# Annex D – Validation Checks

< < Most recent version of Validation Checks > >

At least two types of validation checks are needed:

* Dataset validation checks for individual datasets. These checks operate on individual objects in datasets and on individual datasets as a whole. They should check the integrity of individual objects in the dataset (spatial, feature and information types); associations between objects in the dataset; any embedded metadata or header information in the dataset; and support files referenced in the dataset.
* Package validation checks for verifying the structure and content of packages (for example exchange sets) and accompanying metadata.

A common set of validation checks is under development (see S-97 Part C). A recommended set of data quality measures has been developed based on dataset statistics derived from the validation checks. The recommended measures are also described in S-97 Part C.

## F.1.0 Validation checks for datasets

Validation checks for datasets should cover:

1) Completeness; including population of attributes and presence of required information, complex attributes without sub-attributes, etc.

2) Logical consistency; for example, missing association targets.

3) Spatial consistency; for example, topological sanity checks for non-crossing external boundaries, excessive vertex density in lines, etc.

4) Positional accuracy; for example, closeness of reported coordinate values to accepted or known absolute or relative coordinate values.

5) Temporal accuracy; for example, closeness of reported time measurements to accepted or known values accepted as or known to be true, correctness of the order of events, or validity of data with respect to time.

6) Thematic accuracy; such as attribute values that are consistent with any other related attributes and within allowed ranges or sets.

7) References to support files.

8) Other requirements specific to the product; for example, encryption, signatures, etc.

Some of these issues are addressed in the common set of validation checks. A recommended common set of validation checks is described in S-97 Part C. Product Specification developers should supplement the common set with such additional checks as are appropriate for the particular products.

## F.2.0 Validation checks for packages

Validation checks for packages should cover:

1) Package completeness – whether all required components are included, including datasets, support files, metadata and appropriate catalogues (for example exchange set catalogues, Feature catalogues and Portrayal catalogues). Note that the Product Specification must indicate which catalogues are appropriate to the delivery method; for example, message-based delivery methods may not include catalogues in the delivery packages.

2) Package container format and structure – whether the package is in the approved container format (for example ISO 8211, TIFF, etc) and whether appropriate encryption and signatures have been applied at the container level. Examples of package validation checks are:

* Assuming the Product Specification specified delivery as zip files, is the container a zip file of the appropriate type?
* If the package is arranged in a directory (folder) structure, are the structure and names of directories (folders) as required in the Product Specification?

Package validation checks are required to validate delivery packages, but are expected to be out of the scope of S-97 Part C and Product Specification teams may have to specify their own. The tests for exchange set and service delivery modes will obviously be different, but the matter of validating the delivery package or stream should be addressed for all delivery modes covered in the Product Specification.

## F.3.0 Common validation checks

Given that some features, information types and Application Schema constructs are used in multiple products, there will be validation checks in common with existing Product Specifications and any such related Product Specifications should be consulted for validation checks. Spatial consistency checks in particular, as well as consistency checks related to meta-features, can be expected to be in common with several Product Specifications.

Spatial operations used in validation checks must be the operations defined in IHO ENC Validation Checks (S-58 Edition 6.0.0 or its successor).

## F.4.0 Validation checks for base versus update datasets

If the Product Specification defines an update dataset format, the validation checks developed for new (base) datasets should be reviewed for their applicability to update dataset formats.

**or following S-124 draft:**

1. References

IHO S-58 ENC VALIDATION CHECKS Edition 7.0.0, October 2022

IHO S-97 Part C IHO data quality. Edition 1.1.0 – June 2020

1. Abbreviations

PS – Product Specification

DCEG – Data Capture and Encoding Guide

1. Production validation checks for S-412 Weather and Wave Warnings

The following checks are intended for production systems designed to produce S-412 Weather and Wave Warnings datasets. The checks can be administered at any time during the production phase. All checks should be considered as warnings, even though more severe classifications are available, due to the status of the development and lack of experience with system use of S-412 datasets, it is considered premature to classify any checks as error or critical error at this time. All operators and spatial expressions are defined in Annex I.

3.1 Check classification

| C | Critical Error | An error which would make an MTM 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 MTM 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 duplication or an inconsistency which will not noticeably degrade the usability of an MTM dataset in ECDIS. |

3.2 Checks relating to S-412 Product Specification

There is a table in the S-58 that is 17 pages long, copied here:

| 3.1 Checks Relating to S-57 Data Structure | | | | | | |
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| **No** | **Check description** | **Check message** | **Check solution** | **Conformity to:** | **Cat** | **Product Spec #** |
| 1 | For each edge which is COINCIDENT with another edge. | Partially duplicated edges. | Remove duplication, add nodes and edit edges as required. | Part 2 (2.2.1.2) | E | 57, 411,412, 413,414 |
| 2 | For each edge which does not have a beginning or end node. | VE edge missing  beginning or end  node. | Add nodes as  required. | Part 2 (2.2.1.2) | C | 57, 411,412, 413,414 |
| 3 | For each record where the record identifier NAME (concatenation of the  RCNM & RCID subfields) is not unique within the file. | Record identifier  NAME is not unique. | Amend Record  identifier NAME to be unique. | Part 3 (2.2) | C | 57, 411,412, 413,414 |
| 4 | For each RCNM where the value is not in table 2.2 of S-57 Part 3. | Invalid value of  RCNM. | Amend RCNM value | Part 3 (2.2.1) | C | 57, 411,412, 413,414 |
| 5 | For each RCID which is Less than 1 OR Greater than 232 -2 (4294967294). | RCID is out of range. | Amend RCID value. | Part 3 (2.2.2) | C | 57, 411,412, 413,414 |
| ~~6~~ |  |  |  |  |  |  |
| 7 | For each feature object with invalid AGEN, FIDN or FIDS values. | Invalid values of  AGEN, FIDN or  FIDS. | Amend AGEN, FIDN or FIDS value. | Part 3 (4.3.1) and (4.3.2) | C | 57, 411,412, 413,414 |
| 8 | For each feature object where an attribute code is repeated. | Duplicate attribute code on an object. | Remove or amend  duplicate attribute  code. | Part 3 (4.4), (4.5) and (5.1.2) | C | 57, 411,412, 413,414 |
| 9a | For each feature object of geometric primitive line where ORNT is Not equal to 1 (forward) OR 2  (reverse). | Invalid value of  ORNT. | Set value of ORNT to 1 (forward) or 2  (reverse). | Part 3 (4.7.2) | C | 57, 411,412, 413,414 |
| 9b | For each feature object of geometric primitive line where USAG is Not equal to Null. | Invalid value of  USAG. | Set value of USAG to 255 (Null). | Part 3 (4.7.2) and Appendix B.1  (3.8) | C | 57, 411,412, 413,414 |
| 9c | For each feature object of geometric primitive line where MASK is notNull AND is Not equal to 1  (mask) AND is Not equal to 2 (show). | Invalid value of  MASK. | Set MASK to 1 (mask), 2 (show) or Null. | Part 3 (4.7.2) and Appendix B.1  (3.8) | C | 57, 411,412, 413,414 |
| 10a | For each feature object of geometric primitive point where ORNT is Not equal to 255 (direction is not  relevant). | Invalid value of  ORNT. | Set ORNT to 255  (direction is not  relevant). | Part 3 (4.7.1) | E | 57, 411,412, 413,414 |
| 10b | For each feature object of geometric primitive point where USAG is Not equal to 255 (Null). | Invalid value of  USAG. | Set USAG to 255  (Null). | Part 3 (4.7.1) | E | 57, 411,412, 413,414 |
| 10c | For each feature object of geometric primitive point where MASK is Not equal to 255 (masking is not  relevant). | Invalid value of  MASK. | Set MASK to 255  (masking is not  relevant). | Part 3 (4.7.1) | C | 57, 411,412, 413,414 |

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| 11 | For each edge reference where USAG is Equal to 3 (exterior boundary  truncated by the data limit) not also referenced by a M\_COVR meta object. | Edge reference with USAG = 3 (exterior boundary truncated  by the data limit) is not referenced by a M\_COVR object. | Set USAG to  1(exterior) or  2(interior). | Part 3 (4.7.3.3) | E | 57, 411,412, 413,414 |
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| 12 | For each feature object (excluding C\_AGGR and C\_ASSO collection objects) which does not reference a spatial record. | Feature object  without geometry. | Remove the feature object or reference the feature object to  a spatial record  of allowable  geometric primitive. | Part 3 (4.7) | C | 57, 411,412, 413,414 |
| 13a | For each feature object of geometric primitive line which references multiple edges where the vector records are not referenced sequentially. | Edges are not  referenced  sequentially. | Amend records to  reference edges  sequentially. | Part 3 (4.7.2) | C | 57, 411,412, 413,414 |
| 13b | For each feature object of geometric primitive line which references multiple edges where the end node of a vector record is not identical to the beginning node of the following vector record. | Sequential edges do not have the same end and beginning nodes. | Ensure end and  beginning nodes of sequential edges  match. | Part 3 (5.1.3.2) | C | 57, 411,412, 413,414 |
| 13c | For each feature object of geometric primitive area where a polygon ring  references multiple edges where the vector records are not referenced  sequentially. | Edges are not  referenced  sequentially. | Amend records to  reference edges  sequentially. | Part 3 (4.7.2) and (4.7.3) | C | 57, 411,412, 413,414 |
| 13d | For each feature object of geometric primitive area where a polygon ring  references multiple edges where the end node of a vector record is not  identical to the beginning node of the following vector record. | Sequential edges do not have the same end and beginning nodes. | Ensure end and  beginning nodes of sequential edges  match. | Part 3 (4.7.2) and (4.7.3) | C | 57, 411,412, 413,414 |
| 14 | For each feature object of geometric primitive area where the exterior  boundary shares more than one node with an interior boundary. | Exterior and interior boundaries share  more than one node. | Amend boundary to share at most one  node. | Part 3 (4.7.3) | C | 57, 411,412, 413,414 |
| 15 | For each feature object of geometric primitive area where the exterior  boundary or an interior boundary is not closed. | First and last edge of an area boundary do not meet at a  common connected node. | Amend edges  bounding the area to meet at a common  connected node. | Part 3 (4.7.3.1) | C | 57, 411,412, 413,414 |
| 16 | For each feature object of geometric primitive area where the exterior  boundary is not encoded clockwise. | Area exterior  boundary not  encoded clockwise. | Ensure area exterior boundary is encoded clockwise. | Part 3 (4.7.3.2) | C | 57, 411,412, 413,414 |
| 17 | For each feature object of geometric primitive area where an interior boundary is not encoded counter clockwise. | Area interior  boundary not  encoded counter  clockwise. | Ensure area interior boundary is encoded counter-clockwise. | Part 3 (4.7.3.2) | C | 57, 411,412, 413,414 |

