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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



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ISO/DIS 7673-2

Agricultural field operations data — Part 2: Observations and measurements

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 23, Tractors and machinery for agriculture and forestry, Subcommittee SC 19, Agricultural electronics.

A list of all parts in the ISO 7673 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Agriculture, and agrifood systems in general, are under pressure to be more demonstrably principled and data-driven. Ever-growing pressure from regulators and business partners makes it increasingly necessary for crop and livestock producers, food, feed, fiber and fuel manufacturers, distributors and retailers, and the input providers for all of these stakeholders, to collect data that can be used to justify actions taken, drive decisions based on sound scientific principles, and maximize the efficiency of their business processes.

Observations and measurements (O&M) have a very important role in enabling a principled, data-driven approach to agrifood systems. Examples of O&M in agrifood systems include:

- Soil fertility laboratory measurements performed before planting.
 - Soil survey maps, which serve multiple agronomic purposes, can also be expressed as a collection of O&M data.
- Observations of soil moisture, temperature and trafficability, performed to determine if a crop can be planted.
 - Weather forecasts also represent a special case within the model of O&M.
- Once the crop is growing, fields are scouted for pests, diseases and signs of water-, heat-, or other abiotic stress.
- Determine the development stage of a growing crop, including whether it is ready to harvest.
- Post-harvest processes are also rich in O&M, such as the quality properties (e.g., moisture content, protein content, starch content, fiber length, percent broken grains) of a harvested commodity, and the environmental variables (e.g., temperature, humidity, oxygen and ethylene content) in the facilities and vehicles where a harvested commodity is stored, ripened, transported, and so forth.

Accurately and unambiguously representing these O&M in digital form is very important to enable data-driven, principled decision-making in the agrifood industry at scale. This capability has been advanced significantly with standards such as ISO 11783-10 and ISO 15143-3 for the subset of agricultural data produced by agricultural machinery such as planters, sprayers and harvesters, the domain of agrifood O&M as exemplified above is larger than what can be covered by those standards.

ISO has developed an abstract standard for representing O&M, ISO 19156. That standard, along with related ones such as ISO 19115 and ISO 19157 provides a comprehensive framework that systematizes the different aspects of O&M that must be represented to communicate accurately and unambiguously without loss of meaning. As described in ISO 19156 itself, however, additional work is necessary for the abstract concepts presented therein to be applicable to a specific domain (agrifood systems, in this case).

This standard ISO 7673-2 is an implementation standard for ISO 19156, providing a common data model and language that enable integration of the disparate sources of O&M information typically used in agrifood systems.

Agricultural field operations data —

Part 2: Observations and measurements

1 Scope

The purpose of this part of the standard is to enable the representation and exchange of observations and measurements (O&M) data (e.g., weather, soil moisture, crop scouting, crop quality measurements, food product properties), currently stored in a variety of proprietary original equipment manufacturer (OEM) formats, using an industry-wide data model that can be used by agrifood systems in general and digital agriculture (e.g, irrigation) data analysis and prescription-making programs in particular. This implementation is based on the ISO 19156 Standard for Observations and Measurements.

The scope of this standard is primarily discrete observations of environmental (or other agrifood-related) variables along with the metadata, data quality elements and semantic resources necessary for their use in agrifood systems. This standard should enable a developer to represent observations and measurements accurately and unambiguously in terms of a set of objects adapted from the ISO 19156 standard.

1.1 How the standard is structured

The specific material begins with a review of the ISO 19156 standard in clause 5, providing agrifood examples and guiding principles for what follows.

Clause 6 goes deeper into the specifics of the implementation, describing the basic classes used to exchange observations & measurements data.

Clause 7 describes how the meaning of an observation is represented in this standard and the semantic resources needed to do so at scale.

Clause 8 describes additional reference data used to describe equipment, as well as a quick review of master/setup data presented in Part 1 of this standard.

Clause 9 brings together the concepts described above using a set of examples.

Clause 10 provides additional implementation notes.

Annex A presents a sample set of controlled vocabularies for code components, semantic resources that can be used to enrich observations.

Annex B presents a sample set of controlled vocabularies for *code components*, semantic resources that can be used to enrich observations.

