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oSIST prEN ISO 19111:2006

februar 2006

Geografske informacije - Lociranje s koordinatami (ISO/DIS 19111:2005)

Geographic information - Spatial referencing by coordinates (ISO/DIS 19111:2005)

ICS 07.040; 35.240.70

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English Version

Geographic information - Spatial referencing by coordinates (ISO/DIS 19111:2005)

Information géographique - Système de références spatiales par coordonnées (ISO/DIS 19111:2005)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 287.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (prEN ISO 19111:2005) has been prepared by Technical Committee ISO/TC 211 "Geographic information/Geomatics" in collaboration with Technical Committee CEN/TC 287 "Geographic Information", the secretariat of which is held by NEN.

This document is currently submitted to the parallel Enquiry.

This document will supersede EN ISO 19111:2005.

Endorsement notice

The text of ISO 19111:2005 has been approved by CEN as prEN ISO 19111:2005 without any modifications.

DRAFT INTERNATIONAL STANDARD ISO/DIS 19111

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Voting begins on: **2005-11-03**

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Geographic information — Spatial referencing by coordinates

Information géographique — Système de références spatiales par coordonnées

[Revision of first edition (ISO 19111:2003)]

ICS 35.240.70

ISO/CEN PARALLEL ENQUIRY

The CEN Secretary-General has advised the ISO Secretary-General that this ISO/DIS covers a subject of interest to European standardization. **In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, consultation on this ISO/DIS has the same effect for CEN members as would a CEN enquiry on a draft European Standard.** Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

In accordance with the provisions of Council Resolution 15/1993 this document is circulated in the English language only.

Conformément aux dispositions de la Résolution du Conseil 15/1993, ce document est distribué en version anglaise seulement.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19111 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

This second edition cancels and replaces the first edition (ISO 19111:2003), which has been technically revised.

Introduction

Geographic information contains spatial references which relate the features represented in the data to positions in the real world. Spatial references fall into two categories:

— those using coordinates;

— those based on geographic identifiers.

Spatial referencing by geographic identifiers is defined in ISO 19112. This International Standard describes the structured metadata required for spatial referencing by coordinates.

This International Standard describes the elements that are necessary to fully define various types of coordinate systems and coordinate reference systems applicable to geographic information. The subset of elements required is partially dependent upon the type of coordinates. This International Standard also includes optional fields to allow for the inclusion of non-essential coordinate reference system information. The elements are intended to be both machine and human readable.

In this International Standard, a *coordinate* is one of *n* scalar values that define the position of a single point. In other contexts the term *ordinate* is used for a single value and coordinate for multiple ordinates. Such usage is not part of this International Standard.

A *coordinate tuple* is an ordered list of *n* coordinates that define the position of a single point. The coordinate tuple is composed of one, two or three spatial coordinates. The coordinates are mutually independent and their number is equal to the dimension of the coordinate space.

EXAMPLE A coordinate tuple cannot contain two heights.

Coordinates are ambiguous until the system to which those coordinates are related has been fully defined. Without the full specification of the system, coordinates are ambiguous at best and meaningless at worst. A *coordinate reference system* (CRS) defines the coordinate space such that the coordinate values are unambiguous. The order of the coordinates within the coordinate tuple and their unit(s) of measure are parts of the coordinate reference system definition.

For some interchange purposes it is sufficient to confirm the identity of the coordinate reference system without necessarily having its definition.

In this International Standard, a *coordinate set* is a collection of coordinate tuples. All coordinate tuples within a coordinate set should be referenced to the same coordinate reference system. A CRS identification or definition in accordance with this International Standard should be associated with every coordinate tuple. If only one point is being described the association between coordinate tuple and coordinate reference system may be direct but for a coordinate set one CRS identification or definition is associated with the coordinate set and all coordinate tuples in that coordinate inherit the association. The semantic meaning of coordinate tuple and coordinate set is reflected in the modelling of classes DirectPosition and GM_Object in ISO 19107.

The conceptual relationship between coordinates describing the spatial location of a feature and coordinate reference system is shown in Figure 1.