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| 18a | For each feature object of geometric primitive area where the number of  exterior boundaries are Not equal to 1. | Area object without an exterior boundary or with several  exterior boundaries. | Amend geometry so that the area object has one exterior boundary. | Part 3 (4.7.3.2)  and (4.7.3.3) | C | 57, 411,412, 413,414 |
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| 18b | For each feature object of geometric primitive area where the exterior  boundary is not referenced first. | Area object with  exterior boundary which is not  referenced first. | Amend geometry so that the exterior  boundary is referenced first. | Part 3 (4.7.3.1), (4.7.3.2) and  (4.7.3.3) | C | 57, 411,412, 413,414 |
| 18c | For each feature object of geometric primitive area with one or more interior boundaries where any  interior boundary does not have USAG set to 2  (interior boundary). | Interior boundary has invalid USAG value. | Amend edge to USAG = 2 (interior boundary). | Part 3 (4.7.3.2)  and (4.7.3.3) | C | 57, 411,412, 413,414 |
| 19 | For each edge which is COINCIDENT with the data limit borders (that is limits of M\_COVR with CATCOV is Equal to 1 (coverage  available)) where USAG is Not equal to 3 (exterior boundary truncated by the data limit). | Edge coincides with the data limit and  USAG does not  equal 3 (exterior  boundary truncated by the data limit). | Amend edge to USAG = 3 (exterior boundary truncated by the data limit) if the real world feature extends  beyond the data limit of the cell. | Part 3 (4.7.3.3) | W | 57, 411,412, 413,414 |
| 20a | For each feature object where a geometric primitive is not one of those  permitted. | Geometric primitive of this type is not  permitted for this  object class. | Use alternative  geometric primitive or alternative object class as required. | Part 3 (4.2.1),  Appendix B.1  (3.3) and  Supplement No.3 Ch.3 (3.3) | C | 57, 411,412, 413,414 |
| 20b | For each spatial  record which is not  referenced by a  feature object. | Orphaned geometry. | Remove orphaned  geometry. | Logical  consistency  and Part 2 (1) | C | 57, 411,412, 413,414 |
| 21 | For each VRPT field which is not pointed to by an edge vector record. | VRPT field not  referenced by an  edge vector record. | Ensure VRPT field is referenced by an edge vector record or  remove. | Part 3 (5.1.3) | C | 57, 411,412, 413,414 |
| 22 | For each edge where the End node is referenced before the beginning node. | Beginning and end nodes are not in the correct sequence. | Amend edge to  reference beginning node before end node. | Part 3 (5.1.3.2) | C | 57, 411,412, 413,414 |
| 23 | For each coordinate which is not a SG2D or SG3D field. | Coordinate is not a SG2D or SG3D field. | Amend coordinate to valid field. | Part 3 (5.1.4) | C | 57, 411,412, 413,414 |
| 24 | For each SOUNDG feature object which does not  reference a SG3D field with X, Y and Z values. | SOUNDG does not reference a SG3D field. | Amend coordinate  type or values for  SOUNDG. | Part 3 (5.1.4.1) | C | 414 |
| 25a | For each edge where the beginning and end are not encoded as connected nodes. | Beginning or end  nodes of an edge are not encoded as  connected nodes. | Amend beginning or end nodes to be  connected nodes. | Part 3 (5.1.4.4) | C | 57, 411,412, 413,414 |
| ~~25b~~ | *Check removed.* |  |  |  |  |  |
| 25c | For each edge where the beginning or end node is not referenced using the vector record pointer. | Beginning or end  nodes not referenced by the vector record pointer. | Amend edge to ensure beginning and end  nodes are referenced. | Part 3 (5.1.4.4) | C | 57, 411,412, 413,414 |
| 26a | For each subfield where the value is not within the range defined in the S-57 format description. | Subfield value does not conform to S-57 format specification. | Amend subfield value. | Part 3 (7.2.2.1)  and (7.3) | C | 57, 411,412, 413,414 |

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| 26b | For each subfield value which is not within the legal range for attribute values (for attribute values of type "float", the resolution given in the format statement by the integer part (for  example **XX**.X) must not be checked). | Subfield value  outside of the  permitted range for an attribute value. | Amend subfield value to permitted attribute value. | Appendix A,  Chapter 2 | E | 57, 411,412, 413,414 |
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| 27 | For each subfield which is not formatted in accordance with S-57. | Subfield not  formatted in  accordance with S 57. | Amend formatting of subfield value. | Part 3 (7.2.2.2) | C | 57, 411,412, 413,414 |
| 28 | If the count of records in the DSSI field is Not equal to the total number of records. | DSSI field record  count incorrect. | Amend the DSSI field record count. | Part 3 (7.3.1.2) | E | 57, 411,412, 413,414 |
| 29 | For each of the following: FFPC-NFPT, FSPC-NSPT, SGCC-CCNC, and VRPC NVPT subfields where the value is Not equal to the number of records/pointers. | Invalid number of  records/pointers in the following FFPC NFPT, FSPC-NSPT, SGCC-CCNC or  VRPC-NVPT. | Amend subfield to  equal the number of records/pointers. | Part 3 (7.6.5)  (7.6.7), (7.7.1.5) and (7.7.1.3) | C | 57, 411,412, 413,414 |
| 30 | For each of the following: FFPC-FFIX, FSPC-FSIX, SGCC-CCIX, and VRPC VPIX subfields where the  index position for updating is invalid. | Invalid index position for updating in the following subfields FFPC-FFIX, FSPC FSIX, SGCC-CCIX or VRPC-VPIX. | Amend to valid index position for updating. | Part 3 (7.7.1.5), (7.6.5), (7.6.7)  and (7.7.1.3) | C | 57, 411,412, 413,414 |
| 31 | For each edge where  SG2D coordinates are  identical to the beginning or end node coordinates. | Edge where  beginning or end  node coordinates are the same as the  SG2D coordinates. | Amend SG2D  coordinates to differ from beginning and end node coordinates. | Part 3 (7.7.1.6) | C | 57,411,412,413, 414 |
| 32 | For each record update which does not refer to a valid record NAME. | Record update does not refer to a valid record NAME. | Amend record update to refer to a valid  record NAME. | Part 3 (8.3.2) | C | 57, 411,412, 413,414 |
| 33 | For each attribute update which does not refer to a valid record NAME and attribute label/code. | Attribute update does not refer to valid  record NAME and attribute label/code. | Amend attribute  update to refer to valid values. | Part 3 (8.3.3) | C | 57, 411,412, 413,414 |
| 34 | For each of the following fields FFPT, FSPT or VRPT where the update pointer index does not refer to a valid record NAME and index. | Update pointer index does not refer to a valid record NAME and index for FFPT, FSPT or VRPT. | Ensure update pointer index refers to a valid record NAME and  index. | Part 3 (8.3.4) | C | 57, 411,412, 413,414 |
| 35 | For each feature object where RVER is out of  sequence. | RVER is out of  sequence. | Ensure RVER is  sequential. | Part 3 (8.4.2.1)  and (8.4.3.1) | C | 57, 411,412, 413,414 |
| 36a | For each feature or vector update record which is DELETE AND contains further fields. | DELETE update  contains additional fields. | Remove additional  fields from update  record. | Part 3 (8.4.2.2)  and (8.4.3.2) | C | 57, 411,412, 413,414 |
| 36b | For each feature or vector update record which is MODIFY OR INSERT and contains no further fields. | MODIFY or INSERT update does not  contain additional fields. | Add additional fields to update record. | Part 3 (8.4.2.2)  and (8.4.3.2) | C | 57, 411,412, 413,414 |
| ~~37~~ | *Check renumbered 1006.* |  |  |  |  |  |

