Contents

Document History

Changes to this Specification are coordinated by the Nautical Information Provision Working Group, an IHO working group under HSSC. 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	Approved By	Purpose
1.0.0	2022-11-25		Draft 1 of validation checks
1.0.0	2022-12-31		Version date updated to sync with other artefacts

1   Overview

1.1   Preface

The "Validation Checks" Annex has been developed to provide conformance tests for S-100 compliant Marine Harbour Infrastructure (S-131) data and exchange sets.

The purpose of the Validation Checks Annex is to facilitate testing of the validity of S-131 datasets and exchange sets and their compliance with the S-131 Product Specification and the S-100 Universal Hydrographic Data Model.

The entire S-100 Universal Hydrographic Data Model, including the S-131 Product Specification, is available at the following web site, http://www.iho.int.

NOTE: Due to the fact that generic validation checks for S-100 are still under development at the time this Annex is being written, this entire Annex is designated as "Informative".

1.2   Document Metadata

The metadata in this clause uniquely identifies this Annex to the Product Specification and provides information about its creation and maintenance.

Table 1.1 - Document metadata

Metadata	Content
Title:	The International Hydrographic Organization Marine Harbour Infrastructure Product Specification, Annex D - Validation Checks
Version:	1.0.0
Date:	15 March 2023
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 Fax: +377 93 10 81 40 URL: www.iho.int
Identifier:	S-131 Annex D Data Classification and Encoding Guide
Maintenance:	Changes to S-131 Annex D - Validation Checks are coordinated by the IHO Nautical Information Provision Working Group (NIPWG) and must be made available via the IHO web site.

1.3   Terms and definitions

For terms and definitions, see the Marine Harbour Infrastructure (MHI) Product Specification, Clause 1.4.2.

1.4   Abbreviations

For a list of abbreviations, see the MHI Product Specification, Clause 1.4.3.

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, or recommended.

1.6   Maintenance

Changes to this document must occur in accordance with the S-131 Product Specification clause 1.7.

2   Introduction

This S-131 Validation Checks Annex defines tests for the structure, format and content of S-131 Marine Harbour Infrastructure datasets. It also defines tests for exchange set structure, components, the content of exchange catalogues and metadata for exchange sets containing S-131 datasets.

The validation checks are primarily intended for production systems designed to produce S-131 Marine Harbour Infrastructure datasets and exchange sets. Production systems should implement these checks to ensure that datasets and exchange sets produced conform to the MHI Product Specification. The checks may optionally also be applied at later stages in the distribution chain from producer to the end-user, as well as on end-user systems.

Checks are divided into:

- Dataset checks, that validate the integrity and conformance of individual MHI dataset files and support files referenced from within MHO datasets.

- Exchange set checks, that validate the integrity and conformance of exchange sets containing MHI datasets.

NOTE: Generic S-100 validation checks are currently being developed by the IHO S-100 working group. When the generic checks are finalized, a future edition of this Annex will be harmonized with the generic S-100 checks. Until such harmonization is accomplished, implementers who encounter discrepancies between this Annex and the future S-100 generic validation checks should consult the NIPWG Chair for advice on how to proceed.

3   Check Classification

Checks are classified as Critical, Error, or Warning as described in the table below.

Table 3.1 - Classification of checks by importance

Indicator	Type	Description
C	Critical Error	An error which would make a dataset unusable in ECDIS through not loading or causing an ECDIS to crash or presenting data which is unsafe for navigation.
E	Error	An error which may degrade the quality of the dataset through appearance or usability but which will not pose a significant danger when used to support navigation.
W	Warning	An error which may be a duplication or an inconsistency which will not noticeably degrade the usability of a dataset in ECDIS.

4   Check Application

Certain dataset checks apply to only base datasets, some checks only to update datasets, and some can be applied only to complete datasets after an update has been applied. The application of checks to datasets or dataset updates is indicated by one or more of the indicators in the leftmost column of the table below.

Table 4.1 - Check application indicators

Indicator	Applies to	Description
B	Base	Apply check to new dataset, new edition, and post-update dataset (after updates have been applied to the base).
U	Update	Apply check to update datasets in isolation.
S	Post-update	Apply check only to a post-update dataset, i.e., subsequent to application of all available updates.

Checks do not apply to dataset terminations or cancellations, except where the check description explicitly states it applies in case of a termination or cancellation.

5   Validation processing

Automatic validation of MHI datasets and exchange catalogues must consist of at least the following phases:

- Schema validation: Verification of conformance to the XML schema that defines its format. For the GML dataset, this is the schema defined in Annex B (Encoding Format). For the exchange catalogue, it is the S-100 generic exchange catalogue schema.