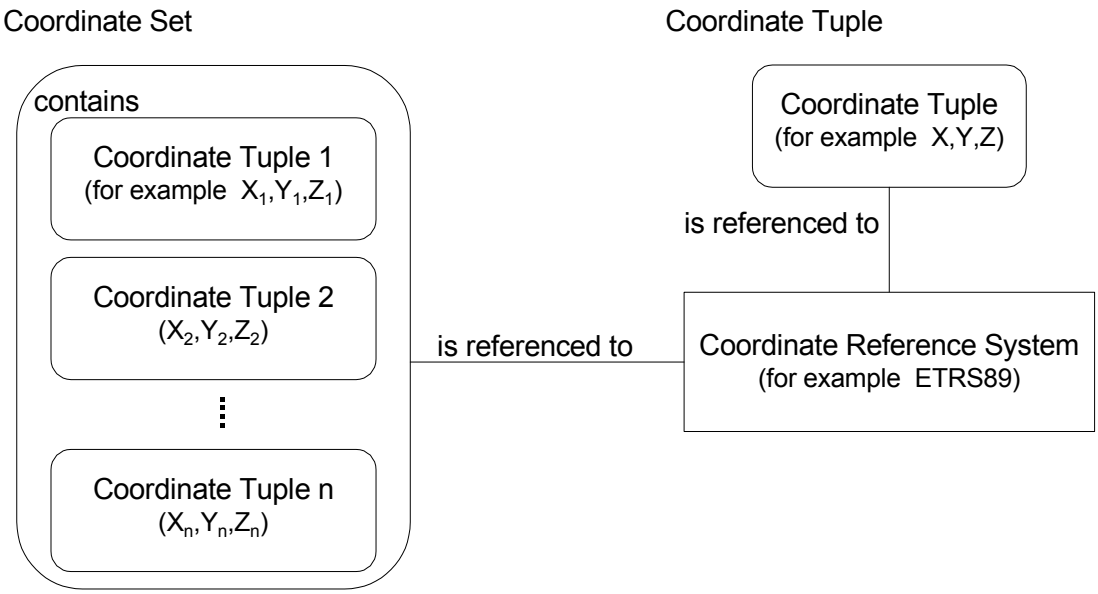


Figure 1 — Conceptual relationship of coordinates to coordinate reference system

In this International Standard a coordinate reference system is comprised of one coordinate system and one datum (see Figure 2).

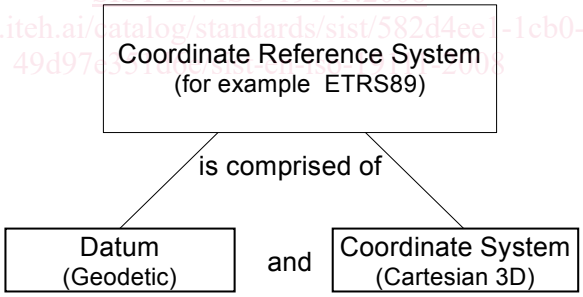
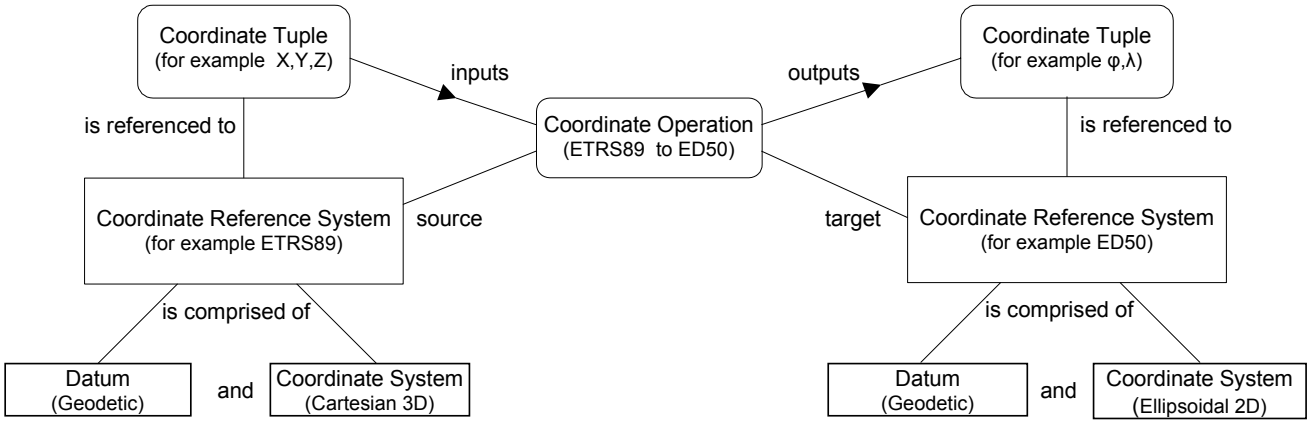