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| 38 | For each update record which contains more than one of the following fields: FFPC, VRPC, FSPC or SGCC. | Update record  contains more than one of the following fields: FFPC, VRPC, FSPC or SGCC. | Remove additional  fields from update  record. | Part 3 (8.4.2.3), (8.4.3.2b),  (8.4.2.4) and  (8.4.3.3) | C | 57, 411,412, 413,414 |
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| ~~39~~ | *Check removed.* |  |  |  | ~~C~~ |  |
| 40 | For any pair of feature  objects of geometric  primitive line where class and attribute values are identical AND which have one or two common  connected nodes which is (are) a beginning node or an end node of each linear feature AND each common connected node is not  shared by more than two objects which are not  chained together. | Linear objects with the same class and attribute values  which are connected and are not chained together. | Chain linear objects together. | Logical  consistency | W | 57, 411,412, 413,414 |
| ~~41~~ | *Check removed.* |  |  |  |  |  |
| 42 | For each edge which is referenced by Group 1 objects AND is not  referenced by a M\_COVR meta object with CATCOV is Equal to 1 (coverage available) which does not appear twice with different ORNT (forward and  reverse) values. | Group 1 coverage is not correct, a hole or an overlap exists. | Amend Group 1  coverage, to remove hole or overlap. | Appendix B.1  (3.10.1) and  Logical  consistency  2.8.1 of Appendix B Ed. 4.1.0 | C | 57, 411, 412, 413, 414 |
| 43 | For each DEPCNT feature object which is not  COINCIDENT with two Group 1 feature objects AND is not WITHIN an UNSARE or DRGARE. | DEPCNT does not coincide with two  Group 1 objects. | Amend DEPCNT or Group 1 objects as required. | Appendix B.1  (3.10.1) and  Logical  consistency | W | 411, 414  \*need to discuss further\* |
| 44a | For each DEPARE feature object which is not an  isolated shallow area1 AND where DRVAL1 is not Equal to a value of VALDCO on DEPCNT feature objects found in the ENC AND is not shallower than the  shallowest value of  VALDCO contained within the ENC. | The value of  DRVAL1 is different from one of the  values of VALDCO found in the ENC. | Amend value of  DRVAL1 so that it  equals a value of  VALDCO. | Appendix B.1,  Annex A (5.4.3) | W |  |
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1 An “isolated shallow area” is a DEPARE feature object that is bound entirely by a single DEPCNT feature object and having DRVAL1 for the DEPARE less than or equal to the VALDCO of the bounding DEPCNT.

2 An “isolated deep area” is a DEPARE feature object that is bound entirely by a single DEPCNT feature object and having DRVAL2 for the DEPARE greater than the VALDCO of the bounding DEPCNT.

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| 45a | For each feature object (excluding BERTHS,  CBLOHD, CBLSUB,  CONVYR, DWRTCL,  FERYRT, MARCUL,  MORFAC, NAVLNE,  PIPSOL, RCRTCL and RECTRC) of geometric primitive line which is  COINCIDENT with another feature object of the same class and geometric  primitive. | Coincident linear  objects of the same class. | Remove coincident object. | Logical  consistency | W | 57, 411,412, 413,414 |
| 45b | For each BERTHS,  CBLOHD, CBLSUB,  CONVYR, DWRTCL,  FERYRT, MARCUL,  MORFAC, NAVLNE,  PIPSOL, RCRTCL, or  RECTRC feature object of geometric primitive line which is COINCIDENT with another feature object of the same class and  geometric primitive and the same attribute values. | Coincident line  objects of the same class and attribute values. | Remove coincident object. | Logical  consistency | W | 57, 411,412, 413,414 |
| 46 | For each feature object where DATEND and  DATSTA are Known AND DATEND is Less than or equal to DATSTA. | DATEND is less than or equal to DATSTA. | Amend values of  DATEND or DATSTA accordingly. | Logical  consistency | E | 57, 411, 412, 413, 414 |
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| ~~66~~ | *Check removed.* |  |  |  |  |  |
| 67a | For each feature object where the object class, attribution and geometry is identical to another feature object. | Duplicate object  exists. | Remove duplicate  object. | Data structure | E | 57, 411, 412, 413, 414 |
| 67b | For each collection object which references exactly the same set of feature objects as another  collection object. | Duplicate collection object exists. | Remove duplicate  collection object. | Data structure | E | 57, 411, 412, 413, 414 |
| ~~68~~ | *Check renumbered 1007.* |  |  |  |  |  |
| ~~69~~ | *Check removed.* |  |  |  |  |  |
| ~~70a~~ | *Check removed.* |  |  |  |  |  |
| ~~70b~~ | *Check removed.* |  |  |  |  |  |
| 71a | For each feature object of geometric primitive area that is not COINCIDENT with the M\_COVR  boundary where all edges are masked (that is USAG is Equal to 3 (exterior  boundary truncated by the data limit) OR MASK is Equal to 1 (mask)). | Area object has all of its edges masked and is not the edge of the data coverage. | Remove masking. | Logical  consistency | W | 411?, 412, 413 |

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| 71b | For each feature object of geometric primitive line which has any edges  masked (that is MASK is Equal to 1 (mask)). | Line object with  masked edges. | Remove masking from line object. | Logical  consistency | E | 411, 412, 413 |
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| 72a | For each set of hierarchical relationships which form a loop (for example master object is slave of its own slave). | Relationships form a loop. | Amend relationships to remove loop. | Logical  consistency | E | 57, 411, 413, 414 |
| 72b | For each feature object which is both a slave and master object. | Object which is slave and master object at the same time. | Review the  relationship so that there is only one  master and one or  more slaves. | Appendix B.1  (12.1.2) | E | 57, 411, 413, 414 |
| 73a | For each attribute value which contains a leading or trailing space. | Attribute value  contains leading or trailing spaces. | Remove leading or trailing spaces. | Logical  consistency | W | 57, 411, 412, 413, 414 |
| 73b | For each attribute value of type list which contains spaces. | List attribute value contains spaces. | Remove spaces. | Logical  consistency | W | 57, 411, 412, 413, 414 |
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| 78 | For each feature object of geometric primitive area where its boundary crosses itself. | Boundary of an area object crosses itself. | Amend boundary to remove part which  crosses itself. | Logical  consistency | C | 57, 411, 412, 413, 414 |

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| 79 | For each feature object of geometric primitive line where a component edge CROSSES another  component edge without a connected node at the  crossing point. | Component edges of a line object cross without a connected node at the crossing point. | Insert connected node at crossing point. | Topology | E | 57, 411, 412, 413, 414 |
| --- | --- | --- | --- | --- | --- | --- |
| 80a | For each feature object of geometric primitive area where an interior boundary is WITHIN an interior  boundary. | Interior boundary  within an interior  boundary. | Amend boundaries so that interior boundary is not within another interior boundary. | Topology | C | 57, 411, 412, 413, 414 |
| 80b | For each feature object of geometric primitive area where an interior boundary is not WITHIN an exterior boundary. | Interior boundary  outside of an exterior boundary. | Amend boundaries so that interior boundary is within exterior  boundary. | Topology | C | 57, 411, 412, 413, 414 |
| 80c | For each feature object of geometric primitive area where an exterior boundary is WITHIN an interior  boundary. | Exterior boundary within an interior  boundary. | Amend boundaries so that exterior boundary is not within the interior boundary. | Topology | C | 57, 411, 412, 413, 414 |
| 81 | For each Spot Sounding (point of sounding array) which position EQUALS another spot sounding.  (EQUALS applies to the horizontal component only). | Spot Soundings  position is equal. | Remove coincident sounding. | Topology | E | 414 |
| 82 | For each feature object of geometric primitive line or area which references the same edge more than  once. | Object references the same edge more than once. | Remove duplicate  reference to the edge. | Topology | C | 57, 411, 412, 413, 414 |
| 83 | For each node which  EQUALS another node (connected or isolated). | Nodes are  coincident. | Remove or amend  coincident node. | Topology | W | 57, 411, 412, 413, 414 |
| 84a | For each node which is physically isolated AND is marked as connected. | Isolated node  marked as  connected. | Amend to isolated  node. | Part 3 (5.1.1) | C | 57, 411, 412, 413, 414 |
| 84b | For each node which is not physically isolated AND is marked as isolated. | Connected node  marked as isolated. | Amend to connected node. | Part 3 (5.1.1) | C | 57, 411, 412, 413, 414 |
|  |  |  |  |  |  |  |
| 86 | For each feature object of geometric primitive point which references more than one vector record. | Point feature  references more than one vector record. | Remove references to additional vector  records. | Part 3 ( 4.7.1 ) | C | 57, 411, 412, 413, 414 |
| 87 | For each edge with EQUAL consecutive vertices. | Consecutive vertices are coincident. | Remove coincident vertices from edge. | Part 3 (4.7.2) | E | 57, 411, 412, 413, 414 |
| 88a | For each feature object of geometric primitive area where ORNT is Not equal to 1 (forward) AND is Not equal to 2 (reverse). | Invalid value of  ORNT. | Set value of ORNT to 1 (forward) or 2  (reverse). | Part 3 (4.7.3) | C | 57, 411, 412, 413, 414 |