  Off-the-shelf XML validation software tools or libraries that are "schema-aware" can be used for this phase. "Schema-aware" means that the tool or library must be capable of checking the dataset or catalogue against the structure and constraints defined in the governing schema and schemas imported or included in it.

  Schema-validation must ensure that an appropriate edition of the controlling schema is used for validation.

  Implementers are free to use alternate methods or implement custom validation provided the end-result is equivalent to schema-validation as described here.

- Non-schema constraint validation. Verification of conformance to constraints which cannot be expressed in XML schema form. These constraints are formally specified as Schematron rules. Product-specific constraints for datasets and exchange catalogues as well as generic constraints for the exchange catalogue will be made available from the IHO schema server). The constraints can be checked with a Schematron-capable processor (many commercial XML validation tools and software libraries are also capable of checking Schematron rules), but may be converted to or re-implemented in any form preferred by the implementer.

- Annex D checks: Verification of conformance to the checks defined in this Annex. This may be implemented by any means or combination of means the implementer prefers, including but not limited to Schematron processing, XSLT templates, code written in common programming languages, etc.

The checks specified in this Annex are formally **supplemental** to schema-validation of the dataset with the GML application schema (for datasets) or the S-100 exchange catalogue schema (for exchange catalogues).

If both generic and product-specific constraints are defined for a component, both sets must be checked. This applies in particular to the exchange catalogue, which will have generic checks defined as part of the generic S-100 schema distribution as well as additional product-specific checks defined as part of the S-131 MHI Product Specification.

In addition to automatic validation, visual validation and data quality checks must be carried out as appropriate, for example, to verify that attribute values match reality, file references point to the correct files, etc.

6   Check Description Format

6.1   Structure of check specifications

Individual checks are defined in the format described in Table 6.1.

Table 6.1 - Check specification format

Column	Description
Data Quality Measure or Theme	Quality measure or theme from S-97 Part C.
Check ID / Short Name	Identifier for check
Check condition description	Specification of check condition, written in structured English.
	The conditions are written so that if the condition evaluates to TRUE it indicates an error or other issue exists in the dataset.
	Conditions beginning with "For each <item>…" are applied to every instance of the designated item. Items may be features, information type, attributes, associations, roles, etc. Box brackets are used for grouping phrases where the interpretation may be ambiguous (for example, "X AND [Y OR Z]").
	"Object" means an instance of a feature or information type.
	The logical and spatial operators used in check conditions are listed following this table.
Check message	Message to emit if the dataset fails the check condition (i.e., the condition evaluates to TRUE).
Check solution	Solution to be applied to correct the failure.
Conformity	Reference to place in S-100 or S-131 where more information about the check can be found, e.g., lists of allowed values for enumerations. All S-100 references for checks are to S-100 Edition 5.0.0.
Classification	Whether check failure is a critical, error, or warning issue.
Apply To	Whether the check should be applied to a base dataset, update dataset, or to a complete dataset after an update has been applied.

6.2   Comparison and logical operators

The following comparison and logical operators are used:

(1) Equal (=)
(2) Not equal (≠)
(3) Less than (<)
(4) Less than or equal to (≤)
(5) Greater than (>)
(6) Greater than or equal to (≥)
(7) AND (∧)
(8) OR (inclusive OR) (∨)

6.3   Geometry and spatial operators

The spatial operators (EQUALS, DISJOINT, TOUCHES, WITHIN, OVERLAPS, CROSSES, INTERSECTS, CONTAINS, and COINCIDENT), based on those laid out in the ISO standard 19125-1, are used to describe spatial relationships tested within the checks.

The definitions of the spatial operators are as specified in IHO S-58 Edition 7.0.0 clause 2[1].

For all spatial operators, the default tolerance is the same as the coordinate precision specified in the MHI Product Specification.

6.4   Values

The following terms are used for types or values of attributes in data objects or metadata, such as attributes of features, information types, or metadata blocks in exchange catalogues:

- Present: The attribute is present and may or may not be populated with a value.

- Known: The attribute is Present and has been populated with a value.

- Unknown: The attribute is Present, but has not been populated with a value..

- Optional: The encoding of the attribute is optional. It may be Present or not Present.

The following terms are used in relation to XML element content in GML or other XML files, or for values of XML attributes (including the GML data format and exchange catalogues):

- Whitespace: One or more of the characters defined as white space in the W3C XML specification: space, tab, carriage return or line feed.

