

Universal Hydrographic Data Model Validation Checks

Edition 1.0.0 – February 2025

Aligned to S-100 Edition 5.2.0

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Document History

Changes to this Specification are coordinated by the IHO S-100 working Group (S-100 WG). 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	2024-08-23	RM	Initial draft
0.2.0	2024-12-01	RM	Removed checks whose deletion was agreed by S-100 Validation subgroup (see GitHub issues); source document references in list of checks edited to conform to currently agreed format; split checks into specification and data sections, added Part 10b checks; added Part15 checks from PRIMAR; commenced addition of generic checks from S-158:102, 104, 111 and S-158:98 98 lists; elaborated language on tolerances for spatial operators.
1.0.0 Draft 1	February 2025	RM	Apply feedback; use standard language for more checks
1.0.0	February 2025	HSSC17	First implementation and testing Edition of S-158:100.

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 validation tools for S-100 based data products must implement in their validation software. Validation software is used to ensure that data are compliant with the S-100 Universal Hydrographic Data Model and Product Specifications based on S-100. The initial list of checks for S-100 was compiled by the IHO S-100 Validation Checks sub-group for the IHO. This list of checks derives in part original material in the S-100 standard and in part from validation checks for S-57 ENC's defined in IHO S-58 (ENC Validation Checks), which were provided by a number of hydrographic offices and software companies.

The checks listed in this document are generic checks applicable to all S-100 products which include the relevant S-100 concepts.

1.1 Scope

This document, designated as "S-158:100" by the IHO, specifies validation checks for data products conforming to Product Specifications based on Edition 5.2.0 and subsequent editions of the S-100 (Universal Hydrographic Data Model) Standard.

This document specifies validation checks for both datasets and exchange sets.

The checks specified in this document are intended to be supplemented by product-specific checks described in publications specific to each S-100 based Product Specification, designated as S-158:1xx publications, where "1xx" indicates the IHO number assigned to the data product. Both sets of validation checks, those described in S-158:100 as well as those defined in the applicable S-158:1xx publication, must be applied to test the validity of S-100 based 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.

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 5.2.0 of S-100 (Universal Hydrographic Data Model).

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>S-100 ECDIS and Interoperability Specification, IHO Publication S-98, Edition 2.0.0, ??? 2025. In Preparation.</i> |
| S-100 | <i>IHO Universal Hydrographic Data Model, Edition 5.2.0, June 2024</i> |
| S-158 | <i>Validation Checks – Introduction and Structure, Edition 1.0.0, ??? 2025. In preparation.</i> |

1.3.2 Informative references

- | | |
|----------------|---|
| ISO 19157:2013 | <i>Geographic information – Data Quality. As amended by Amendment 1, 2018</i> |
|----------------|---|

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:

aggregation

special form of association that specifies a whole-part relationship between the aggregate (whole) and a component part (see composition) [ISO 19103]

association

semantic relationship between two or more classifiers that specifies connections among their instances [ISO 19103]

NOTE: A binary association is an association among exactly two classifiers (including the possibility of an association from a classifier to itself)

association link

the record, field, or tag in the dataset which encodes an association between instances of feature, information, or spatial types. The format of an association link depends on the S-100 data format.

carrier metadata

metadata encoded within HDF5 datasets, as either HDF5 attributes or datasets

composition

form of aggregation association with strong ownership and coincident lifetime as part of the whole [ISO 19103]

NOTE: Parts with non-fixed multiplicity may be created after the composite itself, but once created they live and die with it (that is, they share lifetimes). Such parts can also be explicitly removed before the death of the composite. Composition may be recursive. Synonym: Composite aggregation.

embedded metadata

See **carrier metadata**.

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 association

relationship that links instances of one feature type with instances of the same or a different feature type [ISO 19110]

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

local name (XML)

the part of a name following the namespace prefix. The **local name** follows the final : in a qualified name. Also called **local part**

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)

registry

The IHO Geospatial Information Registry (<https://registry.iho.int>). May be referred to as “GI Registry” or simply “Registry”.

relationship

semantic connection among model elements [ISO 19103]

NOTE: Kinds of relationships include association, generalization, metarelationship, flow, and several kinds grouped under dependency.

tag (XML)

delimiters marking the beginning and end of an XML element, consisting of a name enclosed by < and > for a “start tag” and </ and > for an “end tag”. Empty elements may consist of a name enclosed by < and />.

1.4.2 Abbreviations

This Product Specification uses the abbreviated terms defined in S-158. In addition, the following abbreviations are used:

FC Feature Catalogue

GI Registry IHO Geospatial Information Registry (<https://registry.iho.int>)

PC Portrayal Catalogue

PS Product Specification

S-1xx S-100 based data product, where “1xx” stands for the product number assigned by the IHO (which may begin with numbers other than “1”)

SRS Spatial Reference System. GML-specific term for the GML attribute that indicates the coordinate reference system.

NOTE: The Part 10a checks use the field tags defined in S-100 Part 10a for ISO 8211 fields instead of the full field names. There are too many fields named in the checks to list individually in this clause. S-100 Part 10a should be consulted to identify ISO 8211 fields from the tag names.

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-158:100 is a specification describing generic validation checks for S-100 based products. There are no data products based directly on this edition of S-158:100 and therefore no general information applicable to data products conforming to it.

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:	Universal Hydrographic Model Validation Checks
Version:	1.0.0
Date:	February 2025
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-158:100
Maintenance:	Changes to this Specification are coordinated by the S-100 Validation Checks sub-group under the S-100 Working Group (S-100 WG) of the IHO 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-158:100 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-158:100 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-158:100 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-158:100.

