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**S-158:102**



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4b quai Antoine 1er

Principauté de Monaco

Tel: (377) 93.10.81.00

Fax: (377) 93.10.81.40

info@iho.int

www.iho.int

**Bathymetric Surface Validation Checks**

**(Draft) Edition 0.2.0-20241118**

**Aligned to S-102 Edition 3.0.0**

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Document History

Changes to this Specification are coordinated by the IHO S-100 Working Group S-102 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).

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| --- | --- | --- | --- |
| **Version Number** | **Date** | **Author/Editor** | **Purpose** |
| 0.1.0 | 2024-10-15 | RM | Initial draft for S100 Validation Checks GitHub repository. This is based on the August 2023 checks from the S-102 PT, which are aligned to the unpublished S-102 Edition 2.3.0. |
| 0.2.0 | 2024-11-18 | RM | Editorial updates agreed at S-100 WG9. Continues to based on the August 2023 checks. |
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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](#_Toc179925755)

[1.1 Scope 1](#_Toc179925756)

[1.2 Conformance 1](#_Toc179925757)

[1.3 References 1](#_Toc179925758)

[1.3.1 Normative references 1](#_Toc179925759)

[1.3.2 Informative references 1](#_Toc179925760)

[1.4 Terms, definitions and abbreviations 2](#_Toc179925761)

[1.4.1 Terms and definitions 2](#_Toc179925762)

[1.4.2 Abbreviations 2](#_Toc179925763)

[1.4.3 Symbols 3](#_Toc179925764)

[1.5 Use of language 3](#_Toc179925765)

[1.6 General description 3](#_Toc179925766)

[1.7 Specification metadata and maintenance 3](#_Toc179925767)

[1.7.1 Specification metadata 3](#_Toc179925768)

[1.7.2 Specification maintenance 4](#_Toc179925769)

[2 Check Structure 5](#_Toc179925770)

[3 Check Syntax 5](#_Toc179925771)

[4 Organisation 5](#_Toc179925772)

[5 Other Applicable Checks 6](#_Toc179925773)

[5.1 Generic S-100 checks 6](#_Toc179925774)

[5.2 Interoperability checks 7](#_Toc179925775)

[6 Check Application Sequence 7](#_Toc179925776)

[7 Check Classification 8](#_Toc179925777)

[8 Geometry and Spatial Operators 8](#_Toc179925778)

[9 Other Components of this Specification 8](#_Toc179925779)

# Introduction

This document specifies a set of checks that producers of S-102 Bathymetric Surface validation tools must implement in their validation software. Validation software is used to ensure that S-102 data are compliant with the S-102 Product Specification. The initial list of checks for S-102 was compiled by the IHO S-102 Project Team of the IHO S-100 Working Group.

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).

## Scope

This document, designated as “S-158:102” by the IHO, specifies validation checks for data products conforming to Edition(s) 3.0.x of the S-102 (Bathymetric Surface) Product Specification.

This document specifies product-specific validation checks for both S-102 datasets and exchange sets containing S-102 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-158:102, must be applied to test the validity of S-102 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-102 datasets. The checks can be administered at any time during the production phase.

## 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) 3.0.x of IHO Product Specification S-102 (Bathymetric Surface).

## References

### Normative references

S-98 *Data Product Interoperability in S-100 Navigation Systems, IHO Publication S-98, Edition 2.0.0, ??? 2024*. In Preparation.

S-100 *IHO Universal Hydrographic Data Model*, Edition 5.2.0, June 2024

S-102 *Bathymetric Surface Product Specification, Edition 3.0.0, ??? 2024*. In preparation.

S-158 *Validation Checks – Introduction and Structure, Edition 1.0.0, ??? 2024.* In preparation.

S-158:100 *Universal Hydrographic Data Model Validation Checks, Edition 1.0.0, ??? 2024*. In preparation.

### Informative references

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

## Terms, definitions and abbreviations

### 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)

### Abbreviations

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

In addition, this Specification uses the following abbreviated terms:

FDG Feature Data Group. The values group specified in S-100 Part 10c and represented by Level 3 and Level 4 in S-102 Figure 10 (Hierarchy of S-102 product).

FIDS Feature Information Dataset in “Group\_F” - see S-100 Part 10c. See S-102 Figure 10 (Hierarchy of S-102 product) and S-102 clause 10.2.3.