- Null: The XML element or attribute has no content or the content is the empty (0-length) string.

    o   String type attributes consisting of only whitespace characters **are not** considered to be empty.

    o   URI, URL, or URN type attributes consisting of only whitespace characters **are** considered to be empty.

    o   Numeric, enumeration, date, time, dateTime, or Boolean types consisting of only whitespace characters **are** considered to be empty. This situation is an error (unless the

---

[1] For the purposes of this Annex, the terms used in S-58 should be treated as their S-100 equivalents: Surface for Polygon, Point for Point, Curve or Composite Curve for LineString.

attribute is declared nillable in the GML application schema). Such errors should be detected by XML validation software when the file is validated against its XML schema.

- Nilled: The value of the XML element is Null and the element has the XML attribute xsi:nil="true". A **nillable** attribute is one which the GML application schema or GML profile allows to be nilled.

- notNull: The attribute has been populated with a value.

The following terms are used to combine the above terms for brevity:

- Missing: The attribute is either not present, or present and either null or nilled.

- Populated: The attribute is present and has been assigned a value conforming to its constraints.

The terms for types and content are used in relation to GML data files as well as exchange catalogues, which are XML files.

7   Dataset validation checks

The following table contains the checks applicable to MHI datasets.

Implementers should note that validation with schema-aware validation software and the official GML schema defined in Annex B will detect many of the check conditions described in Table 7.1, and others can be detected by defining Schematron validation rules which can also be detected with software capable of processing Schematron rules.

The "code" for features and information types referenced in some checks is the camel case code.

To provide for future harmonization with S-101, a reference to a similar S-101 check (as of 11/11/2022) may be included in parentheses.

Table 7.1 - MHI Dataset checks

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Topological Consistency	101	For each feature object where its geometry is not COVERED_BY the UNION of all DataCoverage meta-features	Objects fall outside the coverage object.	Ensure objects are not outside of the limits of the cell.	PS 7.1.3	E	B, S
Logical Consistency / Topological Consistency	102	For each DataCoverage feature where its referenced surface spatial object has an inner ring AND that ring is not external for another DataCoverage.	Data Coverage has an inner ring without adjoined another Data Coverage.	Modify geometry.		E	B
Logical Consistency / Conceptual Consistency	103	For each DataCoverage feature where the attributes maximum display scale and minimum display scale are Present AND value of maximum display scale is larger or equal to the value of the minimum display scales.	Maximum display scale is larger or equal to the value of the minimum display scale.	Correct values of maximum and minimum display scales.	DCEG 4.4.1	E	B
Logical Consistency / Topological Consistency	104	For each DataCoverage feature that OVERLAPS or is WITHIN another DataCoverage.	Dataset contains overlapping DataCoverage features.	Remove overlap.	DCEG 4.4.1	E	B
Logical Consistency / Conceptual Consistency	105	For each DataCoverage feature where the value of the attribute minimum display scale is different from other Data Coverage meta features.	DataCoverage features have different values of the attribute minimum display scale.	Use the same values of minimum display scale.	DCEG 4.4.1	E	B
Logical Consistency / Format Consistency	106	If the dataset file size is greater than the limit set in the Product Specification.	Dataset exceeds size limits.	Ensure that the dataset is no larger than the applicable limit specified in the Product Specification.	PS 13.7	E	B, S