1.2 Implementing ISO 19156 for agrifood systems

The ISO 19156 standard provides a fundamental, albeit abstract framework for representing observations and measurements. Implementing ISO 19156 in a specific domain involves adding the necessary detail to support the processes, and required data exchange, in that domain. This ISO 7673-2 standard provides the subset of concepts and elements from ISO 19156 employed to support activities in the agrifood (agriculture & food) sector. This includes data pertaining to weather and soil conditions, plant health, pest and disease presence, and so forth. A special emphasis is placed on the data needed to support data-rich irrigation activities. Note that "observations" of the application of irrigation water, i.e., those recording the irrigation activity itself, are documented in Part 3 of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6709:2022, *Standard representation of geographic point location by coordinates*

ISO 8601-1:2019, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO 9834-8:2014, *Information technology — Procedures for the operation of object identifier registration authorities — Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

ISO 19107:2019, *Geographic information — Spatial schema*

ISO 19112:2019, *Geographic information — Spatial referencing by geographic identifiers*

ISO 19156:2011, *Geographic information — Observations and Measurements*

Agrisemantics <https://>

Dublin Core™ Metadata Element Set, Version 1.1: Reference Description, <https://www.dublincore.org/specifications/dublin-core/dces/>

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

aggregation method

Describes the statistic used to derive a reported observation result from a sample distribution. This is especially relevant in the context where a reported observation (e.g., an hourly average air temperature) is derived from a set of shorter (e.g., 10-second) sampling observations.

3.2

alias

An *identifier* ([3.22](#)), not necessarily globally unique, but considered unique within the boundaries of a system (for example, a farmer's farm management information system software), that is used to identify a resource (a device, a farm, a field, etc.) or a data record within that system.

Note 1 to entry: This standard seeks to associate globally unique identifiers to resources and data records, as one mechanism to eliminate ambiguity. Matching up aliases in incoming *observations* ([3.28](#)) with their corresponding unique identifiers is one of the challenges of processing observations data.

3.3

class

description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: ISO/IEC 19505-2:2012, 7.3.7]

3.4

code component

A small unit of metadata, used as a building block for an observation code. Describes some aspect of an observation (e.g., observed property, feature of interest, *observation procedure*, [3.33](#)). Can also be used as a parameter of an observation, or to provide an observation with more meaning than is expressed in its observation code.

3.5**code component definition**

A data record, assumed to be housed in a registry, containing a machine-readable description of the small unit of metadata, used as a building block for an observation code. Describes some aspect of an observation (e.g., observed property, feature of interest, *observation procedure*, [3.33](#)). Can also be used as a parameter of an observation.

3.6**configuration data**

the information that specifies the particular state of specific instances of things such as farm equipment and instruments (e.g. soil sensors, irrigation pivots, combines)

3.7**data logger**

device that can read various types of electrical signals and record the data in internal memory for later transmission by telemetry or downloaded to a laptop or memory card

[SOURCE: ISO 772:2022, 7.29]

3.8**data quality**

degree to which a set of inherent characteristics of data fulfils requirements

[SOURCE: ISO 19157-1: 2023 (en), 3.7]

3.9**data quality element**

a component describing a certain aspect of the quality of geographic data. The descriptors of a data quality element are the measure (the type of evaluation, i.e., data quality variable, being evaluated), the evaluation method, and the result.

[SOURCE: ISO 19157-1: 2023(en), 7.3, 7.4]

3.10**data stream**

The result of encoding a data set into a continuous set of packets, as opposed to the bulk or batch form.

3.11**data type**

domain of values

EXAMPLE Integer, Real, Boolean, String, and Date are all data types.

Note 1 to entry: The data types shown above are simple data types. It is possible to describe complex data types derived from them; for example, an enumerated data type can be composed of a finite set of specific strings that represent valid crops such as EPPO codes (EPPO, 2021).

Note 2 to entry: Complex data types can be composed by grouping more than one data type. For example, the wet yield property of a harvested commodity can be considered a data type that includes a numeric (e.g., real) value, and an enumerated value such as a unit of measure code.

[SOURCE: ISO 10303-11:2004, 3.3.5]

3.12**dataset**

identifiable collection of data.

[SOURCE: ISO 19115-1:2014(en), 4.3]

Note 1 to entry: Note1 to entry: Datasets are created for a specific use or purpose. As such, they are often attributed with metadata and *data quality* ([3.8](#)) measures. Especially when produced as a result of a Data Product Specification.

3.13 device

A physical or logical entity that is used to produce or consume data.

