



# 8<sup>th</sup> MEETING OF THE S-100 WORKING GROUP

## Proposal on revising S-97 Part C

### Agenda Item 10.4d

S-100WG-8, Singapore, 13 - 17 November 2023



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# INTRODUCTION

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During the review and revision of S-100, it was found that S-97 also needs to be revised according to ISO 19157.



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# DISCUSSION AND RECOMMENDATIONS

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## It is recommended to:

a) Update the C 6.6 Positional Accuracy to maintain consistency within S-97 and with ISO 19157.

The recommended amendments are as follows:

Positional Accuracy is described by S-100 Part 4c – Metadata - Data Quality.

This is further subdivided into Absolute or External Accuracy (**including Vertical Position Accuracy and Horizontal Positional Accuracy**) , **Relative or internal accuracy** ~~Vertical Position Accuracy, Horizontal Positional Accuracy, Gridded Data Position Accuracy.~~

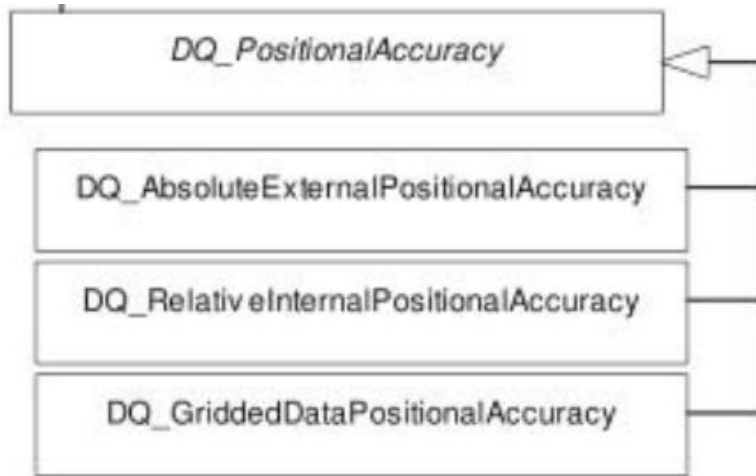


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# DISCUSSION AND RECOMMENDATIONS

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## ISO 19157



## S-97

### C-5.1 Data quality measures

Positional Accuracy is defined as the accuracy of the position of features within a spatial reference system. It consists of three Data Quality Elements:

- ☐ Absolute or external accuracy – closeness of reported coordinate values to values accepted as or being true;
- ☐ Relative or internal accuracy – closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true;
- ☐ Gridded data positional accuracy – closeness of gridded data spatial position values to values accepted as or being true.



b) The recommended amendments of table 7-1 are as follows:

## ① Amendments of **Absolute or External Accuracy**.

13	Positional Accuracy / Absolute or External Accuracy	Closeness of reported coordinative values to values accepted as or being true.	<b>RMSError</b> <del>Root Mean Square Error</del> / Standard deviation, where the true value is not estimated from the observations but known a priori.	spatial object / spatial object type	PS with objects that have coordinative values associated.
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## S-100 Part 4C

### RMSError[0..1] : Real

Standard deviation where the true value is not estimated from the observations but known a priori.

~~[Adapted from ISO 19138]~~ [Adapted from ISO 19157].

The Public Attribute is only used for vertical positional uncertainties.



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# DISCUSSION/RECOMMENDATIONS

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## ISO 19157

Table D.41 — Root mean square error

Line	Component	Description
1	Name	root mean square error
2	Alias	RMSE
3	Element name	absolute or external accuracy
4	Basic measure	not applicable
5	Definition	
6	Description	<p>The true value of an observable <math>Z</math> is known as <math>z_t</math>. From this, the estimator</p> $\sigma_z = \sqrt{\frac{1}{N} \sum_{i=1}^N (z_{mi} - z_t)^2}$ <p>yields to the linear root mean square error <math>RMSE = \alpha_z</math>.</p>
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	39



② Amendments of Vertical Position Accuracy.

14	Positional Accuracy / Vertical Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	<b>linearMapAccuracy3Sigma</b> <del>linearMapAccuracy2Sigma</del> / Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%.	spatial object / spatial object type	PS with objects that have coordinative values Associated.
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S-100 Part 4C

**linearMapAccuracy2Sigma[0..1] : Real**

Half length of the interval defined by an upper and lower limit in which the true value lies with probability **90%**. [~~Adapted from ISO 19138~~] [Adapted from ISO 19157].