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Completeness / Omission	107	If any of the mandatory meta feature objects do not exist within the data set.	Mandatory meta feature objects are missing.	Include all mandatory meta feature objects	DCEG 4.2	C	B, S
Completeness / Omission	108	If any mandatory attributes are not present.	Mandatory attributes are not encoded.	Populate mandatory attributes (If unknown encode attribute with empty value).	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Format Consistency	109	For each feature object with an attribute of type Float or Integer where the value contains zeroes before the first numerical digit or after the last numerical digit.	Values have been padded with non-significant zeroes.	Remove non-significant zeroes.	PS 12.4	W	B, U
Logical Consistency / Topological Consistency	110	For each feature object with an attribute value identical to a corresponding attribute of a meta feature object it is COVERED_BY.	An attribute value of a meta feature object is duplicated on a geo object.	Remove duplicate value from geo object.	--	W	B, S
Logical Consistency / Conceptual Consistency	111	For each association between feature instances, feature instances and information instances, and between information instances that is not defined in the feature catalogue.	Wrong association used.	Use correct association type.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	112	For each role name on associations that is not defined in the feature catalogue.	Wrong role used.	Use correct role name.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	113	For each association where the object references itself	Self-referential association (InvalidFeatureBinding, InvalidInformationBinding)	Correct association target	--	E	B, U
Logical Consistency / Conceptual Consistency	114	For each association that is not defined in the feature catalogue.	Unknown association is used.	Use association that is defined in the feature catalogue.	PS 4.2, FC, DCEG	E	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Conceptual Consistency	115	For each role name that is not defined in the feature catalogue.	Unknown role name is used.	Use role name that is defined in the feature catalogue.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	116	For each association that refences an object not permitted by the object binding in the feature catalogue.	Object association is not allowed. (MissingFeatureBinding)	Ensure correct association is used between classes.	PS 4.2, FC, DCEG	E	B, U, S
Logical Consistency / Conceptual Consistency	117	For each role name ensure it is only used with permitted associations.	Role name is used on an illegal association.	Ensure correct role names are used on the association.	PS 4.2, FC, DCEG	E	B, U, S
Logical Consistency / Format Consistency	118	Dataset fails schema validation with the GML schema for the corresponding edition and revision of the Product Specification.	Dataset must conform to the GML schema for its Product Specification edition and revision.	Ensure conformance to the GML schema for the PS edition and revision specified in the dataset.	PS 10.4 & 12.1	C	B, U
Logical Consistency / Format Consistency	119	For each text field using a character encoding different from UTF-8.	Character encoding for text must be UTF-8.	Change character encoding to UTF-8.	PS 12.5	E	B, U
Logical Consistency / Conceptual Consistency	120	For each feature or information type where more than one featureName is present, and the *name* sub-attribute of two or more featureName instances is equal.	Values of "name" sub attribute of "featureName" are identical.	Ensure that *name* sub-attributes are populated with the correct values.	--	E	B, U
Completeness / Commission	121	For each feature, information type, or complex attribute where two or more *information* attributes are present, AND the *text* sub-attributes of information are equal.	Values for "text" sub-attribute of "information" are identical.	Ensure that *text* sub-attributes are populated with the correct values.	--	W	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Completeness / Commission	122	For each feature, information type or complex attribute where two or more *information* complex attributes are present AND they have different language value AND identical pair of notNull values of the sub-attributes fileLocator and fileReference.	Different languages information refers to the same external file and its fragment.	Replace with the correct fileLocator and fileReference combination.	--	W	B, U
Logical Consistency / Domain Consistency	123	For each information complex attribute where the sub-attribute fileReference has a file name with extension which is not equal one of .TXT or .HTM or .XML.	File reference attribute refers to a file with inadmissible format.	Correct fileReference value and/or support file type.	DCEG 2.4.9.2	W	B, U
Completeness / Commission	124	For each object where textContent attribute is present, and two or more information sub-attributes are present, and the combination of fileReference and fileLocator sub-attributes are equal.	Values for file reference and locator combinations are identical.	Ensure that national language attributes are populated with the correct values.	--	W	B, U
Completeness / Omission	125	For each featureName sub-attribute with language not equal to eng, and where featureName sub-attributes with language equal to eng is not present.	Name is encoded in national language only.	Populate text attribute with English text.	PS 3	W	B, U
Completeness / Omission	126	For each information sub-attribute with language not equal to eng, and where information sub-attribute with language equal to eng is not present.	Text is encoded in national language only	Populate name attribute with English text.	PS 3	W	B, U
Logical Consistency / Domain Consistency	127	If the horizontal CRS in the dataset is Not equal to EPSG:4326 (WGS 84).	Horizontal CRS is not EPSG 4326	Set the horizontal CRS EPSG 4326 and verify that all spatial primitives are in EPSG:4326	PS 6.1 and 7.3.3	C	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Topological Consistency	128	For each feature instance that does not OVERLAP OR is WITHIN an area of DataCoverage	Object outside area of coverage.	Remove object or amend coverage.	PS 10.9 DCEG 2.6.3	E	B, S
Logical Consistency / Conceptual Consistency	129	For each object which is present in the dataset but not present in the feature catalogue.	Datasets must only contain the feature and information types listed in the FC. (ProhibitedObject)	Delete object or replace with an instance of a feature or information type defined in the feature catalogue.	PS 4.2, FC	C	B, U
Logical Consistency / Domain Consistency	130	For each object where another object has identical attribute values and identical geometry (if applicable)	Object is a duplicate of another object (DuplicateObject)	Remove duplicate object	--	E	B, U, S
Logical Consistency / Conceptual Consistency	131	For each object which does not have a valid feature or information type label/code as defined by the feature catalogue.	Object has invalid feature class code.	Amend object class code.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	132	For each attribute which does not correspond to an attribute code as defined by the feature catalogue.	Attribute has invalid attribute.	Amend attribute name.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	133	For each object which contains attributes outside the list of permissible attributes for the feature class (as defined in the feature catalogue).	Attribute not permitted on feature or information type. (InvalidAttributeBinding, ProhibitedAttribute)	Remove attribute.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Conceptual Consistency	134	For each object which is present in the dataset which references a geometry which is not permitted in the feature catalogue (including noGeometry if allowed)	Feature types must only have permitted geometric primitives. (ProhibitedGeometry)	Use allowed spatial primitive.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Domain Consistency	135	For each integer or real attribute whose value does not conform to the range (if any) defined in the feature catalogue	Error in numeric attribute value. (ProhibitedAttributeValue)	Correct value	FC	C	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Domain Consistency	136	For each enumeration attribute whose code or value do not conform to the values permitted in the feature catalogue.	Value of attribute is outside range. (ProhibitedAttributeValue)	Correct value	FC	C	B, U
Logical Consistency / Domain Consistency	137	For each enumeration or codelist attribute whose code and value do not correspond to the same listed value in the feature catalogue.	Code and value of enumeration or codelist attribute do not match.	Correct attribute code or value.	FC	C	B, U
Logical Consistency / Domain Consistency	138	For each attribute which does not correspond to the format defined for the attribute value specified in the feature catalogue	Attribute values must be in the correct format. (AttributeFormat)	Correct format of value	DCEG	E	B, U
Logical Consistency / Topological Consistency	139	For each feature instance which is not COVERED_BY the combined coverage of QualityOfNonBathymetricData meta feature instances.	Feature instance not covered by an QualityOfNonBathymetricData instance.	Ensure full coverage of QualityOfNonBathymetricData instance.	PS 12.11	E	B, S
Logical Consistency / Topological Consistency	140	For each feature instance where a depth attribute is present AND which is not COVERED_BY the combined coverage of SoundingDatum meta feature instances.	Feature instance not covered by SoundingDatum instance.	Ensure full coverage of SoundingDatum instance.	PS 12.15	E	B, S
Logical Consistency / Topological Consistency	141	For each feature instance where an elevation attribute is present AND which is not COVERED_BY the combined coverage of VerticalDatumOfData meta feature instances.	Feature instance not covered by VerticalDatumOfData instance.	Ensure full coverage of VerticalDatumOfData instance.	PS 12.15	E	B, S
Completeness / Omission if < 1 Commission if > 1	142	If there is not exactly one instance each of SoundingDatum and VerticalDatumOfData present in the dataset.	Exactly one instance of SoundingDatum and VerticalDatumOfData are required.	Ensure that the dataset contains exactly one instance each of SoundingDatum and VerticalDatumOfData.	DCEG 4.6.1, 4.7.1	E	B, S