3.14 dimension

expression of the dependence of a quantity on the base quantities (see table in Note 5 below) of a system of quantities as a product of powers of factors corresponding to the base quantities, omitting any numerical factor (Adapted from ISO 80000-1:2009, 3.7)

EXAMPLE 1 In the International System of Quantities (ISQ), the quantity dimension of force is denoted by $\dim F = LMT^{-2}$.

EXAMPLE 2 In the same system of quantities, $\dim \rho B = ML^{-3}$ is the quantity dimension of mass concentration of component B , and ML^{-3} is also the quantity dimension of mass density, ρ .

EXAMPLE 3 The period, T , of a particle pendulum of length l at a place with the local acceleration of free fall g is

$$T = 2\pi\sqrt{l/g} \quad \text{or} \quad T = C(g)\sqrt{l} \quad \text{where} \quad C(g) = 2\pi/\sqrt{g}$$

Hence $\dim C(g) = T \cdot L^{-1/2}$.

Note 1 to entry: A power of a factor is the factor raised to an exponent. Each factor is the dimension of a base quantity.

Note 2 to entry: The conventional symbolic representation of the dimension of a base quantity is a single upper case letter in roman (upright) type. The conventional symbolic representation of the dimension of a derived quantity is the product of powers of the dimensions of the base quantities according to the definition of the derived quantity. The dimension of a quantity Q is denoted by $\dim Q$.

Note 3 to entry: In deriving the dimension of a quantity, no account is taken of its scalar, vector, or tensor character.

quantities of the same kind have the same quantity dimension,

quantities of different quantity dimensions are always of different kinds, and

quantities having the same quantity dimension are not necessarily of the same kind.

Note 4 to entry: In a given system of quantities,

Note 5 to entry: Symbols representing the dimensions of the base quantities in the ISQ are:

Base quantity	Symbol for dimension
Length	L
Mass	M
Time	T
electric current	I
thermodynamic temperature	θ
amount of substance	N
luminous intensity	J

Thus, the dimension of a quantity Q is denoted by $\dim Q = L^\alpha M^\beta T^\gamma I^\delta \theta^\epsilon N^\zeta J^\eta$ where the exponents, named dimensional exponents, are positive, negative, or zero. Factors with exponent zero and the exponent 1 are usually omitted. When all exponents are zero, see ISO 80000-1:2009, 3.8 ("dimensionless quantity").

Note 6 to entry: Adapted from ISO/IEC Guide 99:2007, definition 1.7, in which Note 5 and Examples 2 and 3 are different and in which "dimension of a quantity" and "dimension" are given as admitted terms.

3.15 direct position

position described by a single set of coordinates within a coordinate reference system.

[SOURCE: ISO 19129:2009(en), 4.1.11]

**3.16
element**

XML (3.58) element; bounded component of the logical structure of an XML document that has a type and that may have XML attributes and content

Note 1 to entry: This definition pertains only to XML elements. This standard also uses the term “element” to refer to *system elements* (3.52). Use context to distinguish between the two.

[SOURCE: ISO 10303-28:2007, 3.3.1]

**3.17
enumeration item**

A single entity that is a member of a fixed set or controlled vocabulary.

**3.18
extensible markup language**

Text-based data description language used for exchanging data on the Internet

[SOURCE: ISO 19847:2018, 3.13]

**3.19
feature**

abstraction of real-world phenomena. In this standard it will represent some part of the world that is the object of an observation: the feature of interest.

[SOURCE: ISO 19101:2002, 4.11]

**3.20
feature of interest**

subject of the observation

[SOURCE: ISO 19156:2023(en), 3.8]

**3.21
gazetteer**

register of location instances of one or more location sub-types, containing some information regarding position

Note 1 to entry: The positional information need not be coordinates, but could be descriptive.

[SOURCE: ISO 19112:2019(en), 3.1.1]

**3.22
identifier**

linguistically independent sequence of characters capable of uniquely and permanently identifying that with which it is associated

[SOURCE: ISO 19135-1: 2015, 4.1.5]

**3.23
incoming observation**

Data corresponding to an Observation object received by a processing system. That Observation may be fully self-contained (i.e., not needing anything other than data type definitions for its meaning to be fully understood) or not. If the latter, it may be necessary to use ObservationConfiguration objects to store the missing metadata so it can be added when data are received.

**3.24
integration partner**

A third-party that enables a data exchange connection between its system and those of customers and other stakeholders.