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| 88b | For each feature object of geometric primitive area where USAG is Not equal to 1 (exterior) AND is Not equal to 2 (interior) AND is Not equal to 3 (exterior boundary truncated by the data limit). | Invalid value of  USAG. | Set USAG to  1(exterior), 2(interior) or 3 (exterior  boundary, truncated by the data limit). | Part 3 (4.7.3) | C | 57, 411, 412, 413, 414 |
| --- | --- | --- | --- | --- | --- | --- |
| 88c | For each feature object of geometric primitive area where MASK is Not equal to 1 (mask) AND is Not equal to 2 (show) AND is Not equal to 255 (masking is not relevant). | Invalid value of  MASK. | Set MASK to 1 (mask), 2 (show) or 255  (masking is not  relevant). | Part 3 (4.7.3) | C | 57, 411, 412, 413, 414 |
| 89a | For each master object which references the same slave more than once. | Master object  references the same slave more than  once. | Remove duplicate  reference to slave  object. | Part 3 (6.3);  Appendix B.1  (3.9) and  Appendix B.1,  Annex A (12.1.2) | C | 57, 411, 413, 414 |
| 89b | For each slave object which is referenced by more than one master object. | Slave object has  more than one  master. | Remove incorrect  master from slave  object. | Part 3 (6.3);  Appendix B.1  (3.9) and  Appendix B.1,  Annex A (12.1.2) | C | 57, 411, 413, 414 |
| ~~90a~~ | *Check renumbered 1009* |  |  |  |  |  |
| 90b | For an EN file where the DDR does not contain only the description of the base cell file structure. | Invalid DDR in EN file. | Amend DDR. | Part 3 (7) and  Part 3 (A.2) | W | 57, 411, 412, 413, 414 |
| 90c | For an ER file where the DDR does not contain only the description of the  update cell file structure. | Invalid DDR in ER file. | Amend DDR. | Part 3 (7) and  Part 3 (A.2) | W | 57, 411, 412, 413, 414 |
| ~~91~~ | *Check removed.* |  |  |  |  |  |
| ~~92~~ | *Check renumbered 1010.* |  |  |  |  |  |
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| 93b |  |  |  |  |  |  |
| 93c |  |  |  |  |  |  |
| 94 | For each combination of FSPC and FSPT fields within an ER file that does not modify a feature. | ER file contains a  redundant  combination of FSPC and FSPT fields. | Remove irrelevant  FSPC field from ER file. | Logical  consistency | E | 57, 411, 412, 413, 414 |

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| 95 | If the COMT subfield of the DSID and DSPM fields contains text which is not lexical level (0). | COMT subfield  contains text which is not lexical level (0). | Amend text to conform to lexical level (0). | Part 3 (2.4) | E | 57, 411, 412, 413, 414 |
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| 96 | For each relationship which does not reference a  C\_ASSO or C\_AGGR  collection object AND the RIND subfield of the FFPT field is set to 3 (peer). | Invalid value of  RIND. | Amend the relationship indicator to 2 (slave) or remove as  appropriate. | Part 3 (6.2) and Appendix B.1  (3.9) | E | 57, 411, 412, 413, 414 |
| 97 | For each feature object where SUREND and  SURSTA are Known AND SUREND is Less than  SURSTA. | SUREND less than SURSTA. | Ensure SURSTA is earlier than SUREND. | Logical  consistency | E | 57, 411, 412, 413, 414 |
| 98 | For each feature object which has a relationship AND references an object which does not exist. | Object references an object that does not exist | Remove reference to non-existent object | Logical  consistency. | E | 57, 411, 412, 413, 414 |
| 99 | For SG3D that contains > 8250 3D coordinates | Sounding bundle  contains more than 8250 individual  depths | Split sounding bundle | Part 3 (2.7) | E | 414 |
| 100 | For SG2D that contains > 12375 2D coordinates | Edge contains more than 12375  coordinates | Split or optimise  geometry | Part 3 (2.7) | E | 57, 411, 412, 413, 414 |
| 101 | For FSPT that references > 12375 VRID records | FSPT record  contains references to more than 12375 spatial records | Optimise geometry, merging referenced edges where possible | Part 3 (2.7) | E | 57, 411, 412, 413, 414 |

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| 3.2 Checks Relating to the ENC Product Specification | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **Check description** | **Check message** | **Check solution** | **Conformity to:** | **Cat** |  |
| 500 | For each feature object where its geometry is not COVERED\_BY a M\_COVR meta object with CATCOV Equal to 1 (coverage  available). | Objects fall outside the coverage object. | Ensure objects are not outside of the limits of the coverage area for the cell. | 2.2 | C | 57, 411, 412, 413, 414 |
| 501 | If the combined coverage of all M\_COVR meta objects limits are not rectangular. | Cell is not  rectangular. | Ensure cell limits are rectangular. | 2.2 | E | 57, 411, 412, 413, 414 |
| 502 | If the cell file size is greater than 5 Megabytes. | The cell is larger  than 5Mb in size. | Ensure that the cell is not larger than 5Mb. | 2.2 | E | 57, 411, 412, 413, 414 |
| 503 | For each feature object where the FOID is not  unique WITHIN the dataset. | Duplicate FOIDs  exist within the  dataset. | Ensure that no  duplicate FOIDs exist. | 3.1 | W | 57, 411, 412, 413, 414 |
|  |  |  |  |  |  |  |
| 505 | If either M\_COVR,  M\_NSYS or M\_QUAL meta objects do not exist within the data set. | Mandatory feature objects are missing. | Include mandatory  feature objects  M\_COVR, M\_NSYS and M\_QUAL. | 3.4 | C | 57, 411, 413, 414 |
| ~~506~~ | *Check removed.* |  |  |  |  |  |
| 507 | If any mandatory attributes are not Present. | Mandatory attributes are not encoded. | Populate mandatory attributes (If unknown encode attribute with empty value). | 3.5.2 and  Supplement No.3 Ch.4 (3.5.2.1) | C |  |
| 508a | For each feature object (excluding LIGHTS) where more than one value of COLOUR is encoded AND COLPAT is not Present. | COLOUR has  multiple values  without a value for COLPAT. | Ensure COLPAT has a value where multiple COLOUR values are encoded. | 3.5.2 and Logical consistency  Section 2.4 of S-57 Appendix B | E | 57, 411, 412, 413, 414 |
| 508b | For each feature object where COLPAT is Known AND COLOUR is Unknown OR only has one value. | COLPAT is  populated without multiple COLOUR values. | Ensure multiple  COLOUR values are populated or remove COLPAT value. | 3.5.2 and Logical consistency  Section 2.4 of S-57 Appendix B | E | 57, 411, 412, 413, 414 |

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| 509 | For each feature object listed below where the  attribute stated is Unknown: ARCSLN: NATION;  ASLXIS: NATION;  CONZNE: NATION;  COSARE: NATION;  CTNARE: INFORM or  TXTDSC;  CUSZNE: NATION;  DEPARE: DRVAL1 and DRVAL2;  DEPCNT: VALDCO;  DRGARE: DRVAL1;  DWRTPT: ORIENT;  DWRTCL: ORIENT;  EXEZNE: NATION;  FSHZNE: NATION;  LNDELV: ELEVAT;  M\_COVR: CATCOV;  M\_CSCL: CSCALE;  M\_NSYS: MARSYS or ORIENT;  M\_QUAL: CATZOC;  M\_SDAT: VERDAT;  M\_VDAT: VERDAT;  MAGVAR: VALMAG;  NEWOBJ: CLSDEF and CLSNAM;  RCTLPT: ORIENT;  RESARE: CATREA or  RESTRN;  STSLNE: NATION;  SWPARE: DRVAL1;  TESARE: NATION;  TS\_PAD: TS\_TSP. | Mandatory attribute has not been  populated with a  value. | Populate mandatory attributes; in these  cases the object is  meaningless without this value. | 3.5.2 and  Supplement No.3 Ch.4 (3.5.2.1) | E |  |
| --- | --- | --- | --- | --- | --- | --- |
| ~~510~~ | *Check removed.* |  |  |  |  |  |
| 511 | For each feature object where any of the attributes DUNITS, HUNITS,  RECDAT, RECIND,  SCAMAX, PUNITS or  CATQUA is Present. | Prohibited attributes have been encoded. | Remove prohibited attributes. | 3.5.3 | C | 57, 411, 412, 413, 414 |
| 512 | 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. Example: For a  signal period of 2.5 sec, the value of  SIGPER must be 2.5 and not 02.500. | Remove non  significant zeroes. | 3.5.4 | E | 57, 411, 412, 413, 414 |
| 513 | For each feature object with an attribute value identical to a corresponding attribute of a meta object it is  COVERED\_BY. | An attribute value of a meta object is  duplicated on a geo object. | Remove duplicate  value from geo object. | 3.5.6 | E | 57, 411, 414 |
| ~~514~~ | *Check removed.* |  |  |  |  |  |