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Format Consistency	143	If the order of the data in a dataset is not correct.	Incorrect data order.	Amend data order.	PS 12.13	W	B, U
Logical Consistency / Format Consistency	144	For each attribute instance where the total number of instances exceed the permitted number of instances	Too many instances of attribute.	Ensure correct attribute encoding.	PS 4.2, FC, DCEG	E	B, U
Logical Consistency / Domain Consistency	145	For each feature instance where periodicDateRange sub-attributes dateEnd and dateStart are notNull AND their values are identical.	Object has identical values of periodicDateRange sub-attributes dateEnd and dateStart.	Ensure values of periodicDateRange sub-attributes dateEnd and dateStart are logical.	--	W	B, U
Completeness / Omission	146	For each feature instance where periodicDateRange sub-attribute dateStart OR dateEnd is missing.	Periodic date range must have both dateEnd and dateStart.	Populate both dateStart and dateEnd.	--	E	B, U
Logical Consistency / Topological Consistency	147	For each linear geometry which contains vertices at a density Greater than 0.3mm at maximum display scale.	Vertex density exceeds the allowable tolerance.	Generalise edge(s).	PS 7.3.1	W	B, U
Logical Consistency / Domain Consistency	148	For each instance of ServiceHours where an instance of scheduleByDayOfWeek attribute has temporal overlaps specified by timeIntervalByDayOfWeek attribute.	Time intervals within the same scheduleByDayOfWeek attribute overlap.	Review time intervals and remove time overlap.	--	E	B, U
Logical Consistency / Domain Consistency	149	For each instance of ServiceHours with more than one instance of scheduleByDayOfWeek, and where an instance of scheduleByDayOfWeek has a temporal overlap with another instance of scheduleByDayOfWeek.	Schedule overlaps.	Review service hour intervals and remove time overlap.	--	E	B, U
Completeness / Omission	150	For each instance of a file referenced in the data and not present in the exchange set.	File referenced in the dataset is not present in the exchange set.	Add file to exchange set or remove reference to file.	PS 13.1	E	B, S