3.25

measurement

set of operations having the purpose of determining the value of a quantity

[SOURCE: ISO/TS 19101-2:2018, 4.20]

3.26

metadata

data about a resource

[SOURCE: ISO 19115-1:2014, 4.10]

3.27

object

Instance of a class (4.3).

3.28

observation

the act of measuring or otherwise determining the value of a property.

[SOURCE: ISO 19156:2011, 4.11]

3.29

observation code

This standard works under the assumption that at its simplest, and where spatial and temporal context are managed, an Observation is essentially a key-value pair. The observation code, i.e., the key in that simplified model, represents the meaning of the observation.

3.30

observation code definition

A data record, assumed to be housed in a registry, containing a set of machine-readable descriptions of small units of metadata (e.g., code components), used to describe the meaning of an observation (e.g., observed property, feature of interest, *observation procedure*, [3.33](#)), and represented by an observation code.

3.31

observation collection

A data object that can group related observations and express the properties those observations have in common. This can be done for the purposes of facilitating search, or for reducing transmission bandwidth requirements (by removing the common properties from the child Observations and leaving them in the collection).

Note 1 to entry: Observation collections provide context to observations as per the ISO 19156 model.

3.32

observation configuration

A class or object that provides state-dependent metadata to complete the meaning of an observation. Can include an observation code, a unit of measure code, a geographical extent, and CodeComponent instances. Is represented by, and referred to, using an observation configuration code\, which shall be unique, at least within the scope of the document it is contained in.

3.33

observation procedure

method, algorithm or instrument, or system of these, which may be used in making an observation

[SOURCE: ISO 19156:2011, 4.12]

3.34**observed property**

This is a property of the feature of interest wherein the process of observing the feature of interest results in a value that, generally speaking, quantifies (or categorizes) the property.

EXAMPLE (from ISO 19156, 7.2.2.12): A feature type “Pallet” might be defined as having the property “mass” of type “Measure”. An observation providing the value of this property shall have `observedProperty=“mass”`, the result shall be of the type “Measure” and the scale (unit of measure) shall be suitable for mass measurements.

Note 1 to entry: While ISO 19156 does not define observed property as a term, the object model for Observation does include a property called “observedProperty”. 7673-2 uses the term “observed property” in a way consistent with the meaning of the property `Observation::observedProperty` described in 19156.

3.35**observation result**

estimate of the value of a property determined through a known *observation procedure* ([3.33](#))

[SOURCE: ISO 19156:2011, 4.14]

3.36**parameter**

Optional key-value pairs that form part of an observation and help contextualize its result. Parameters may indicate the value of an environmental variable, a setting of an instrument, etc.

EXAMPLE The depth underground at which a soil water content observation is made.

3.37**property**

facet or attribute of an object referenced by a name

[SOURCE: ISO 19156:2011, 4.15]

3.38**proximate feature of interest**

entity that is directly of interest in the act of observing

Note 1 to entry: This is a specialized form of the feature-of-interest.

[SOURCE: ISO 19156:2023(en), 3.20]

3.39**quantity**

property of a phenomenon, body, or substance, where the property has a magnitude that can be expressed as a number and a reference.

Note 1 to entry: A reference can be a *measurement* ([3.25](#)) unit, a measurement procedure, a reference material, or a combination of such.

[SOURCE: ISO/TS 19159-2:2016, 4.30]

3.40**record**

Related data treated as a unit of information.

[SOURCE: ISO/IEC 18809:2000(en), 4.35]

3.41**reference data**

the information that a manufacturer makes available for the purchase, setup and/or use of their products.

3.42

register

set of files containing *identifiers* (3.22) assigned to items with descriptions of the associated items

[SOURCE: ISO 19135-1: 2015, 4.1.9]

3.43

registry

information system on which a *register* (3.42) is maintained

[SOURCE: ISO 19135-1: 2015, 4.1.13]

3.44

sample

object that is representative of a concept, real-world object or phenomenon

[SOURCE: ISO 19156:2023(en), 3.22]

3.45

sampling method

Describes the mechanisms whereby a set of results (of the same observed property on the same feature of interest, using the same observation method) is collected into a *sample* (3.44), which can be described by a sample distribution.

3.46

sampling period

Describes the time interval over which a set of results (of the same observed property on the same feature of interest, using the same observation method) is collected into a *sample* (3.44), described by a sample distribution.