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| 515 | For each edge where the subfield USAG (Usage indicator) is Equal to 3  (exterior boundary,  truncated by the data limit) AND the MASK subfield is Not equal to 255 (masking is not relevant). | Edge with USAG = 3 (exterior boundary truncated by the data limit) does not have MASK = 255  (masking is not  relevant). | Set MASK to 255  (masking is not  relevant) for edges with USAG = 3. | 3.8 | W | 57, 411, 412, 413, 414 |
| --- | --- | --- | --- | --- | --- | --- |
| 516a | For each master feature object of geometric  primitive point which does not share the geometry of the related slave objects. | Master and slave  point objects do not share the same  node. | Ensure master and slave point objects  share the same node. | 3.9 and Appendix B.1, Annex A  (12.1.1 and  12.1.2) | E | 57, 411, 413, 414 |
| 516b | For each master feature object of geometric  primitive line where the slave object does not  INTERSECT the master object. | Slave object is not located on the  master line object. | Ensure the master and slave objects overlap. | 3.9 and Appendix B.1, Annex A  (12.1.1 and  12.1.2) | E | 57, 411, 413, 414 |
| 516c | For each master feature object of geometric  primitive area where the slave object is not  COVERED\_BY the master object. | Slave object is not covered by the  master area object. | Ensure the slave  object covered by the master object. | 3.9 and Appendix B.1, Annex A  (12.1.1 and  12.1.2) | E | 57, 411, 413, 414 |
| 517a | For each collection feature object which does not  reference at least two  feature objects. | Collection feature object does not  reference at least  two feature objects. | Remove collection  feature object or  ensure that it  references at least two feature objects. | 3.9 and Appendix B.1, Annex A  (15), and Part 3 (6.2) | E | 57, 411, 412, 413, 414 |
| 517b | For each collection feature object which references itself. | Collection feature object references  itself. | Remove circular  reference. | 3.9 and Appendix B.1, Annex A  (15), and Part 3 (6.2) | E | 57, 411, 412, 413, 414 |
| 517c | For each collection feature object where the subfield PRIM is Not equal to Null {255} (no geometry). | Invalid value of  geometric primitive subfield. | Set PRIM subfield to Null {255} (no  geometry). | 3.9 and Appendix B.1, Annex A  (15), and Part 3 (6.2) | E | 57, 411, 412, 413, 414 |
| ~~517d~~ | *Check removed.* |  |  |  |  |  |
| 517e | For each collection feature object where the RIND subfield is not 3 (peer) OR which references feature objects where the subfield RIND is Not equal to 3 (peer). | Collection feature object which is peer, references non-peer feature objects. | Amend feature objects to peer. | 3.9 and Appendix B.1, Annex A  (15), and Part 3 (6.2) | E | 57, 411, 412, 413, 414 |
| 517f | For each collection feature object that references the same feature more than once. | Collection feature object contains  multiple references to the same feature object. | Remove duplicate  reference. | 3.9 and Appendix B.1, Annex A  (15), and Part 3 (6.2) | E | 57, 411, 412, 413, 414 |
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| 518 b | For each feature object (excluding FLODOC,  DRGARE, LNDARE,  HULKES, PONTON,  DEPARE and UNSARE of geometric primitive area) where the GRUP subfield of the FRID is Not equal to 2 (Group 2). | Group 2 objects are not encoded as  Group 2. | Ensure that the FRID subfield GRUP is set to 2 (Group 2) for all non-skin of the earth feature objects. | 3.10.2 | C | 57, 411, 412, 413, 414 |
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| 520a | If the AALL subfield of the DSSI is Not equal to 0 AND is Not equal to 1. | Invalid value of  AALL. | Set value of AALL to 0 or 1. | 3.11, 3.5.5,  6.3.2.2 and  6.4.2.2 | E | 57, 411, 412, 413, 414 |
| 520b | If the NALL subfield of the DSSI is Not equal to 0 AND is Not equal to 1 AND is Not equal to 2. | Invalid value of  NALL. | Set value of NALL to 0, 1 or 2. | 3.11, 3.5.5,  6.3.2.2 and  6.4.2.2 | E | 57, 411, 412, 413, 414 |
|  |  |  |  |  |  |  |
| 520d | If lexical level 2 has been used anywhere other than the NATF field. | Lexical level 2 used outside of the NATF field. (Return  character sets used and the sequence found.) | Amend text to remove lexical level 2  characters. | 3.11 and 3.5.5 | E | 57, 411, 412, 413, 414 |
| 520e | If any ATTF or NATF field contains characters of a lexical level greater than that in the DSSI -  AALL/NALL subfields  correspondingly. | Lexical level of  characters in the  attribute or encoding of DSSI-AALL/NALL is inconsistent. | Amend characters or the subfield encoding as required. | 3.11 and 3.5.5 | E | 57, 411, 412, 413, 414 |
| 520f | If the UT or FT is not  encoded at the lexical level specified for that field. | The UT or FT is not of the correct lexical level. | Amend UT and FT to the correct lexical  level. | Part 3, Annex B (B.2) | E | 57, 411, 412, 413, 414 |
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| 521a | For each feature object where OBJNAM and  NOBJNM are Known AND are Equal. | Values for OBJNAM and NOBJNM are identical. | Ensure that national language attributes are populated with the  correct values. | 3.11.1 | W | 57, 411, 412, 413, 414 |

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| 521b | For each feature object where INFORM and  NINFOM are Known AND are Equal. | Values for INFORM and NINFOM are  identical. | Ensure that national language attributes are populated with the  correct values. | 3.11.1 | W | 57, 411, 412, 413, 414 |
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| 521d | For each feature object where TXTDSC and  NTXTDS are Known l AND are Equal. | Values for TXTDSC and NTXTDS are  identical. | Ensure that national language attributes are populated with the  correct values. | 3.11.1 | W | 57, 411, 412, 413, 414 |
| 522 | For each feature object where NOBJNM is Known AND OBJNAM is Unknown OR not Present. | NOBJNM is  populated without OBJNAM. | Populate OBJNAM. | 3.11.1 | E | 57, 411, 412, 413, 414 |
| 523 | If the HDAT subfield of the DSPM field is Not equal to 2 (WGS 84). | HDAT does not  equal 2 (WGS 84). | Set the HDAT subfield to 2 (WGS 84). | 4.1 | C | 57, 411, 412, 413, 414 |
|  |  |  |  |  |  |  |
| 525 | If the PUNI subfield of the DSPM is Not equal to 1 (metres). | PUNI does not equal 1 (metres). | Set the PUNI subfield to 1 (metres). | 4.4 | C | 57, 411, 413, 414 |
| 526 | If the COUN subfield of the DSPM field is Not equal to 1 (latitude/longitude). | COUN does not  equal 1  (latitude/longitude). | Set the COUN subfield to 1  (latitude/longitude). | 4.4 | C | 57, 411, 412, 413, 414 |
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| 531 | If the Dataset file name is not in accordance with the ENC Product Specification. | Dataset file name is not in accordance with the ENC  Product  Specification. | Amend file names. | 5.6.3 and MD8  1. CL.37 and  1.Co.32 | C | 57, 411, 412, 413, 414 |
| 533 | If the UADT subfield of the DSID field is used in an ER file. | DSID-UADT subfield populated in an ER file. | Remove value of  DSID-UADT subfield. | 5.7 | C | 57, 411, 412, 413, 414 |
| 534 | If a delete cell message contains anything other than the DSID field AND EDTN is Equal to 0. | Incorrect delete cell message. | Remove additional  information from delete cell message. | 5.7 | C | 57, 411, 412, 413, 414 |
| ~~535~~ | *Check renumbered 1016.* |  |  |  |  |  |
| 536 | If a field without a repetition factor repeats. | Field without a  repetition factor  repeats. | Remove repeating  value. | 6.1.3 | C | 57, 411, 412, 413, 414 |
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| 539 | If DSID-PROF is Not equal to 1 (EN) AND is Not Equal to 2 (ER). | Invalid value of  DSID-PROF. | Set DSID-PROF to either 1 (EN) or 2  (ER). | 6.3 and 6.4 and Part 3 (7.3.1.1) | C | 57, 411, 412, 413, 414 |
| 540a | If mandatory records, fields and subfields are not  Present OR are Null where the “Null” value is not  allowed. | Mandatory records, fields or subfields are not used. | Add mandatory  records/values. | 6.1.4, 6.3 and 6.4 | C | 57, 411, 412, 413, 414 |
| 540b | If data set file contains prohibited records, fields or subfields. | Prohibited records, fields or subfields  used. | Remove prohibited records/values. | 6.3 and 6.4 | C | 57, 411, 412, 413, 414 |

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| 544 | For each feature object that OVERLAPS, CROSSES OR is WITHIN an area of M\_COVR where CATCOV is Equal to 2 (no coverage available). | Object within an area of no coverage. | Remove object or  amend coverage. | 2.2 | C  57, 411, 412, 413, 414 |
| 545 | For each feature object which does not have a valid feature object class  label/code as defined by the Object catalogue and S-57 Supplement No.3. | Object has invalid object class code. | Amend object class code. | 3.2 and  Supplement No.3 Ch.2 | C  57, 411, 412, 413, 414 |
| 546 | For each attribute which does not have a valid  attribute label/code as  defined by the Object  catalogue and S-57  Supplements No.3. | Attribute has invalid attribute label/code. | Amend attribute  label/code. | 3.2 and  Supplement No.3 Ch.3 | C  57, 411, 412, 413, 414 |

