

Data Product Interoperability Validation Checks

Edition 1.0.0 – February 2025

Aligned to S-98 Edition 2.0.0

IHO



International
Hydrographic
Organization

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

© Copyright International Hydrographic Organization 2025

This work is copyright. Apart from any use permitted in accordance with the Berne Convention for the Protection of Literary and Artistic Works (1886), and except in the circumstances described below, no part may be translated, reproduced by any process, adapted, communicated or commercially exploited without prior written permission from the International Hydrographic Organization (IHO). Copyright in some of the material in this publication may be owned by another party and permission for the translation and/or reproduction of that material must be obtained from the owner.

This document or partial material from this document may be translated, reproduced or distributed for general information, on no more than a cost recovery basis. Copies may not be sold or distributed for profit or gain without prior written agreement of the IHO Secretariat and any other copyright holders.

In the event that this document or partial material from this document is reproduced, translated or distributed under the terms described above, the following statements are to be included:

“Material from IHO publication [reference to extract: Title, Edition] is reproduced with the permission of the IHO Secretariat (Permission No/...) acting for the International Hydrographic Organization (IHO), which does not accept responsibility for the correctness of the material as reproduced: in case of doubt, the IHO’s authentic text shall prevail. The incorporation of material sourced from IHO shall not be construed as constituting an endorsement by IHO of this product.”

“This [document/publication] is a translation of IHO [document/publication] [name]. The IHO has not checked this translation and therefore takes no responsibility for its accuracy. In case of doubt the source version of [name] in [language] should be consulted.”

The IHO Logo or other identifiers shall not be used in any derived product without prior written permission from the IHO Secretariat.

Document History

Changes to this Specification are coordinated by the IHO S-100 Working Group. 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 Edition 1.0.0 of S-98 Annex C and S-100 WG7 8.1.
0.2.0	2024-12-01	RM	Updated maintenance section; updated tolerances; added some generic checks to S-100, updated conformance statement. Draft is WIP pending Dec. 9 VTC.
0.2.1	2024-12-11	RM	DQ Measure column removed; refined checks for overlaps; added check for holes in S-102; additional terms in cover document; classification now uses C/E/W indicators.
1.0.0	2025-02-24	RM	Applied S-100WG feedback; updated terms and definitions; updated references; updated check numbering; added S-98 Ed. 1.8.0 clause references in list of checks; added clause requiring check messages to identify location of error
1.0.0	Feb 2025	HSSC17	First implementation and testing Edition of S-158:98.

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)	

Contents	Page
1 Introduction	1
1.1 Scope	1
1.2 Conformance	1
1.3 References	1
1.3.1 Normative references	1
1.3.2 Informative references	2
1.4 Terms, definitions and abbreviations	2
1.4.1 Terms and definitions	2
1.4.2 Abbreviations	2
1.4.3 Symbols	2
1.5 Use of language	2
1.6 General description	3
1.7 Specification metadata and maintenance	3
1.7.1 Specification metadata	3
1.7.2 Specification maintenance	3
2 Check Structure	4
3 Check Syntax	5
4 Organisation	5
5 Other Applicable Checks	5
6 Check Application Sequence	5
6.1 Check messages	6
7 Check Classification	6
8 Geometry and Spatial Operators	6
9 Other Components of this Specification	7

1 Introduction

This document specifies a set of checks that producers of validation tools must implement in their validation software in order to ensure conformance of S-100 datasets and exchange sets with requirements specified in S-98. The initial list of checks for S-98 was compiled by the IHO S-100 Working Group (S-100 WG) in conjunction with the Tides, Water Level, and Currents Working Group (TWCWG) and NIPWG (Nautical Information Provision Working Group).

The checks listed in this document apply to different products or combinations of products as specified in each individual check. 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) and the product-specific validation checks for each product, described in other specifications pertaining to particular data products.

1.1 Scope

This document, designated as “S-158:98” by the IHO, specifies validation checks for data products conforming to any of the Product Specifications listed below (“x” indicates any number):

- S-101 Edition 2.0.x
- S-102 Edition 3.0.x
- S-104 Edition 2.0.x
- S-111 Edition 2.0.x
- S-124 Edition 2.0.x
- S-128 Edition 2.0.x
- S-129 Edition 2.0.x

This document specifies product-specific validation checks for both datasets and exchange sets containing datasets conforming to the listed Product Specifications.

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) and product-specific validation checks for each product (collectively designated “S-158:1xx Validation Checks”). While the S-158:100 and S-158:1xx Validation Checks verify the integrity of individual datasets and exchange sets, the checks in S-158:98, must be applied to verify the cross-compatibility of datasets and exchange sets intended for use on ECDIS.

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 2.0.x of IHO Product Specification S-98 (Data Product Interoperability in S-100 Navigation Systems).

Edition 1.0.0 of S-158:98 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 *Validation Checks – Introduction and Structure, Edition 1.0.0, ??? 2025. In preparation.*

S-158:100 *Universal Hydrographic Data Model Validation Checks, Edition 1.0.0, ??? 2025. In preparation.*

1.3.2 Informative references

ISO 19157:2013 *Geographic information – Data Quality. As amended by Amendment 1, 2018*

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 are used in this document or the accompanying list of checks:

compatible CRSs

for the purposes of this specification, compatible coordinate reference systems are those which are based on the same horizontal datum, or at least members of the same ensemble (i.e., different realisations).

fill value

a special value denoting the absence of a data value in an HDF5 dataset. Product specifications using the HDF5 format designate the fill value for each attribute for which a fill value is allowed.

successor (dataset)

a subsequent forecast, prediction, etc., for the same area as a predecessor dataset, but covering a time period that starts strictly after the period covered by the predecessor dataset. A successor dataset is not necessarily designated as an update, new edition, or reissue.