The Public Attribute is only used for vertical positional uncertainties.

**linearMapAccuracy3Sigma[0..1] : Real**

Half length of the interval defined by an upper and lower limit in which the true value lies with probability **95%**. [~~Adapted from ISO 19138~~] [Adapted from ISO 19157].

The Public Attribute is only used for vertical positional uncertainties.



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# DISCUSSION/RECOMMENDATIONS

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## ISO 19157

Table D.38 — Linear map accuracy at 95 % significance level

Line	Component	Description
1	Name	linear map accuracy at 95 % significance level
2	Alias	LMAS 95 %
3	Element name	absolute or external accuracy
4	Basic measure	LE95 or LE95(r), depending on the evaluation procedure
5	Definition	half length of the interval defined by an upper and a lower limit, in which the true value lies with probability 95 %
6	Description	See <a href="#">G.3.2</a>
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	36

Table D.37 — Linear map accuracy at 90 % significance level

Line	Component	Description
1	Name	linear map accuracy at 90 % significance level
2	Alias	LMAS 90 %
3	Element name	absolute or external accuracy
4	Basic measure	LE90 or LE90(r), depending on the evaluation procedure
5	Definition	half length of the interval defined by an upper and a lower limit, in which the true value lies with probability 90 %
6	Description	See <a href="#">G.3.2</a>
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	35





③ Amendments of Horizontal Position Accuracy.

15	Positional Accuracy / Horizontal Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	<b>circularError95/Radius describing a circle in which the true point location lies with the probability of 95%.<del>linearMapAccuracy2Sigma/</del> Half length of the interval defined by an upper and lower limit in which the true value lies with probability 95%.</b>	spatial object / spatial object type	PS with objects that have coordinative values Associated.
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S-100 Part 4C

**linearMapAccuracy2Sigma[0..1] : Real**

Half length of the interval defined by an upper and lower limit in which the true value lies with probability 90%.

~~[Adapted from ISO 19138]~~ [Adapted from ISO 19157].

The Public Attribute is only used for vertical positional uncertainties.

**circularError95[0..1] : Real**

Radius describing a circle in which the true point location lies with the probability of 95%. ~~[Adapted from ISO 19138]~~ [Adapted from ISO 19157].

The Public Attribute is only used for horizontal positional uncertainties.



## ④ Add : Positional Accuracy / Relative or Internal Accuracy

16	Positional Accuracy / Relative or Internal Accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true.	relativeVerticalError/ An evaluation of the random errors of one relief feature to another in the same data set or on the same map/chart. It is a function of the random errors in the two elevations with respect to a common vertical datum. [Adapted from ISO 19157]	spatial object / spatial object type	PS with objects that have coordinative values associated.
17	Positional Accuracy / Relative or Internal Accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true.	relativeHorizontalError/ An evaluation of the random errors in the horizontal position of one feature to another in the same data set or on the same map/chart. [Adapted from ISO 19157]	spatial object / spatial object type	PS with objects that have coordinative values associated.



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# DISCUSSION/RECOMMENDATIONS

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## S-100 Part 4C

### **DQ\_RelativeInternalPositionalAccuracy**

Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true. [Per ISO 19115]

#### **Public Attributes:**

#### **relativeVerticalError[0..1] : Real**

An evaluation of the random errors of one relief feature to another in the same data set or on the same map/chart. It is a function of the random errors in the two elevations with respect to a common vertical datum. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.

#### **relativeHorizontalError[0..1] : Real**

An evaluation of the random errors in the horizontal position of one feature to another in the same data set or on the same map/chart. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.

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# DISCUSSION/RECOMMENDATIONS

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## ISO 19157

**Table D.54 — Relative vertical error**

Line	Component	Description
1	Name	relative vertical error
2	Alias	Rel LE90
3	Element name	absolute or external accuracy
4	Basic measure	not applicable
5	Definition	evaluation of the random errors of one relief feature to another in the same dataset or on the same map/chart  It is a function of the random errors in the two elevations with respect to a common vertical datum.