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Topological Consistency	151	For each feature instance which CROSS the 180° meridian.	Data crossing the 180° meridian.	Split the dataset along the 180° meridian.	PS 12.2, DCEG 2.6.10	E	B, U
Logical Consistency / Domain Consistency	152	For each fixedDateRange where dateEnd and dateStart are not Null and dateEnd is less than or equal to dateStart.	dateEnd precedes dateStart.	Amend values of dateEnd or dateStart accordingly.	--	E	B, U
Completeness / Omission	153	For each fixedDateRange where both dateEnd and dateStart are missing.	FixedDateRange not populated making the attribute meaningless.	Populate at least one of dateEnd or dateStart.	PS 12.16, DCEG 5.2.1	E	B, U
Completeness / Omission	154	For each fixedDateRange where dateEnd or dateStart is not Null but the year component is not specified.	Year is required in fixedDateRange dates.	Populate year component of dateStart and dateEnd	--	E	B, U
Completeness / Omission	155	For each textContent attribute where both information and onlineResource are missing.	TextContent is not populated with meaningful information.	Populate information or onlineResource.	--	E	B, U
Completeness / Omission	156	For each information attribute where both fileReference and text sub-attributes are missing.	Information is not populated with meaningful information.	Populate fileReference or text attribute.	--	E	B, U
Logical Consistency / Domain Consistency	157	For each instance of the text attribute that contains more than 300 characters	Text attribute contains more than 300 characters.	Reduce content of text attribute or move to support file.	DCEG 17.111	E	B, U
Completeness / Omission	158	For each contactAddress where all sub-attributes are missing.	Contact address is not populated with meaningful information.	Populate at least one sub-attribute of contactAddress.	PS 12.16	E	B, U
Completeness / Omission	159	For each frequencyPair with sub-attributes frequencyShoreStationTransmits and frequencyShoreStationRec eives both missing.	Frequency pair frequency attributes are not populated with meaningful information.	Populate at least one of frequencyShoreStation Transmits or frequencyShoreStation Receives.	--	E	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Completeness / Omission	160	For each Regulations, Restrictions, Recommendations, or NauticalInformation with both graphic and textContent missing.	Regulations, Restrictions, Recommendations, NauticalInformation not populated.	Populate at least one of graphic and textContent.	--	E	B, U
Completeness / Omission	161	For each Applicability without at least one of its attributes populated, or with only logicalConnectives populated.	Applicability is not populated with meaningful information.	Populate at least one attribute of Applicability other than logicalConnectives.	PS 12.16	E	B, U
Completeness / Omission	162	For each Applicability with *logicalConnectives* missing AND [more than one of the other attributes populated OR more than one *vesselsMeasurements*].	Logical connective not encoded in Applicability instance.	Add the appropriate value of logicalConnectives.	DCEG 12.1.1	W	B, U
Logical Consistency / Domain Consistency	163	For each Applicability with mutually inconsistent values of vessel measurements in the attribute *vesselsMeasurements.*	Vessel measurements are mutually inconsistent.	Correct the inconsistency.	DCEG 12.1.1	W	B, U
Completeness / Omission	164	For each NonStandardWorkingDay with all of dateFixed, dateVariable, and information missing.	NonStandardWorkingDay not populated with meaningful information.	Populate at least one of dateFixed, dateVariable, and information.	--	E	B, U
Completeness / Omission	165	For each ContactDetails with all attributes missing.	ContactDetails not populated with meaningful information.	Populate at least one attribute of ContactDetails.	PS 12.16	E	B, U
Completeness / Omission	166	For each feature or information association where the target object is not present in the dataset.	Associated feature or information type not present.	Correct or remove the association, or add the missing feature or information type.	--	E	B, S
Completeness / Omission	167	For each weatherResource with both onlineResouce and textContent missing.	Weather resource information is not present.	Populate at least one of onlineResource or textContent.	DCEG 6.8.1	E	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Completeness / Omission	168	For each weatherResource with dynamicResource = 2 or 3 and onlineResource missing.	Complex attributes for dynamic resources must indicate a source for the dynamic information.	Populate the onlineResource attibute.	DCEG 6.8.1	E	B, S
Completeness / Omission	169	For each weatherResource with onlineResource present and dynamicResource missing.	Complex attributes for online weather resources must indicate whether the resource is static or dynamic.	Populate the dynamicResource attibute.	DCEG 6.8.1	W	B, S
Logical Consistency / Conceptual Consistency	170	For each SpatialQuality information type which is referenced by a Surface spatial object.	SpatialQuality is associated with a Surface spatial object.	Remove prohibited association.	DCEG 14.1	W	B, U
Logical Consistency / Conceptual Consistency	171	For each SpatialQuality information type which has vertical uncertainty populated and is referenced by a Curve or Composite Curve spatial object.	Prohibited vertical uncertainty attribute of SpatialQuality for curve spatial object.	Remove prohibited association.	DCEG 14.1	W	B, U
Logical Consistency / Domain Consistency	172	For each *language* attribute which is populated with a value other than one of the 3-character ISO 639-2/T codes.	Language code not from ISO 639-2/T list.	Correct language code.	DCEG 2.4.8.3	W	B, U
Logical Consistency / Topological Consistency	173	For each surface where the exterior boundary shares more than one node with an interior boundary.	Geometry does not conform to S-100. (Self-intersection)	Correct spatial object.	S-100 Part 7 3a-3	C	B, U
Logical Consistency / Topological Consistency	174	For each curve segment with >1 segment and composite curve components where the individual components do not have coincident start/end points (e.g. end segment N != start segment N+1).	Curve segments must be well formed. (Well formed curve segments)	Correct spatial object(s).	S-100 Part 7 3a-4	C	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Topological Consistency	175	For each feature of primitive surface where the exterior boundary is not oriented clockwise (surface to the right).	Spatial object error. (Orientation of Surfaces)	Correct spatial object(s).	S-100 Part 7 3a-5	C	B, U
Logical Consistency / Topological Consistency	176	For each feature of primitive surface where an interior boundary is not oriented anti-clockwise (surface to the right).	Spatial object error. (Orientation of Surfaces)	Correct spatial object(s).	S-100 Part 7 3a-6	C	B, U
Logical Consistency / Topological Consistency	177	For each surface where an interior boundary is within an interior boundary.	Spatial object error (interiors can not be inside interiors).	Correct spatial object(s).	S-100 Part 7 3a-7	C	B, U
Logical Consistency / Topological Consistency	178	For each surface where an interior boundary is not within one exterior boundary.	Spatial object error (interiors must be inside an exterior).	Correct spatial object(s).	S-100 Part 7 3a-8	C	B, U
Logical Consistency / Topological Consistency	179	For each surface where an exterior boundary is within an interior boundary.	Spatial object error (exteriors can not be inside interiors)	Correct spatial object(s).	S-100 Part 7 3a-9	C	B, U
Logical Consistency / Topological Consistency	180	For each feature of geometric primitive surface with >1 spatial associations (SPAS) ?	Spatial object error. (Surface features must associate with only one surface)	Correct spatial object(s).	S-100 Part 7 3a-10	C	B, U
Logical Consistency / Topological Consistency	181	Curves and Composite curves (including Polygons referenced by Surface features in level 3a/b) must not self-intersect [defined with reference to diagram].	Spatial object error. (Self-intersection)	Correct spatial object(s).	S-100 Part 7 11	C	B, U