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| 547 | For each feature object which contains attributes outside the list of  permissible attributes for the feature object as  defined in the Object  catalogue and S-57  Supplement No.3. | Attribute not  permitted on feature object class. | Remove attribute. | 3.2 and  Supplement No.3 Ch.2 | C  57, 411, 412, 413, 414 |  |
| --- | --- | --- | --- | --- | --- | --- |
| 548a | If the combined coverage of M\_COVR meta objects is Not equal to the cell  extents. | Cell not entirely  covered by M\_COVR objects. | Edit M\_COVR  coverage to match cell extents. | 3.4 | C | 57, 411, 412, 413, 414 |
| 548b | For each M\_COVR meta object that OVERLAPS or is COVERED\_BY another M\_COVR object. | Cell contains  overlapping  M\_COVR objects. | Amend M\_COVR  objects to remove  overlap. | 3.4 | C | 57, 411, 412, 413, 414 |
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|  |  |  |  |  |  |  |
| 551a | If text attribute values use (C0) characters (C0 as defined in S-57 Part 3, Annex B). | C0 characters used in text attribute  values. | Correct text attribute values. | 3.5.5 and Part 3 Annex B | C | 57, 411, 412, 413, 414 |
| 551b | If the delete character is used outside of the update mechanism, (that is in  records where RUIN is Equal to 3 (modify)). | Delete character  used outside of the update mechanism. | Only use delete within the update  mechanism. | 3.5.5 | E | 57, 411, 412, 413, 414 |
| ~~552~~ | *Check removed.* |  |  |  |  |  |
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| 555a | If the order of the data in a base or update file is not correct, except for when: 1. Isolated nodes (SG2D) are listed before isolated nodes (SG3D) OR  2. Connected nodes are listed before isolated nodes (SG3D) OR  3. Connected nodes are listed before isolated nodes (SG2D) OR  4. Geo features are listed before Meta features. | Incorrect data order. | Amend data order. | 6.1.1 | C | 57, 411, 412, 413, 414 |
| --- | --- | --- | --- | --- | --- | --- |
| 555b | If the order of the data in a base or update file is such that:  1. Isolated nodes (SG2D) are listed before isolated nodes (SG3D) OR  2. Connected nodes are listed before isolated nodes (SG3D) OR  3. Connected nodes are listed before isolated nodes (SG2D) OR  4. Geo features are listed before Meta features. | Incorrect data order. | Amend data order. | 6.1.1 | E |  |
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| 559a | For each feature object where STATUS includes the value 1 (permanent) in combination with at least one of 2 (occasional), 5 (periodic/intermittent) or 7 (temporary). | Illogical combination of STATUS values. | Amend values for  STATUS. | Appendix A Ch.2 (code 149) and Logical  consistency | E | 414 |
| 559b | For each feature object where STATUS includes the value 3 (recommended) in combination with at least one of 4 (not in use) or 11 (extinguished). | Illogical combination of STATUS values. | Amend values for  STATUS. | Appendix A Ch.2 (code 149) and Logical  consistency | E | 414 |
| 559c | For each feature object where STATUS includes the value 4 (not in use) in combination with at least one of 5  (periodic/intermittent) or 9 (mandatory). | Illogical combination of STATUS values. | Amend values for  STATUS. | Appendix A Ch.2 (code 149) and Logical  consistency | E | 414 |

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| 559d | For each feature object where STATUS includes the value 5  (periodic/intermittent) in combination with 11  (extinguished). | Illogical combination of STATUS values. | | Amend values for  STATUS. | | Appendix A Ch.2 (code 149) and Logical  consistency | E | 414 |
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| 560a | For all feature objects with the same FOID where the object class and attribute values are not identical. | Objects with the  same FOID do not have the same  feature encoding. | | Ensure objects with the same FOID have the same object class and attribute values. | | 3.1 | C | 57, 411, 412, 413, 414 |
| 560b | For all feature objects with the same FOID where the geometric primitives are Point OR are not of the same geometric primitive. | Objects with the  same FOID are of geometric primitive point or have  different geometric primitives. | | Ensure point objects do not have the same FOID and that line and area objects which  share FOIDs have the same geometric  primitive. | | 3.1 | C | 57, 411, 412, 413, 414 |
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| 567 | For each attribute of type ‘list’ (excluding COLOUR, NATQUA and NATSUR) with more than one  instance of the same value. | List attribute contains the same value more than once. | | Remove unnecessary attribute value. | | Logical  consistency | E | 413, 414 |
| 568 | For each feature object where PERSTA and  PEREND are Known AND their values are identical. | Object has identical values of PERSTA and PEREND. | | Ensure values of  PERSTA and  PEREND are logical. | | Logical  consistency | E | 57, 411, 412, 413, 414 |
| 569 | For each feature object where PERSTA is Known AND PEREND is Unknown OR not Present. | Object has PERSTA without a value of PEREND. | | Populate PEREND or remove PERSTA. | | Logical  consistency | E | 57, 411, 412, 413, 414 |
| 570 | For each feature object where PEREND is Known AND PERSTA is Unknown OR not Present. | Object has PEREND without a value of PERSTA. | | Populate PERSTA or remove PEREND. | | Logical  consistency | E | 57, 411, 412, 413, 414 |
| 571 | For each edge which  contains vertices at a  density Greater than  0.3mm at compilation  scale. | Vertex density  exceeds the  allowable tolerance. | | Generalise edge(s). | | 3.8 | W | 57, 411, 412, 413, 414 |
| 572 | For each feature object where NINFOM is Known AND INFORM is Unknown OR not Present. | NINFOM is  populated without INFORM. | | Populate INFORM. | | 3.11.1 | E | 57, 411, 412, 413, 414 |
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| 574 | For each feature object where NTXTDS is Known AND TXTDSC is Unknown OR not Present. | NTXTDS is  populated without TXTDSC. | | Populate TXTDSC and include relevant text file. | | 3.11.1 | E | 57, 411, 412, 413, 414 |
| 575 | If the DSTR subfield of the DSSI field is Not equal to 2 (chain node). | DSTR does not  equal 2. | | Set the DSTR subfield to 2 (chain node). | | 6.3.2.2 and  6.4.2.2 | C | 57, 411, 412, 413, 414 |
| 576 | For each M\_QUAL meta object which OVERLAPS or is WITHIN another  M\_QUAL meta object. | M\_QUAL objects  overlap. | | Amend objects to  remove overlap. | | 3.4 and Appendix B1, Annex A  (2.2.3.1) | E | 57, 411, 412, 413, 414 |

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| 3.3 Exchange Set Level Checks | | | | | |  |
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| **No** | **Check description** | **Check message** | **Check solution** | **Conformity to:** | **Cat** |  |
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| 1006 | If an update and its base cell do not have the same lexical level. | Update and base cell do not have the  same lexical level. | Amend the lexical  level of the update. | Part 3 (8.4.2.2a) | C | 57, 411, 412, 413, 414 |
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| 1008 | For each ER (update) file where an AGEN subfield value of the DSID field or FOID field is not identical to the AGEN subfield values in the EN (base) file. | AGEN subfield  values do not agree between ER (update) and EN (base) files. | Amend AGEN subfield values to agree. | Part 3 (4.3.1) and (7.3.1.1) | C | 57, 411, 412, 413, 414 |
| 1009 | For a catalogue file where the DDR(Data Descriptive Record) does not contain only the description of the catalogue file structure. | Invalid DDR in  catalogue file. | Amend DDR. | Part 3 ( 7 ) and  Part 3 (A.2) | W | 57, 411, 412, 413, 414 |
| 1010 | For each FRID field in an ER (update) file where RUIN is Equal to 3 (modify) AND the FOID for the  modified object is not  identical in the EN (base) and ER (update) files. | FOID for the  modified object is not identical in the EN (base) and ER  (update) files. | Amend FOIDs to be identical or make  separate insert and delete updates. | Part 3 (8.4.2) | C | 57, 411, 412, 413, 414 |
| 1011 | For each feature object where TXTDSC, NTXTDS, PICREP is Known and references a file that is Not present in the exchange set OR their names do not conform to the ENC  Product Specification. | Text or picture file referenced by a  feature object is not present in the  exchange set or its name is non  conformant. | Ensure referenced  files exist and are  named correctly. | Appendix B.1  (5.4.1 and 5.6.4) | C | 57, 411, 412, 413, 414 |
| 1012 | If a catalogue file does not exist. | No catalogue file  exists. | Create a catalogue file. | Appendix B.1  (5.4.1) | C | 57, 411, 412, 413, 414 |
| 1013 | If volume name is not in accordance with the ENC Product Specification. | Volume name is not in accordance with the ENC Product  Specification. | Amend the volume name. | Appendix B.1  (5.4.2) | C | 57, 411, 412, 413, 414 |
| 1014 | If the directory structure for physical media is not in accordance with the ENC Product Specification. | The directory  structure for physical media is not in  accordance with the ENC Product  Specification. | Correct the directory structure of the  physical media. | Appendix B.1  (5.4.3) | C | 57, 411, 412, 413, 414 |
| 1015 | If the text and picture file names are not in  accordance with the ENC Product Specification. | Text and picture file names have  incorrect  format/name. | Use correctly  formatted and named text and picture files. | Appendix B.1  (5.6.4) and  Appendix B.1,  Annex A (2.3) | C | 57, 411, 412, 413, 414 |
| 1016 | If the calculated CRC value of a file is Not equal to that stated in the catalogue file. | CRC values do not match. | Amend CRC value. | Appendix B.1  (5.9.1) | C | 57, 411, 412, 413, 414 |
| 1017 | If the format of the  catalogue file is not correct. | catalogue file format not correct. | Amend format of the catalogue file. | Appendix B.1  (6.2) | C | 57, 411, 412, 413, 414 |
| 1018 | If the IMPL subfield of the CATD field is Not equal to “BIN” for the data set file. | CATD-IMPL is not equal to “BIN”. | Amend CATD-IMPL. | Appendix B.1  (5.1 and 6.2.2) | E | 57, 411, 412, 413, 414 |