3.47

scale

kind of relation that is used to classify relations between physical properties and numbers, thus indicating a method for quantifying sizes or extents of aspects by mathematical values or ranges

Note 1 to entry: A scale is meant to provide a mechanism to relate quantitative aspects (physical properties) to numbers or ranges that represent the sizes or intensities of the aspects on the scale. The number 1 on a scale is a unit of measure that refers to a (standard) reference value of the kind of aspect for which the scale is meant.

EXAMPLE length scale, velocity scale, temperature scale

Note 2 to entry: Qualitative scales are usually called units of measure. They are subtypes of scale.

[SOURCE: ISO 16354:2013(en)]

3.48

semantic resource

A data type definition, implemented as a *Class* (3.3), the instances of which exist in a semantic infrastructure. These definitions can be simple (e.g., describing the meaning of a temperature represented as a real value) or complex (describing an enumeration as part of a controlled vocabulary).

3.49

sensor

element of a measuring system that is directly affected by a phenomenon, body, or substance carrying a quantity to be measured

[SOURCE: ISO/IEC GUIDE 99:2007, 3.8]

3.50**setup data**

the information needed to set up data exchange between the grower and machinery or other actors (e.g., crop advisors.) Unlike Reference Data, it is producer-specific, and includes the description of resources such as fields, cropzones, and devices, albeit without including state information (such as where a sensor may be installed at a given time).

3.51**system**

set or series of interconnected or interdependent parts or entities that act together in a common purpose or produce results that are impossible by the action of one alone

[SOURCE: ISO 17966:2016]

3.52**system element**

Member of a set of entities that constitute a system

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.47]

3.53**ultimate feature of interest**

entity that is ultimately of interest in the act of observing

[SOURCE: ISO 19156:2023(en), 3.25]

3.54**uniform resource identifier (URI)**

unique identifier for a resource, structured in conformance with IETF RFC 2396

[SOURCE: ISO 19136-1:2020(en)]

3.55**(UUID)****universally unique identifier (UUID)**

128-bit number used to guarantee unique identification (3.2.1.26) for different objects (3.1.1.01) on the internet (3.1.9.01) over time

[SOURCE: ISO 5127:2017(en)]

3.56**unique identifier**

Identifier (3.22) which is guaranteed to be unique among all identifiers used for those objects and for a specific purpose

[SOURCE: ISO 29404:2015, 3.26]

3.57**value**

element of a type domain

Note 1 to entry: A value considers a possible state of an object within a class or type (domain).

Note 2 to entry: A data value is an instance of a datatype, a value without identity.

Note 3 to entry: A value can use one of a variety of *scales* (3.47) including nominal, ordinal, ratio and interval, spatial and temporal. Primitive datatypes can be combined to form aggregate datatypes with aggregate values, including vectors, tensors and images.

Note 4 to entry: This standard will represent values as strings, and use the information provided about the value's meaning (observed property, *observation procedure* (3.33), etc.) to help interpret that string.

Note 5 to entry: This initial version of the standard does not provide specific allowances for representing spatially-dense coverages (e.g. observations that can be expressed as gridded data) as anything other than key-value pairs associated with spatial extent.

[SOURCE: ISO 19156:2011, 4.18]

3.58

XML

see *extensible markup language* ([3.18](#))

4 Symbols (and abbreviated terms)

None

4.1 Note on multiplicity of properties

This standard defines an abstract object model. The standard utilizes UML diagrams to *specify* the classes and their properties. The body text of the document *describes* the properties. For the reader's convenience, we have included the multiplicity specification in the body text of each classes' description. [Table 1](#) shows the UML multiplicity specification and its meaning, as used in the body text of this standard. When the multiplicity is not shown (in the diagram or the description), the multiplicity shall be assumed as [\[1\]](#).

Table 1 — Multiplicity codes

Text	Meaning
[0..1]	The property is optional and may appear only once
[1]	The property is required and shall appear only once
[0..*]	The property is optional and may appear any number of times
[1..*]	The property is required and may appear any number of times

5 Basic concepts about observations

5.1 Fundamentals of observations

This ISO 7673-2 standard is derived directly from the object model defined in ISO 19156. The following clauses reiterate the salient components of the Observation and related classes and provide context for the implementation of 19156's abstract model within the agrifood systems domain.

5.2 Attributes of an ISO 19156 Observation

The Observation class has five properties (shown inside the box representing the Observation class in the UML diagram of [Figure 1](#)):