FINST Feature Instance. Instance of BathymetryCoverage in S-102 3.0.0. Represents the BathymetryCoverage.nn groups within the BathymetryCoverage feature type group.

FTYPE Feature Type. Represents the container group BathymetryCoverage in S-102. See Level 1 of Figure 10 (Hierarchy of S-102 product).

FTYPE.N Feature instance groups. “N” denotes the N-th Feature instance group in the dataset. See Level 2 of Figure 10 (Hierarchy of S-102 product).

QINST Quality feature instance. Instance of QualityOfBathymetryCoverage in S-102 3.0.0. Represents the BathymetryCoverage.nn groups within the BathymetryCoverage feature type group.

QTYPE Quality Feature Type. Represents the container group for QualityOfBathymetryCoverage in S-102 (ed. 3.0.0). See Level 1 of Figure 10 (Hierarchy of S-102 product).

QTYPE.N Instance groups for the quality features. “N” denotes the N-th Quality feature instance group in the dataset. See Level 2 of Figure 10 (Hierarchy of S-102 product).

### Symbols

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

## 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.

## General description

S-158:102 is a specification describing product-specific validation checks for S-102 products. There are no data products based directly on this edition of S-158:102 and therefore no general information applicable to data products conforming to it.

The validation checks are intended for production systems designed to produce S-102 Bathymetric Surface datasets. The checks can be administered at any time during the production phase.

~~General information about data products conforming to this specification.~~

**~~Title:~~** ~~S-158:102 Bathymetric Surface Validation Checks~~

**~~Abstract:~~** ~~This document describes validation checks for S-102 data products.~~

**~~Content:~~** ~~Not applicable~~

**~~Spatial Extent:~~**  ~~N/A~~

**~~Temporal Extent:~~** ~~N/A~~

**~~Specific Purpose:~~** ~~Validation of S-102 datasets and exchange sets.~~

## Specification metadata and maintenance

### Specification metadata

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

**Title:** Bathymetric Surface Validation Checks

**Version:** 0.2.0

**Date:** 2024-11-18

**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](mailto:info@iho.int)

**Role:** Owner

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

**Identifier:** S-158:102

**Maintenance:** Changes to this Specification are coordinated by the IHO S-102 Project Team of 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.

### Specification maintenance

#### Introduction

Changes to S-158:102 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-158:102 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.

*[Designation of an S-158:1xx publication as new edition, revision, or clarification are under review by the S-100 Validation Checks subgroup as of November 2018. Project Teams should await the conclusion of this work before amending the following sub-clauses.]*

#### New Edition

*New Editions* of S-158:102 introduce significant changes. *New Editions* enable new concepts, such as the ability to support new functions or applications, the introduction of new constructs or data types, or significant changes to the basic information or check structure arising from a new edition of S-158. *New Editions* are likely to have a significant impact on either existing users or future users of S-102 and S-158:102. All cumulative *revisions* and *clarifications* must be included with the release of approved New Editions.

#### Revision

*Revisions* are defined as substantive semantic changes to S-158:102. Typically, *revision*s will change S-158:102 to correct factual errors or introduce necessary changes that have become evident as a result of practical experience or changing circumstances, including support for new revisions of S-158. A *revision* must not be classified as a clarification. *Revisions* could have an impact on either existing users or future users of S‑158:102. All cumulative *clarifications* must be included with the release of approved revisions.

Changes in a revision of S-158:102 may or may not correspond to the same revision+edition number of S-102.

#### Clarification

*Clarifications* are changes to S-158:102 arising from non-substantive reasons or from introduction of a new edition or revision of S-102.

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; or revise classifications of checks as critical/error/warning. A *clarification* must not cause any substantive semantic change to S-158:102.

Clarifications to S-158:102 for alignment to a new edition or revision of S-102 may update validation checks or add new validation checks. Validation checks for older but still active editions or revisions of S-102 wil be retained but may be marked as *Deleted* for the new edition/revision of S-102.

#### Version numbers

The associated version control numbering to identify changes (n) to S-158:102 must be as follows:

New Editions denoted as **n**.0.0

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

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

# Check Structure

Check structure in S-158:102 includes the fields specified in S-158 plus the additional fields specified in Table 2-1.

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 and FALSE. The default is 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. |

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.

