root and Feature Information	Validation of root group of HDF5 file and feature type information.

Phase	Check Numbers	Name	Description
2	104_2xxx	Validate Feature Container Groups	Validation of metadata and structure for each feature type ("Feature Container"). In S-104 there is one feature container so this set of checks is executed only once.
3	104_3xxx	Validate Feature Instance Groups	Validation of feature instances. This set of checks, along with Phase 4 checks, must be executed once for each feature instance group contained within a feature container.
4	N/A	Validate Positioning Groups	There are no Phase 4 checks for S-104, which does not use positioning groups. This phase is mentioned in this table only for compatibility with S-158:1xx for coverages which do use positioning groups.
5	104_5xxx	Validate Values Datasets	Validation of data values. This set of checks is applied to the values group in a feature instance group.
6	104_9xxx	Validate Exchange Catalogue	This set of checks relates to product-specific requirements for exchange catalogues

Dataset validation checks the structure and content of individual HDF5 data files. The checks for each HDF5 dataset file are divided into four phases

5 Other Applicable Checks

5.1 Generic S-100 checks

S-104 datasets and exchange sets must also be validated using the following subset of the generic S-100 validation checks defined in S-158:100:

Document reference in S-158:100 list	Checks	Apply to	Remarks
Part 1	N/A	Product Specification	No direct implementation on datasets or exchange sets
Part 2 / 2a	N/A	Product Specification	No direct implementation on datasets or exchange sets
Part 4a	All Collection A checks	Exchange catalogue	
Part 4b	N/A	Product Specification	No direct implementation on datasets or exchange sets
Part 5 / 5a	100_0001 100_0002 100_0003 100_0004 100_0005 100_0006	Datasets	Inapplicable: 100_0009 100_0010 100_0011

Document reference in S-158:100 list	Checks	Apply to	Remarks
Part 6	Only checks in Collection A, if any	Datasets	
Part 7	Only checks in Collection A and applicable to polygons	Domain extent polygons	S-104 uses vector geometry only for domain extent polygons. Note also that domain extent polygons as used in S-104 do not have interior boundaries.
Part 8	Only Collection A checks applicable to regular grid coverages	Dataset	
Part 9 / 9a / 13	N/A	Product Specification	Validation checks for Portrayal Catalogue
Part 10a	None	N/A	S-104 does not use the ISO 8211 format
Part 10b	None	N/A	S-104 does not use the S-100 GML format
Part 10c	Only Collection A checks applicable to regular grid coverages	Dataset	S-104 uses only the regular grid coverage type
Part 11	100_0255	Dataset	There is only one Part 11 generic check, for dataset size
Part 15	All Collection A checks	Exchange catalogue Exchange set	
Part 17	All Collection A checks except those applying to metadata elements not used in S-104	Exchange catalogue Exchange set	

5.2 Interoperability checks

S-104 datasets and exchange sets intended for use on ECDIS must also pass the applicable interoperability checks from those listed in S-158:98.

6 Check Application Sequence

The check application sequence expands and modifies the application sequence described in S-158.

Table 6-1 - Suggested application order of validation checks

Order	Check Collection	Defined in	Apply to
1	S-100 generic checks for datasets	S-158:100	Dataset, in isolation
2	Product-specific checks for datasets	S-158:104	Dataset, in isolation
2.1	Root group checks	S-158:104 checks numbered 104_1xxx	Dataset, in isolation

Order	Check Collection	Defined in	Apply to
2.2	Feature Container group checks	S-158:104 checks numbered 104_2xxx	Dataset, in isolation
2.3	Feature Instance group checks	S-158:104 checks numbered 104_3xxx	Dataset, in isolation
2.4	Values group checks	S-158:104 checks numbered 104_5xxx	Dataset, in isolation
3	Interoperability checks for single S-104 dataset	S-158:98	Dataset, in isolation
4	Inter-dataset, intra-product checks	S-158:104 checks numbered Nxxx	Adjacent or intersecting datasets
?	Inter-version checks(?)	S-158:104 checked numbered Nxxx	Related datasets for different versions of S-104
5	Interoperability checks for combinations of datasets from different products	S-158:98	S-104 dataset in combination with relevant datasets from other products (e.g., S-104)
6	S-100 generic checks for exchange sets	S-158:100	Exchange set
7	Product-specific checks for exchange sets	S-158:104 checks numbered 104_9xxx	Exchange set
8	Product catalogue checks	S-158:128	S-128 datasets describing S-104 datasets

7 Check Classification

The check classification conforms to the scheme described in S-158.

8 Geometry and Spatial Operators

S-104 Edition 2.0.0 datasets use vector geometry only for domain extent polygons. Any spatial operators mentioned in checks on domain extent polygons conform to the operators for vector products described in S-158.

For all spatial operators the default tolerance provided in S-158:100 should be applied in validation software.

9 Other Components of this Specification

The other components of this Specification listed below are provided as separate documents or artefacts accompanying this document and form an integral part of this Specification.

- 1) Spreadsheet of S-104 validation checks named S158_104_1_0_0_YYYYMMDD of the latest build date. (The build date is the YYYYMMDD suffix in the file name.)