Figure 2 — Conceptual model of a coordinate reference system

The traditional separation of horizontal and vertical position outlined in Annex D has resulted in coordinate reference systems that are horizontal (2D) and vertical (1D) in nature, as opposed to truly 3-dimensional. It is established practice to define a 3-dimensional position by combining the horizontal coordinates of a point with a height or depth from a different coordinate reference system. In this International Standard this concept is defined as a compound coordinate reference system.

In addition to describing a coordinate reference system, this International Standard provides for the description of a coordinate transformation or a coordinate conversion between two different coordinate reference systems. With such information, spatial data referred to different coordinate reference systems can be related to one specified coordinate reference system. This facilitates spatial data integration. Alternatively an audit trail of coordinate reference system manipulations can be maintained. Although the position is unchanged the coordinate values will generally be different. The high level abstract model for spatial

referencing by coordinates is shown in Figure 3. The coordinate transformation or coordinate conversion operates on coordinates, not on coordinate reference systems. Coordinate operation has been modelled in ISO 19107 by the operation "Transform" of the GM_Object class.



NOTE A coordinate operation may be single or concatenated. Refer to Clause 11.

Figure 3 — Conceptual model for spatial referencing by coordinates

The description of quality of a spatial reference is covered by the provisions of ISO 19115.

The concept of coordinates may be expanded from a strictly spatial context to include time. ISO 19108 describes temporal schema. Time may be added as a temporal coordinate reference system within a compound coordinate reference system. It is even possible to add two time-coordinates, provided the two coordinates describe different independent quantities.

EXAMPLE The time/space position of a subsurface point of which the vertical coordinate is expressed as the two-way travel time of a sound signal in milliseconds, as is common in seismic imaging. A second time-coordinate indicates the time of observation, usually expressed in whole years.

Certain scientific communities use three-dimensional systems where horizontal position is combined with a non-spatial parameter. In these communities the parameter is considered to be a third, vertical, axis. The parameter, although varying monotonically with elevation or depth, does not necessarily vary in a simple manner thus conversion from the parameter to height or depth is non-trivial. The parameters concerned are normally absolute measurements and the datum is taken with reference to a direct physical measurement of the parameter. These non-spatial parameters are beyond the scope of this International Standard. However the modelling constructs described within this International Standard may be applied through a profile specific to a community.

Geographic information — Spatial referencing by coordinates

1 Scope

This International Standard defines the conceptual schema for the description of spatial referencing by coordinates, optionally extended to spatio-temporal referencing. It describes the minimum data required to define 1-, 2- and 3-dimensional spatial coordinate reference systems with an extension to merged spatial-temporal reference systems. It allows additional descriptive information to be provided. It also describes the information required to change coordinate values from one coordinate reference system to another.

In this International Standard, a coordinate reference system shall not change with time. For coordinate reference systems defined on moving platforms such as cars, ships, aircraft and spacecraft, the transformation to an earth-fixed coordinate reference system may include a time element.

This International Standard is applicable to producers and users of geographic information. Although it is applicable to digital geographic data, its principles can be extended to many other forms of geographic data such as maps, charts, and text documents.

The schema described may be applied to the combination of horizontal position with a third non-spatial parameter which varies monotonically with height or depth. This extension to non-spatial data is beyond the scope of this International Standard but may be implemented through profiles.