# Check Syntax

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

# Organisation

The list of validation checks for this edition of S-158:102 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 | 102\_Dev1xxx | Validate Dataset Root and Feature Information | Validation of root group of HDF5 file and feature type information. |
| 2 | 102\_Dev2xxx | Validate Feature Container Groups | Validation of metadata and structure for each feature type (“Feature Container”). In S-102 there are two feature containers (one for the bathymetry data and another for survey information), so this set of checks is executed only once for each. |
| 3 | 102\_Dev3xxx | 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-102, 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 | 102\_Dev5xxx | Validate Values Datasets | Validation of bathymetry data values. This set of checks is applied to the values group in a feature instance group. |
| 6 | 102\_Dev9xxx | 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

# Other Applicable Checks

## Generic S-100 checks

S-102 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 | All | Product Specification | No direct implementation on datasets or exchange sets |
| Part 2 / 2a | All | Product Specification | No direct implementation on datasets or exchange sets |
| Part 4a | All | Exchange catalogue |  |
| Part 4b | All | Product Specification | No direct implementation on datasets or exchange sets |
| Part 5 / 5a | 100\_Dev0069 | Product Specification | No direct implementation on datasets or exchange sets |
| 100\_Dev0077  100\_Dev0468  100\_Dev0161  100\_Dev0162  100\_Dev0163  100\_Dev0164  100\_Dev0165  100\_Dev0166  100\_Dev0167 | Datasets | Inapplicable:  100\_Dev0168  100\_Dev0169  100\_Dev0170  100\_Dev0171 |
| Part 6 | 100\_Dev0172  100\_Dev0173  100\_Dev0174 | Datasets |  |
| Part 7 | Only checks for polygons | Domain extent polygons | S-102 uses vector geometry only for domain extent polygons. Note also that domain extent polygons as used in S-102 do not have interior boundaries. |
| Part 8 | Only checks applicable to regular grid coverages | Dataset |  |
| Part 9 / 9a / 13 | ? | Product Specitication | Validation checks for Portrayal Catalogue |
| Part 10a | None | N/A | S-102 does not use the ISO 8211 format |
| Part 10b | None | N/A | S-102 does not use the S-100 GML format |
| Part 10c | Only checks applicable to regular grid coverages | Dataset | S-102 uses only the regular grid coverage type |
| Part 11 | 100\_Dev0466 | Dataset | There is only one Part 11 generic check, for dataset size |
| Part 15 | 100\_Dev0476 through 100\_Dev0490 | Exchange catalogue  Exchange set |  |
| Part 17 | All checks except those applying to metadata elements not used in S-102 | Exchange catalogue  Exchange set |  |

## Interoperability checks

S-102 datasets and exchange sets intended for use on ECDIS must also pass the applicable interoperability checks from those listed in S-158:98.

# 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-158:102 | Dataset, in isolation |
| 2.1 | Root group checks | S-158:102 checks numbered 102\_Dev1xxx | Dataset, in isolation |
| 2.2 | Feature Container group checks | S-158:102 checks numbered 102\_Dev2xxx | Dataset, in isolation |
| 2.3 | Feature Instance group checks | S-158:102 checks numbered 102\_Dev3xxx | Dataset, in isolation |
| 2.4 | Values group checks | S-158:102 checks numbered 102\_Dev5xxx | Dataset, in isolation |
| 3 | Interoperability checks for single S-102 dataset | S-158:98 | Dataset, in isolation |
| ~~4~~ | Inter-dataset, intra-product checks | S-158:102 checks numbered Nxxx | Adjacent or intersecting datasets |
| ? | Inter-version checks(?) | S-158:102 checked numbered Nxxx | Related datasets for different versions of S-102 |
| 5 | Interoperability checks for combinations of datasets from different products | S-158:98 | S-102 dataset in combination with relevant datasets from other products (e.g., S-102) |
| 6 | S-100 generic checks for exchange sets | S-158:100 | Exchange set |
| 7 | Product-specific checks for exchange sets | S-158:102 checks numbered 102\_Dev9xxx | Exchange set |
| 8 | Product catalogue checks | S-158:128 | S-128 datasets describing S-102 datasets |

# Check Classification

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

# Geometry and Spatial Operators

S-102 Edition 3.0.0 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 a default tolerance of [??? - PT to decide] should be applied in validation software.

# 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-102 validation checks named S158\_102\_0\_2\_0\_YYYYMMDD of the latest build date. (The build date is the YYYYMMDD suffix in the file name.)