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-158:100. Typically, revisions will change S-158:100 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 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-158:100 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-158:100 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-158:100 includes the fields specified in S-158.

The "Standards document reference" column is used to indicate the S-100 Part.

3 Check Syntax

The check syntax conforms to the syntax and operators for validation checks described in S-158 clause 4.2 with the following modifications for Edition 1.0.0:

- Imperative language ("shall", "shall not", "must", "must not", "allowed ... as long as", etc.) is used when the check is triggered (the message is temitted) if the condition IS NOT satisfied.
- Non-imperative language ("For each", "If x") is used when the check is triggered when the condition IS satisfied (evaluates to TRUE).

4 Organisation

The list of validation checks for this edition of S-158:100 is available separately (see clause 8). The list of checks accompanies this specification and forms an integral part of it.

4.1 Check numbers

Checks are assigned unique check identifiers in the format 100_<checkNumber><optionalAlphaSuffix>.

- The prefix “100_” is common to all the S-100 generic checks defined in this Specification.
- <checkNumber> is a 4-digit number assigned to each check. There is no significance attached to the value of this number.
- A modified check will generally retain the same <checkNumber> as their predecessor.
- If a check is deleted, its number is not reused for later different checks, but may be re-introduced if the original check is revived either with or without modification.
- <optionalAlphaSuffix> is an optional single lower case alphabetic letter suffix in the range a-z. It is used only when a check is split into two or more checks.

EXAMPLES: 100_1002, 100_2036a, 100_2036b.

4.2 Checks for datasets and exchange sets versus checks for specifications

The S-100 list of checks is split into two collections:

Collection A checks apply directly to datasets and exchange sets, in that they are expected to be implemented by software that takes one or more datasets or exchange sets as input and tests conformance of the dataset(s) or exchange set(s) to each relevant check (allowing for omission of irrelevant checks such as checks for a different data format). They will normally be applied whenever it is necessary to verify conformance of the dataset, exchange catalogue, or exchange set to S-100 requirements for the structure, content, and format of datasets, exchange catalogues, and exchange sets. Checks in this collection are expected to be implemented in validation software for datasets, exchange sets, and exchange catalogues.

Collection B checks are not directly applied to datasets or exchange sets, but are checklist items relevant for Product Specifications and related artefacts such as XML Feature Catalogues. They will normally be used by Product Specification developers in the process of preparing a Product Specification, Feature and Portrayal Catalogues, and GML schemas. Checks in this collection are not expected to be implemented in validation software for datasets, exchange sets, and exchange catalogues.

5 Check Application Sequence

5.1 Applicable subset

The S-100 standard defines alternative frameworks for certain portions of Product Specifications, such as data formats (Parts 10a/10b/10c). Where a Product Specification makes a choice between alternate S-100 framework concepts, only the checks relating to the alternative selected by the Product Specification need be applied.

5.2 Application sequence

The check application sequence expands and modifies the application sequence described in S-158. The order below is recommended, not mandatory.

Table 5.1 - Suggested application order of Collection A validation checks

Order	Check Collection	Apply to
1	S-100 generic checks for datasets	Dataset, in isolation

Order	Check Collection	Apply to
1a	Spatial integrity checks	CRS information and spatial primitives in single dataset
1b	Thematic integrity checks	Features and information types in single dataset
1c	Association integrity checks	Feature and information associations in single dataset
1d	Dataset structural conformance	Single dataset
2	Product-specific and interoperability checks for single datasets	Dataset, in isolation. See the relevant S-158:1xx publication and S-158:98 for recommended order
3	S-100 generic checks for exchange sets	Exchange set
3a	Exchange set structural conformance	Structure of exchange set
3c	Signature validity	Signatures
3b	Discovery metadata value conformance	Values in CATALOG.XML
3c	Discovery metadata/exchange set content conformance	Match contents of exchange set to discovery metadata in CATALOG.XML
4	Product-specific checks for exchange sets	Exchange set
5	Product catalogue checks	S-128 datasets. See S-158:128 for recommended order

The application sequence for Collection B checks is left to the discretion of Product Specification Project Teams.

5.3 Check messages

Application software is expected to identify the location in the file where the error was detected, and indicate the location in addition to the check message. The method used to identify and indicate the location will depend on the format and is left to the application software developer.

6 Check Classification

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

7 Geometry and Spatial Operators

7.1 Operators

Geometry and spatial operators conform to the operators for vector products described in S-158.

7.2 Tolerances

If comparisons of spatial coordinates are necessary, a tolerance factor must be applied. The default tolerances for the S-100 generic tests are described below. To ensure that all tests for a given data product, whether generic or product-specific, use the same tolerances, S-158:100 only provides default tolerances, which are overridden by any product-specific tolerances provided in the S-158:1xx specification.

- For Product Specifications which use coordinate multiplication factors, all spatial operators should use a default tolerance of 1/CMFX, 1/CMFY, or 1/CMFZ (corresponding to the coordinate axis) as appropriate in validation software.
- For Product Specification which do not use coordinate multiplication factors, the default tolerance should be 10^{-7} degrees if the axis unit is decimal degrees and 10^{-2} metres when the axis unit is metres.
- The tolerance should be increased to match the precision when either of the coordinate fields being compared uses a lower precision. For example, comparisons involving bounding boxes in discovery metadata should use a precision of 0.01 degrees since that is the precision of coordinate values for bounding boxes in discovery metadata.

In all cases, the respective S-158:1xx may override the default precision described above.

8 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-100 validation checks named S-158_100_1_0_0_YYYYMMDD. The build date is the YYYYMMDD suffix in the file name, whereas the “1_0_0” component represents the edition, revision, and clarification number. The file with the same edition and revision number as this document but with the most recent build date must be used..