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification	Apply to
Logical Consistency / Topological Consistency	182	Each composite curve must be continuous. The end point of each component (taking into account the orientation) must be a duplicate of the start point of the next curve component (again, taking into account the orientation).	Spatial object error. (Composite curves must be well defined.)	Correct spatial object(s).	S-100 Part 7 2a-4	C	B, U
Logical Consistency / Topological Consistency	183	Curve Segments must not start or end with repeated vertices. Segments must not repeat any vertex (this constitutes self-intersection). (For each curve component with EQUAL consecutive vertices.)	Spatial object error. (No self-intersection (repeated vertices))	Correct spatial object(s).	S-100 Part 7 2a-12	C	B, U
Logical Consistency / Topological Consistency	184	A closed curve must have two or more intermediate vertices (or it self-intersects).	Spatial object error. (No self-intersection (number of vertices))	Correct spatial object(s).	S-100 Part 7 2a-13	C	B, U
Logical Consistency / Conceptual Consistency	185	For each feature with more than one of the attributes bollardNumber, metreMarkNumber, manifoldNumber, rampNumber populated.	Too many position numbers.	Review whether all of bollard number, meter mark number, manifold number, and ramp number are appropriate.	DCEG	W	B, S

8   Exchange set validation checks

The checks in this section apply to exchange sets containing MHI datasets.