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| 1019 | For each feature object where TXTDSC AND  NTXTDS are Known AND the files referenced are identical or empty. | Files referenced by TXTDSC and  NTXTDS are the  same or empty. | Ensure files are  different. | Logical  consistency | W | 57, 411, 412, 413, 414 |
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| 1021a | If the data set is not a re issue AND the UPDN  subfield is not equivalent to the extension of the data set file name. | Update number is incorrect or not  equivalent to the  data set file name extension. | Amend UPDN  subfield. | Appendix B.1,  Annex A (2.2.2) | C | 57, 411, 412, 413, 414 |
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| 1023 | For each picture file which is not in the TIF format. | Picture file not in TIF format. | Replace picture file with TIF format  version. | Appendix B.1,  Annex A (4.8.20) | C | 57, 413 |
| 1024a | For a base cell file if the limits contained in the  subfields SLAT, WLON, NLAT, and ELON of the CATD field of the catalogue file are Not equal to the furthest coordinates of the M\_COVR meta object in the corresponding base cell file. | Limits in catalogue do not correspond to M\_COVR limits for a base cell file. | Amend limits in  catalogue or base cell file M\_COVR object to agree. | Appendix B.1  (5.6.3 and 6.2.2) and Logical  consistency | C | 57, 411, 412, 413, 414 |
| 1024b | For an update cell file if the limits are not identical to the limits of the base cell to which they apply. | Update with limits different to that of the base cell. | Amend limits of update file. | Appendix B.1  (5.6.3 and 6.2.2) and Logical  consistency | C | 57, 411, 412, 413, 414 |
| 1024c | For each M\_COVR feature object where CATCOV is Equal to 1 (coverage  available) in an update cell file that moves any part of the M\_COVR boundary of the base cell file coverage  by more than 0.25mm at compilation scale. | ER file changes the extent of data  coverage. | Issue as new edition. | Appendix B.1,  Annex A (2.6) | E | 57, 411, 412, 413, 414 |

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| 3.4 Checks Relating to the Use of the Object catalogue for ENC | | | | | |  |
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| **No** | **Check description** | **Check message** | **Check solution** | **Conformity to:** | **Cat** |  |
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| 1502 | For each spatial object where the attribute  HORDAT is Present. | HORDAT used in a spatial object. | Remove HORDAT. | 2.1.1 | E | 57, 411, 412, 413, 414 |
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| 1504a | If the value of the VDAT subfield of the DSPM field is Null. | VDAT is not  populated. | Populate the VDAT subfield with the  vertical datum of the cell. | 2.1.2 | C |  |
| 1504b | If the value of the VDAT subfield of the DSPM field is notNull AND is Not equal to 3, 16, 17, 18, 19, 20, 21, 24, 25, 26, 28, 29 or 30. | VDAT does not refer to a high water or  local datum. | Encode an allowable value for VDAT. | 2.1.2 | E |  |
| 1505 | For each M\_VDAT meta object where VERDAT is Known AND is Equal to the value of VERDAT in the VDAT subfield of the DSPM field. | Value of VERDAT is identical to the value of the VDAT subfield of the DSPM field. | Remove unnecessary value of VERDAT from M\_VDAT object. | 2.1.2 | E |  |
| 1506 | For each feature object where any of ELEVAT, HEIGHT, VERCCL,  VERCLR, VERCOP or VERCSA is Known AND which OVERLAPS OR CROSSES at least one M\_VDAT meta object. | Object with vertical distance value not split at boundary of M\_VDAT object. | Split object at  boundary of M\_VDAT object or amend the M\_VDAT object to  cover the entire  feature object. | 2.1.2 | E | 413, 414? |
| 1507 | For each M\_VDAT meta object which OVERLAPS OR is COVERED\_BY  another M\_VDAT meta object. | M\_VDAT objects  overlap. | Edit M\_VDAT objects so that they do not  overlap. | 2.1.2 | E | 414? |
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| ~~1509~~ | *Check removed.* |  |  |  |  |  |

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| 1511 | For each M\_SDAT meta object where VERDAT is Equal to the value of the  SDAT subfield of the DSPM field. | M\_SDAT object has the same VERDAT as in the SDAT  subfield of the  DSPM. | Remove M\_SDAT  object or amend value of VERDAT. | 2.1.3 | E |  |
| 1512a | For each SOUNDG feature object which does not lie WITHIN a M\_SDAT meta object AND INTERSECTS a M\_SDAT meta object. | SOUNDG object  reference multiple sounding datums. | Split SOUNDG object at boundary of  M\_SDAT object. | 2.1.3 | E |  |
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| 1513 | If the value of the HUNI subfield of the DSPM field is Not equal to 1 (metres). | HUNI subfield is not equal to 1 (metres). | Set value of HUNI to 1 (metres). | 2.1.4 | C | 413, 414 |
| ~~1514~~ | *Check removed.* |  |  |  |  |  |
| 1515a | For each feature object where a value of DATEND, DATSTA, PEREND or  PERSTA does not conform to the formatting defined in S-57 Appendix B.1, Annex A. | Date attribute not  formatted according to the S-57 Use of the Object catalogue for ENC. | Amend formatting to conform to the S-57 Use of the Object  catalogue for ENC. | 2.1.5 | C | 57, 411, 412, 413, 414 |
| 1515b | For each feature object where a value of SORDAT, SUREND or SURSTA does not conform to the  formatting defined in S-57 Appendix B.1, Annex A. | Date attribute not  formatted according to the S-57 Use of the Object catalogue for ENC. | Amend formatting to conform to ISO the S 57 Use of the Object catalogue for ENC. | 2.1.5 | E | 57, 411, 412, 413, 414 |
| 1516 | For each Group 2 feature object with allowable  attributes STATUS,  PEREND and PERSTA, where STATUS includes 5 (periodic/intermittent) AND PEREND or PERSTA are Unknown OR not Present. | PEREND or  PERSTA not  populated where  STATUS = 5. | Populate PEREND or PERSTA with values or remove STATUS = 5  (periodic/intermittent). | 2.1.5.1 | W | 57, 411, 412, 413, 414 |

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| 1517 | For each feature object where TIMEND or TIMSTA is Known AND their values do not conform to the  format defined in Chapter 2 of S-57 Appendix A. | TIMEND or TIMSTA are not formatted  correctly. | Amend the formatting of TIMEND or  TIMSTA. | 2.1.6 | E | 57, 411, 412, 413, 414 |
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| 1518a | If the AGEN subfield of the DSID field is not one of the values listed in S-62  sections I and II. | Producing Agency code is not a valid S 62 value. | Amend AGEN subfield to a valid S-62 value. | 2.2.1 | C | 57, 411, 412, 413, 414 |
| 1518b | If the first 2 characters of the data set file name do not correspond to the value of the AGEN subfield of the DSID field. | Data set file name does not begin with the agency code  corresponding to that set in the AGEN  subfield of the DSID field. | Amend the first 2  characters of the data set file name. | 2.2.1 | C | 57, 411, 412, 413, 414 |
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| 1522b | If the file extension is not “.000” AND the UADT  subfield of the DSID field is notNull. | UADT is notNull for an update. | Encode UADT as  missing subfield value. | 2.2.2 and  Appendix B. (5.7 and 6.1.4) | C | 57, 411, 412, 413, 414 |
| 1523b | If the data set file name extension is Equal to “.000” AND the ISDT subfield of the DSID field is Less than the value of the UADT  subfield. | The ISDT of a base cell file precedes the UADT. | Amend UADT or ISDT accordingly. | 2.2.2 and  Appendix B.  (5.7) | C | 57, 411, 412, 413, 414 |
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| 1542 | For each spatial object where the value of  POSACC is Equal to the POSACC value of the  M\_ACCY meta object it is COVERED\_BY OR  CROSSES. | POSACC of a spatial object is equal to the POSACC value of the underlying  M\_ACCY object. | Remove unnecessary POSACC value from spatial object. | 2.2.4.1 | W | 57, 411, 412, 413, 414 |
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| 1544 | For each M\_ACCY meta object where HORACC, SOUACC or VERACC are Present. | M\_ACCY object  includes HORACC, SOUACC or  VERACC. | Remove HORACC, SOUACC or VERACC from M\_ACCY object. | 2.2.4.1 | E | 57, 411, 412, 413, 414 |
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| 1548 | For each feature object where SORIND is Known AND SORDAT is Unknown OR not Present. | Value of SORIND without a value of SORDAT. | Populate SORDAT with an appropriate value. | 2.2.5.2 | W | 414 |
| 1549 | If the value of CSCL  subfield of the DSPM field is Null. | CSCL is not  populated with a  value. | Populate CSCL with an appropriate value. | 2.2.6 | C | 413 |
| 1550 | For each M\_CSCL meta object where CSCALE is Equal to the value of CSCL subfield of the DSPM field. | CSCALE of M\_CSCL object is equal to the value given CSCL subfield of the DSPM field. | Remove unnecessary M\_CSCL object. | 2.2.6 | E | 413 |
| 1551 | For each M\_CSCL meta object which OVERLAPS OR is WITHIN another M\_CSCL meta object. | M\_CSCL objects  overlap. | Amend M\_CSCL  objects so that they do not overlap. | 2.2.6 | E | 413 |
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| 1553 | For each value of SCAMIN which is Less than OR  Equal to the compilation scale of the data for the area. | SCAMIN value less than or equal to  compilation scale. | Amend SCAMIN  value. | 2.2.6 and 2.2.7 | E |  |
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| 1554b | For each meta object  where SCAMIN is Present. | SCAMIN present for a meta object. | Remove SCAMIN. | 2.2.7 | C | 57, 411, 412, 413, 414 |
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| 1605 | For each ICEARE feature object which is not  COVERED\_BY the  combined coverage of  LNDARE, UNSARE AND DEPARE feature objects of geometric primitive area. | ICEARE object not covered by  appropriate Group 1 objects. | Amend objects to  ensure Group 1  objects cover. | 4.7.10 | E | 411 |
| 1606 | For each COALNE feature object where CATCOA is Not equal to 6 (glacier  (seaward end)) AND which is COINCIDENT with an ICEARE feature object where CATICE is Equal to 5 (glacier). | COALNE object  without CATCOA = 6 touching an ICEARE object with CATICE = 5. | Populate CATCOA = 6 (glacier (seaward  end)) for the COALNE object. | 4.7.10 | W | 411 |