1.4.2 Abbreviations

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

In addition, this Specification uses the following abbreviated terms:

CNP Catalogue of Nautical Products

S-158:1xx Product-specific checks for the product identified by “1xx”, for example, S-158:111 (Surface Currents Validation Checks).

UPS Universal Polar Stereographic

UTM Universal Transverse Mercator

USSC User Selectable Safety Contour. Defined in S-98 as “User selectable safety contour means creation of the safety contour from the bathymetric grid data based on the value set by the user”.

WLA Water Level Adjustment. Adjustment of depth information by water level height according to the methods described in S-98.

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-158:98 is a specification describing validation checks for S-100 data products intended for use together on ECDIS. There are no data products based directly on this edition of S-158:98 and therefore no general information applicable to data products conforming to it.

The validation checks are intended for systems which produce, compile, distribute, and use certain specified S-100 products on ECDIS. The checks can be administered at any time during the dataset and exchange set production, compilation, and distribution phases. They can also be used on the end-user system to assess compatibility of available datasets and exchange sets.

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: Interoperability 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-158:98

Maintenance: Changes to this Specification are coordinated by the IHO S-100 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-158:98 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-158:98 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-158:98 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-158:98.

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-158:98. Typically, revisions will change S-158:98 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-98, corrections of misinterpretations of any of the Product Specifications within its scope (cf. clause 1.1), 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-158:98 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 (boldface **n**) to S-158:98 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-158:98 includes the fields specified in S-158 plus the additional fields specified in Table 2-1.

The optional "Data Quality Measure" column is not used in S-158:98.

Table 2-1 - Extensions to check structure

Column Name	Description
Products	The data products to which the validation check applies.
Inputs	The product component (for example, dataset, exchange set, exchange catalogue file, etc.) to which the check is applied.
Linked Table	A reference to a table where additional information referenced in the check description is provided.

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-158:98 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 - Categories of data product interoperability checks

Phase	Check Numbers	Name	Description
1	98_1xxx	Dataset Coverage and Datums	Assessment of the compatibility of coverage and datum information in different data products.
2	98_20xx	Data Values	Assessment of the compatibility of attribute and data values.
3	98_30xx	Coverage	Checks related to data overlaps.
4	98_40xx	Grid Structure	Checks related to the structure of gridded datasets.
5	98_50xx	Resources	Checks for data product resources.
6	98_60xx	Dataset Metadata	Assessment of the compatibility of discovery metadata compatibility in CATALOG.XML with dataset content.
7	98_70xx	Cross Validation	Assessment of whether datasets from data products are mutually compatible for the purpose of implementing certain ECDIS functionalities described in S-98.

5 Other Applicable Checks

Datasets and exchange sets intended for use on ECDIS must also pass the applicable generic and product-specific checks described in S-158:100 and S-158:1xx respectively.

6 Check Application Sequence

The suggested check application sequence below elaborates, as far as interoperability validation checks are concerned, on the application sequence described in S-158. Product-specific checks for each data product should be applied in the sequence described in the appropriate S-158:1xx and are included in this table only for context, as are the generic S-100 validation checks.

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-158:1xx	Dataset, in isolation
3	Interoperability checks for combinations of datasets	S-158:98 Checks whose inputs are datasets	Datasets from the products listed in clause 1.1 (Scope).
4	S-100 generic checks for exchange sets	S-158:100	Exchange set
5	Product-specific checks for exchange sets	S-158:1xx	Exchange set
6	Interoperability checks for discovery metadata	S-158:98 Checks whose inputs include CATALOG.XML	CATALOG.XML
7	Product catalogue checks	S-158:128	S-128 datasets

6.1 Check messages

Application software is expected to identify the location where the error was detected, and indicate the location in addition to the check message. The location should be identified to as high a level of detail as possible for the specific check (for some checks this may be individual features, for others it may be only possible to identify the dataset file(s)). The method used to identify and indicate the location will depend on the format and is left to the application software developer.

7 Check Classification

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

8 Geometry and Spatial Operators

S-102 Edition 3.0.x, S-104 and S-111 Editions 2.0.x datasets use coverage spatial types and do not use vector geometry (points, curves, or surface spatial primitives, except that points are used in point coverages and polygon geometry is used in domain extent polygons). The other data products covered by this Specification use vector geometry. In addition, vector geometry is used for coverage information in discovery metadata in all data products.

Any spatial operations mentioned in checks pertaining to vector spatial primitives (for example, domain extent polygons, coverage polygons, etc.) must conform to the operations for vector products described in S-158:100. Any spatial operators mentioned in checks pertaining to positioning information or grid coordinates or extent must conform to the operations for HDF5 coverage geometries specified in S-158:100.

For all spatial operators a default tolerance should be applied in validation software as follows:

- For coordinates in decimal degrees – a tolerance of 10^{-7} degrees or the precision of the lowest-precision coordinate field, whichever is greater.
- For coordinates in metres (UTM or UPS) – a tolerance of 0.01 m or the precision of the lowest-precision coordinate field being compared, whichever is greater.

EXAMPLE: If the coordinates of a bounding box in an HDF5 dataset carrier metadata (data type float or double) are being compared to bounding box coordinates in dataset discovery metadata (precision 2 decimal places) then the tolerance should be 0.01 decimal degrees (given that both use decimal degrees as the unit).

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-98 validation checks named S-158_98_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.

Page intentionally left blank