**Table D.55 — Relative horizontal error**

Line	Component	Description
1	Name	relative horizontal error
2	Alias	Rel CE90
3	Element name	absolute or external accuracy
4	Basic measure	not applicable
5	Definition	evaluation of the random errors in the horizontal position of one feature to another in the same data set or on the same map/chart



⑤ Amendments of Gridded Data Position Accuracy

18	Positional Accuracy / Gridded Data Position Accuracy	Closeness of reported coordinative values to values accepted as or being true.	<del>RMSErrorPlanimetry</del> <b>RMSErrorPlanimetry</b> <del>Root mean square error of planimetry</del> / Radius of a circle around the given point, in which the true value lies with probability P.	spatial object / spatial object type	PS with objects that have a gridded coordinative values associated.
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S-100 Part 4C

**RMSErrorPlanimetry[0..1] : Real**

Radius of a circle around a given point in which the true value lies with true value P. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.

**ISO 19157****Table D.49 — Root mean square error of planimetry**

Line	Component	Description
1	Name	root mean square error of planimetry
2	Alias	RMSEP
3	Element name	absolute or external accuracy
4	Basic measure	not applicable
5	Definition	radius of a circle around the given point, in which the true value lies with probability P

**Table D.49 (continued)**

Line	Component	Description
6	Description	The true values of the observed coordinates $X$ and $Y$ are known as $x_t$ and $y_t$ . From this the estimator
		$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n [(x_{mi} - x_t)^2 + (y_{mi} - y_t)^2]}$
		yields to the linear root mean square error of planimetry $RMSEP = \sigma$
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	47



⑥ Amendments of Temporal Consistency.

19	Temporal Quality / Temporal Consistency	<del>Correctness of ordered events or sequences, if reported. Consistency with time.</del>	<b>chronologicalOrder/ This data quality measure that indicate that an event is incorrectly ordered against the other events. [Adapted from ISO 19157]</b> <del>Correctness of ordered events or sequences, if reported.</del>	dataset/dataset series/spatial object type	PS with objects that have a time value associated.
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S-100 Part 4C

DQ\_TemporalConsistency

Correctness of ordered events or sequences, if reported. [Per ISO 19115]

Public Attributes:

**chronologicalOrder[0..1] : Boolean**

**This data quality measure indicates that an event is incorrectly ordered against the other events. This is a Boolean where TRUE indicates that the event is incorrectly ordered. [Adapted from ISO 19157].**

**ISO 19157****D.5.2 Temporal consistency**

One data quality measure for the data quality element temporal consistency is provided in [Table D.62](#).

**Table D.62 — Chronological order**

Line	Component	Description
1	Name	chronological order
2	Alias	-
3	Element name	temporal consistency
4	Basic measure	error indicator
5	Definition	indication that an event is incorrectly ordered against the other events
6	Description	-
7	Parameter	-
8	Value type	Boolean (true indicates that the event is incorrectly ordered)
9	Value structure	-
10	Source reference	-
11	Example	True (5 historical events are present in the data set but are not ordered correctly).
12	Identifier	159





⑦ Add : Temporal Quality / Temporal Validity and Temporal Quality / DQ\_AccuracyOfATimeMeasurement.

20	Temporal Quality / Temporal Validity	Validity of data with respect to time	numberOfNonConformantItems/ This data quality measure is a count of all items in the dataset that are not in conformance with their value domain. [Adapted from ISO 19157]	dataset/data set series/spatial object type.	PS with objects that have a time value associated.
21	Temporal Quality / DQ_Accuracy OfATimeMeasurement	Correctness of the temporal references of an item (reporting of error in time measurement)	attributeValueUncertainty3Sigma/ This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. [Adapted from ISO 19157]	dataset/data set series/spatial object type.	PS with objects that have a time value associated.



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# DISCUSSION/RECOMMENDATIONS

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## S-97

**Temporal Quality** is defined as the quality of the temporal attributes and temporal relationships of features. It consists of three Data Quality Elements:

- Accuracy of a time measurement – closeness of reported time measurements to values accepted as or known to be true;
- Temporal consistency – correctness of the order of events;
- Temporal validity – validity of data with respect to time.



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## S-100 Part 4C

### **DQ\_TemporalValidity**

Validity of data with respect to time. [Per ISO 19115]

#### **Public Attributes:**

#### **numberOfNonConformantItems[0..1] : Integer**

This data quality measure is a count of all items in the dataset that are not in conformance with their value domain. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.

### **DQ\_AccuracyOfATimeMeasurement**

Correctness of the temporal references of an item (reporting of error in time measurement). [Per ISO 19115]

#### **Public Attributes:**

#### **attributeValueUncertainty3Sigma[0..1] : Real**

This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.