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ENC Validation Checks 52

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ENC Validation Checks 54

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ENC Validation Checks 56

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| 1671 | For each feature object of geometric primitive line which is COINCIDENT with an area feature object of the same feature object class AND has the same attribute values (excluding attributes SORIND,  SORDAT and SCAMIN). | | Line object touching area object of the  same class with the same attribute values except SORIND,  SORDAT and  SCAMIN. | | Remove unnecessary object. | | Logical  consistency | | W | 57, 411, 412, 413, 414 |
| 1672 | For each feature object of geometric primitive point which is COVERED\_BY an area feature object of the same class AND has the same attribute values AND is not a LNDARE, OBSTRN or WRECKS feature object. | | Point object within an area object of the  same class with the same attribute  values. | | Remove duplicate  object or amend  attributes accordingly. | | Logical  consistency | | E | 57, 411, 412, 413, 414 |
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ENC Validation Checks 57

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| 1679 | For each feature object where attributes of types enumerated ('E'), float ('F'), integer ('I') or code string ('A') have more than one value. | More than one value present for attributes of the following  types; enumerated ('E'), float ('F'),  integer ('I') or code string ('A'). | Remove unnecessary attribute values. | Appendix A, Ch.2 (2.1) | C | 57, 411, 412, 413, 414 |
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ENC Validation Checks 58

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ENC Validation Checks 59

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ENC Validation Checks 60

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ENC Validation Checks 61

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| 1720 | For each ICEARE feature object where VERACC or VERDAT is Present. | Prohibited attribute VERACC or  VERDAT populated for an ICEARE  object. | | Remove VERACC or VERDAT from  ICEARE object. | | 11.13.1 | E | 411 |
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ENC Validation Checks 62

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ENC Validation Checks 63

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| ~~1743~~ | *Check removed.* |  |  |  |  |  |
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ENC Validation Checks 64

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ENC Validation Checks 65

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| 1765b | For each M\_QUAL meta object that CONTAINS, OVERLAPS OR is WITHIN a M\_ACCY meta object. | M\_QUAL and  M\_ACCY objects  overlap. | Amend M\_QUAL or M\_ACCY objects to remove overlap. | 2.2.4.1 | W | 414? |
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ENC Validation Checks 66

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ENC Validation Checks 67

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ENC Validation Checks 68

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ENC Validation Checks 69

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| 1777 | For each collection object which references feature objects which do not exist in the cell. | | Collection object  references objects which do not exist within the cell. | Remove invalid  references. | 15 | E |
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ENC Validation Checks 70

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| 1784 | For each spatial object where the value of  HORDAT, POSACC or QUAPOS is Unknown**.** | | | HORDAT, POSACC or QUAPOS  populated with an unknown value. | | | Remove attribute from spatial object or  populate with a known value. | | | | Logical  consistency | | | W | 412, 413, 414 |

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ENC Validation Checks 71

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ENC Validation Checks 72

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| 1792 | If the cell crosses the 180° meridian. | Cell crosses the 180° meridian. | Split the cell at the  180° meridian. | 2.1.8.2 | C | 411, 412, 413, 414 |
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| 1795a | For each feature object which is a slave in a Master to Slave relationship AND where DATSTA or  PERSTA attributes are Known AND the values of DATSTA or PERSTA are Less than the values of DATSTA or PERSTA  encoded on the master object. | Temporal attributes on a slave object  extend beyond those on the master object. | Populate appropriate temporal attributes on master/slave objects. | 2.1.5 | C | 414? |
| --- | --- | --- | --- | --- | --- | --- |
| 1795b | For each feature object which is a slave in a Master to Slave relationship AND where PEREND or  DATEND attributes are Known AND the values of PEREND or DATEND are Greater than the values of PEREND or DATEND  encoded on the master object. | Temporal attributes on a slave object  extend beyond those on the master object. | Populate appropriate temporal attributes on master/slave objects. | 2.1.5 | C | 414? |
| 1795c | For each feature object which is a slave in a Master to Slave relationship AND where DATSTA is Known on the master object AND DATSTA is Not Present or Unknown on the slave  object. | DATSTA not  encoded for slave object of a master object where  DATSTA exists. | Populate temporal  attribute DATSTA on slave objects to match the master object. | 2.1.5 | C | 414? |
| 1795d | For each feature object which is a slave in a Master to Slave relationship AND where PERSTA is Known on the master object AND PERSTA is Not Present or Unknown on the slave  object. | PERSTA not  encoded for slave object of a master object where  PERSTA exists. | Populate temporal  attribute PERSTA on slave objects to match the master object. | 2.1.5 | C | 414? |
| 1795e | For each feature object which is a slave in a Master to Slave relationship AND where DATEND is Known on the master object AND DATEND is Not Present or Unknown on the slave  object. | DATEND not  encoded for slave object of a master object where  DATEND exists. | Populate temporal  attribute DATEND on slave objects to match the master object. | 2.1.5 | C | 414? |
| 1795f | For each feature object which is a slave in a Master to Slave relationship AND where PEREND is Known on the master object AND PEREND is Not Present or Unknown on the slave  object. | PEREND not  encoded for slave object of a master object where  PEREND exists. | Populate temporal  attribute PEREND on slave objects to match the master object. | 2.1.5 | C | 414? |
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ENC Validation Checks 74

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| 1798 | For each value of INFORM OR NINFOM which  contains more than 300 characters. | | INFORM or NINFOM contains more than 300 characters. | Amend value of  INFORM or NINFOM or use TXTDSC or  NTXTDS if  appropriate. | 2.3 | E | 411, 412, 413, 414 |
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| 1803 | For each Master to Slave relationship where  referenced feature objects have been populated with different values of SCAMIN. | | Objects which are in a Master to Slave relationship with  different values of SCAMIN. | Amend values of  SCAMIN to agree. | Logical  consistency | W | 413, 414, ? |
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| 3.5 Checks Relating to Allowable Attribute Values for Particular Feature Object Classes | | | | | | | |  |
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| **No** | **Check description** | | | **Check message** | **Check**  **solution** | **Conformity to:** | **Cat** | **Which S-41x** |
| 2000 | For each feature object where an attribute of type "L" (list) or type "E" (enumerated) is Present AND contains a value that is not listed in the table below for the given feature object class.  - x-y-z: Allowable values (alone or in a list);  \*: All the pre-defined attribute values as listed in S-57 Edition 3.1 – Appendix A, Chapter 2 are allowed;  #: The attribute is mandatory, and an Unknown value is allowed;  (#): The attribute is mandatory, but an Unknown value is prohibited (no logical sense). | | | Attribute value which is not permitted on an object. | Remove  disallowed  attribute  value. | Logical  consistency | E | 411, 412, 413, 414 |
|  | | | | | | | |  |
| Attribute | |  | Code | Allowable attribute values | |  |  |  |
| BCNSHP | |  | 2 |  | |  |  |  |
|  | | **BCNCAR** | 5 | \* # | |  |  |  |
|  | | **BCNISD** | 6 | \* # | |  |  |  |
|  | | **BCNLAT** | 7 | \* # | |  |  |  |
|  | | **BCNSAW** | 8 | \* # | |  |  |  |
|  | | **BCNSPP** | 9 | \* # | |  |  |  |
| Attribute | |  | Code | Allowable Attribute Values | |  |  |  |
| Beaufort Force | |  |  |  | |  |  |  |
|  | | **Light Air** | 1 | \* # | |  |  |  |
|  | | **Light Breeze** | 2 | \* # | |  |  |  |
|  | | **Gentle Breeze** | 3 | \* # | |  |  |  |
|  | | **Moderate Breeze** | 4 | \* # | |  |  |  |
|  | | **Fresh Breeze** | 5 | \* # | |  |  |  |
|  | | **Strong Breeze** | 6 | \* # | |  |  |  |
|  | | **Near Gale** | 7 | \* # | |  |  |  |
|  | | **Gale** | 8 | \* # | |  |  |  |
|  | | **Strong Gale** | 9 | \* # | |  |  |  |
|  | | **Storm** | 10 | \* # | |  |  |  |
|  | | **Violent Storm** | 11 | \* # | |  |  |  |
|  | | **Hurricane** | 12 | \* # | |  |  |  |
|  | | **Calm Wind** | 13 | \* # | |  |  |  |
| Wind Warning Threshold | |  |  |  | |  |  |  |
|  | | **Near Gale Warning** | 1 | \* # | |  |  |  |
|  | | **Gale Warning** | 2 | \* # | |  |  |  |
|  | | **Storm Warning** | 3 | \* # | |  |  |  |
|  | | **Hurricane Force Warning** | 4 | \* # | |  |  |  |
| Freezing Spray Warning  Threshold | |  |  |  | |  |  |  |
|  | | **Moderate Freezing Spray** | 1 | \* # | |  |  |  |
|  | | **Heavy Freezing Spray** | 2 | \* # | |  |  |  |
| Wave Height Warning Threshold | |  |  |  | |  |  |  |
|  | | **Six to Nine Meters** | 1 | \* # | |  |  |  |
|  | | **Nine to Fourteen Meters** | 2 | \* # | |  |  |  |
|  | | **Greater Than Fourteen Meters** | 3 | \* # | |  |  |  |

We can potentially add checks from other S-100 groups that apply here.