Exchange set validation involves the following phases:

1) Checking the presence and correctness of the exchange catalogue (CATALOG.XML).

2) Verification of signatures, including the exchange catalogue signature and signatures for individual datasets, catalogues, and support files.

3) Checking the structure and contents of the exchange set package. This involves the following checks:

    a. The exchange catalogue must contain a discovery block for each dataset, catalogue, and support file in the exchange set, as described in S-100 Part 17 and the MHI Product Specification.

    b. All datasets and catalogues described by a discovery block in the exchange catalogue must be present in the exchange set.

    c. Any support file described by a support file discovery block in the exchange catalogue must either be in the exchange set or already present on the system.

4) Checking that any metadata encoded in a discovery block and repeated in the corresponding component (dataset, catalogue, or support file) are compatible.

The exchange set validation checks are given in the following table. The "Apply To" column is omitted because the checks are for exchange sets and not base or update datasets.

Implementers should note that validation with schema-aware validation software and the official S-100 exchange catalogue schema from the S-100 schema server will detect many of the check conditions described in Table 8.1, and others can be detected using Schematron validation rules.

NOTE: The checks listed in this table are extracted from a preliminary list of generic S-100 checks and the reader's attention is particularly drawn to the note in clause 2 about the ongoing development of S-100 generic checks.

Table 8.1 - MHI Exchange Set checks

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification
Logical Consistency / Domain Consistency	InvalidAgencyCode	If the producer agency code is not a value present in the IHO Producer code register.			S-100 Part 17	E
Logical Consistency / Format Consistency	CatalogStructure	If the structure and content of the CATALOG.XML file is invalid as detected by schema-validation.			S-100 Part 17	C
Completeness / Omission	MissingSupportFile	If a support file included in the SupportFileDiscovery Metadata is not present in the exchange set at the location specified by the file URI.			S-100 Part 17	E
Completeness / Omission	DigitalSignatures	If the digital signature values are not present and valid in the DatasetDiscoveryMetadata or SupportFileDiscoveryMetadata.			S-100 Parts 17, 15	E
Logical Consistency / Domain Consistency	InvalidDatasetName	If the dataset file name is not in accordance with the Product Specification.	Dataset file name is not in accordance with the Product Specification.	Amend file name.	PS 13.3.2, 13.3.3	E
Logical Consistency / Domain Consistency	InvalidSupportFilename	If the support file name is not in accordance with the Product Specification.	Support file name is not in accordance with the Product Specification.	Amend file name.	PS 13.4.1	E

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification
Completeness / Omission	MissingCatalogFile	If the CATALOG.XML file is not present.			S-100 Part 17	C
Logical Consistency / Domain Consistency	CatalogDatasetInconsistent	If any of the metadata attribute values listed in the CATALOG.XML and present in the dataset are not identical.			S-100 Part 17	E
Completeness / Omission	MissingDatasetMetadata	For each instance of a dataset present in the exchange set and that does not have dataset discovery metadata.	Dataset discovery metadata is missing for dataset.	Add dataset discovery metadata.	PS 14.2, 14.3	E
Completeness / Omission	MissingSupportMetadata	For each instance of a support file present in the exchange set and that does not have support file discovery metadata.	Support file discovery metadata is missing for support file.	Support file discovery metadata.	PS 14.3	E
Completeness / Omission	MissingCatalogueMetadata	For each file referenced by the catalogue file in the exchange set and not present in the exchange set.	File is missing from exchange set.	Add file to exchange set or remove reference to file.	PS 14.5, 14.6	E
Completeness / Commission	SuperfluousMetadata	For each dataset discovery metadata file (ISO file) that does not correspond to a dataset in the exchange set.	Dataset discovery ISO metadata file that does not correspond to the dataset discovery metadata content table.	Ensure correct encoding of the discovery metadata file.	PS 13.1	W
Completeness / Commission	ExtraCancellationDataset	For each cancellation (termination) of a dataset where the update exchange set contains a corresponding dataset file.	Cancellations cannot contain data objects.	Remove the dataset file from the exchange set or correct the metadata.	--	W

DQ Measure / Theme	Check ID	Check condition description	Check message	Check solution	Conformity	Classification
Completeness / Omission	EmptyUpdateDataset	For each update dataset, without a feature, information type, or support file.	Empty update.	Add the data or support file or correct the metadata.	--	W

This page intentionally left blank.