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# DISCUSSION/RECOMMENDATIONS

Table D.59 — Time accuracy at 95 % significance level

Line	Component	Description
1	Name	time accuracy at 95 % significance level
2	Alias	-
3	Element name	accuracy of a time measurement
4	Basic measure	LE95 or LE95(r), depending on the evaluation procedure
5	Definition	half length of the interval defined by an upper and a lower limit, in which the true value for the time instance lies with probability 95 %
6	Description	See <a href="#">G.3.2</a>
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	57

ISO 19157

Table D.16 — Number of items not in conformance with their value domain

Line	Component	Description
1	Name	number of items not in conformance with their value domain
2	Alias	-
3	Element name	domain consistency
4	Basic measure	error count
5	Definition	count of all items in the data set that are not in conformance with their value domain
6	Description	-
7	Parameter	-
8	Value type	Integer
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	16



## ⑧ Add : Thematic Accuracy / Non-Quantitative Attribute Accuracy and Quantitative Attribute Accuracy

23	Thematic Accuracy / Non-Quantitative Attribute Accuracy	Correctness of non-quantitative attribute.	$\text{numberOfIncorrectAttributeValue} /$ This data quality measure is count of the total number of erroneous attribute values within the relevant part of the dataset. It is a count of all attribute values where the value is incorrect. [Adapted from ISO 19157]	dataset/data set series/spatial object type.	All S-100 based PS.
24	Thematic Accuracy / Quantitative Attribute Accuracy	Accuracy of a quantitative attribute.	$\text{attributeValueUncertainty3Sigma} /$ This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. [Adapted from ISO 19157]	dataset/data set series/spatial object type.	All S-100 based PS.



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# DISCUSSION/RECOMMENDATIONS

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## S-97

**Thematic Accuracy** is defined as the accuracy of quantitative attributes and the correctness of non-quantitative attributes and of the classifications of features and their relationships. It consists of three Data Quality Elements:

- Classification correctness – comparison of the classes assigned to features or their attributes to a Universe of Discourse (for example ground truth or reference data);
- Non-quantitative attribute correctness – measure of whether a non-quantitative attribute is correct or incorrect;
- Quantitative attribute accuracy – closeness of the value of a quantitative attribute to a value accepted as or known to be true.



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# DISCUSSION/RECOMMENDATIONS

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## S-100 Part 4C

### **DQ\_NonQuantitativeAttributeAccuracy**

Correctness of non-quantitative attribute. [Per ISO 19115]

#### **Public Attributes:**

#### **numberOfIncorrectAttributeValues[0..1] : Integer**

This data quality measure is count of the total number of erroneous attribute values within the relevant part of the dataset. It is a count of all attribute values where the value is incorrect. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.

### **DQ\_QuantitativeAttributeAccuracy**

Accuracy of a quantitative attribute. [Per ISO 19115]

#### **Public Attributes:**

#### **attributeValueUncertainty3Sigma[0..1] : Real**

This data quality measure indicates the attribute value of uncertainty where half the length of the interval defined by an upper and lower limit in which the true value for the quantitative attribute lies with a probability of 95%. ~~[Adapted from ISO 19138]~~ **[Adapted from ISO 19157]**.



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# DISCUSSION/RECOMMENDATIONS

Table D.74 — Attribute value uncertainty at 95 % significance level

Line	Component	Description
1	Name	Attribute value uncertainty at 95 % significance level
2	Alias	-
3	Element name	quantitative attribute accuracy
4	Basic measure	LE95 or LE95(r), depending on the evaluation procedure
5	Definition	half length of the interval defined by an upper and a lower limit, in which the true value for the quantitative attribute lies with probability 95 %
6	Description	see <a href="#">G.3.2</a>
7	Parameter	-
8	Value type	Measure
9	Value structure	-
10	Source reference	-
11	Example	-
12	Identifier	71

ISO 19157

Table D.68 — Number of incorrect attribute values

Line	Component	Description
1	Name	number of incorrect attribute values
2	Alias	-
3	Element name	non-quantitative attribute correctness
4	Basic measure	error count
5	Definition	total number of erroneous attribute values within the relevant part of the data set
6	Description	count of all attribute values where the value is incorrect
7	Parameter	-
8	Value type	Integer
9	Value structure	-
10	Source reference	-
11	Example	5 (5 geographical names are misspelled)
12	Identifier	65





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# **ACTION REQUIRED OF DQWG**

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**The S-100WG is invited to:**

- a. **Note** the information provided.