2 Conformance requirements

This International Standard defines two classes of conformance, Class A for conformance of coordinate reference systems and Class B for coordinate operations between two coordinate reference systems. Any coordinate reference system claiming conformance to this International Standard shall satisfy the requirements given in Annex A, Clause A.1. Any coordinate operation claiming conformance to this International Standard shall satisfy the requirements given in Annex A, Clause A.2.

3 Normative references

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

ISO 1000, *SI units and recommendations for use of their multiples and of certain other units*

ISO/TS 19103, *Geographic information — Conceptual schema language*

ISO 19108, *Geographic information — Temporal schema*

ISO 19115, *Geographic information — Metadata*

Normative reference to ISO 19115 is restricted as follows. In this International Standard normative reference to 19115 excludes the MD_CRS class and its component classes. ISO 19115 class MD_CRS and its component, aggregated, classes specify descriptions of coordinate reference systems elements. These elements are modelled in this International Standard.

4 Terms and definitions

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

4.1
affine coordinate system
coordinate system in Euclidean space with straight axes that are not necessarily mutually perpendicular

4.2
Cartesian coordinate system
coordinate system which gives the position of points relative to *n* mutually perpendicular axes

NOTE *n* is 2 or 3 for the purposes of this International Standard.

4.3
compound coordinate reference system
coordinate reference system using at least two independent **coordinate reference systems**

NOTE Coordinate reference systems are independent of each other if coordinate values in one cannot be converted or transformed into coordinate values in the other.

4.4
concatenated operation
coordinate operation consisting of sequential application of multiple **coordinate operations**

4.5
coordinate
one of a **sequence** of *n* numbers designating the position of a point in *n*-dimensional space

NOTE In a coordinate reference system, the coordinate numbers are qualified by units.

4.6
coordinate conversion
change of **coordinates**, based on a one-to-one relationship, from one **coordinate reference system** to another based on the same **datum**

EXAMPLE Between ellipsoidal and Cartesian coordinate systems or between geodetic coordinates and projected coordinates, or change of units such as from radians to degrees or feet to meters.

NOTE A coordinate conversion uses parameters which have specified values that are not determined empirically.

4.7
coordinate operation
change of **coordinates**, based on a one-to-one relationship, from one **coordinate reference system** to another

NOTE Supertype of coordinate transformation and coordinate conversion.

4.8
coordinate reference system
coordinate system which is related to an object by a **datum**

NOTE For geodetic and vertical datums, the object will be the Earth.

4.9
coordinate set
collection of **coordinate tuples** related to the same **coordinate reference system**

4.10
coordinate system
set of mathematical rules for specifying how **coordinates** are to be assigned to points

4.11
coordinate transformation
change of **coordinates** from one **coordinate reference system** to another **coordinate reference system** based on a different **datum** through a one-to-one relationship

NOTE A coordinate transformation uses parameters which are derived empirically by a set of points with known coordinates in both coordinate reference systems.

4.12
coordinate tuple
tuple composed of a **sequence** of **coordinates**

NOTE The number of coordinates in the coordinate tuple equals the dimension of the coordinate system; the order of coordinates in the coordinate tuple is identical to the order of the axes of the coordinate system.

4.13
cylindrical coordinate system
three-dimensional **coordinate system** with two distance and one angular **coordinates**

4.14
datum
parameter or set of parameters that define the position of the origin, the scale, and the orientation of a **coordinate system**

4.15
depth
distance of a point from a chosen reference surface measured downward along a line perpendicular to that surface

NOTE A depth above the reference surface will have a negative value.

4.16
easting
E
distance in a **coordinate system**, eastwards (positive) or westwards (negative) from a north-south reference line

4.17
ellipsoid
surface formed by the rotation of an ellipse about a main axis

NOTE In this International Standard, ellipsoids are always oblate, meaning that the axis of rotation is always the minor axis.

4.18
ellipsoidal coordinate system
geodetic coordinate system
coordinate system in which position is specified by **geodetic latitude**, **geodetic longitude** and (in the three-dimensional case) **ellipsoidal height**

4.19
ellipsoidal height
geodetic height
h
distance of a point from the **ellipsoid** measured along the perpendicular from the **ellipsoid** to this point positive if upwards or outside of the **ellipsoid**