INTERNATIONAL STANDARD

**ISO 6709**

Third edition
2022-09

# Standard representation of geographic point location by coordinates

*Représentation normalisée de la localisation des points géographiques par coordonnées*



Reference number
ISO 6709:2022(E)



ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

# Contents

Page

# 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.



This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).



This third edition cancels and replaces the second edition (ISO 6709:2008), which has been technically revised. It also incorporates the Technical Corrigendum ISO 6709:2008/Cor. 1:2009.

The main changes are as follows:

— Harmonization with other recently revised ISO/TC 211 International Standards;

— Clarification of normative requirements to maintain rigid backwards compatibility when required;

— Correction of the issues contained in the Technical Corrigendum ISO 6709:2008/Cor. 1:2009;

— Correction of annexes that contained normative requirements but were labelled as informative;

— Deletion of annexes and concepts which have changed and were no longer suitable for the revised edition;

— Correction of instances where European numeric formatting conventions were incorrectly inserted. These conventions will no longer be recommended;

— Clarification of editorial issues.

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.

In accordance with the ISO/IEC Directives, Part 2, 2018, *Rules for the structure and drafting of International Standards*, in International Standards the decimal sign is a comma on the line. However, the General Conference on Weights and Measures (*Conférence Générale des Poids et Mesures*) at its meeting in 2003 passed unanimously the following resolution:

 

*"The decimal marker shall be either a point on the line or a comma on the line."*

In practice, the choice between these alternatives depends on customary use in the language concerned. In the technical areas of geodesy and geographic information it is customary for the decimal point always to be used, for all languages. That practice is used throughout this document.

# Introduction

Geographic point location (GPL) is the description of a well-defined geographic place using a single coordinate tuple. Efficient interchange of GPL data requires formats which are universally interpretable and which allow the identification of points on, above and below the Earth's surface. Users in various disciplines have different requirements. This is exemplified by the use of degrees and decimal degrees, as well as the traditional degrees, minutes and seconds, for recording latitude and longitude. User applications can also require various levels of precision and can use latitude and longitude without height.

ISO 6709:1983 defined a specific format representation of latitude and longitude, and optionally altitude.

ISO 6709:2008 revised the format representation of the 1983 edition by:

— adding the ability to identify the coordinate reference system (CRS) to which coordinates are referenced, without which location is ambiguous, and

— expanding the use of altitude to allow for any ellipsoidal or gravity-related height or depth.

Since the first edition of this document in 1983, the field of geodesy has undergone significant technological advances, along with the continued development of other related geodesy and geomatics standards.

The aim of this edition is to address these new advances and standards and to revise the coordinate string suitable for digital representation (Clause 6) while continuing to support the requirements of the previous edition (Annex B).

Clause 7 defines a simpler structure for the unambiguous representation of GPL in a human-readable format.

In addition, a series of annexes are provided with the following content:

— Annex A (normative) defines the abstract test suite used for conformance testing;

— Annex B (normative) defines the representation of latitude and longitude coordinates that maintain backwards compatibility with ISO 6709:2008;

— Annex C (informative) presents a description and examples of how the position of coordinates can appear ambiguous without the use of a CRS;

— Annex D (informative) presents a table of mathematical precision values of resolution for latitude and longitude;

— Annex E (informative) describes the changes in this document compared to the previous edition of ISO 6709;

— Annex F (normative) specifies encodings for character strings and delimiters required in this document.

The following options are highlighted to users of this document:

a) For all cases where backwards compatibility is not required, this document recommends using the methods and rules specified in Clause 6, GPL representation, or Clause 7, human-readable GPL representation;

b) However, in systems and environments where backwards compatibility with ISO 6709:2008 is required, the methods and rules specified in Annex B can be used.

In addition, when using Annex B, it is recommended that suitable and comprehensive ancillary documentation, not defined within this document or in previous editions of this document, be



 

prepared and accompany all instances of geographic point location text strings and human-readable representations claiming backwards compatibility.

The use of this document:

— establishes an expanded point representation string format supporting the current concepts and standards of geodesy and geographic information;

— when required, continues to support the needs of established user communities by maintaining backwards compatibility with the previous edition of this document (ISO 6709:2008);

— reduces the cost of interchange of data;

— reduces the delay in converting non-standard coding structures in preparation for interchange by providing advance knowledge of the standard interchange format; and

— provides flexible support for geographic point representation.

# Standard representation of geographic point location by coordinates

## 1 Scope

This document specifies the representation of latitude and longitude and optionally height or depth compatible with previous editions of ISO 6709.

This document also supports the representations of other coordinate types and time that can be associated with those coordinates as defined through one or more coordinate reference systems (CRS).

This document describes a text string of coordinates, suitable for electronic data exchange, for one point, including reference system identification to ensure that the coordinates unambiguously represent the position of that point. Files containing multiple points with a single common reference system identification are out of scope. This document also describes a simpler text string structure for coordinate representation of a point location that is more suitable for human readability.

## 2 Normative references



The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 8601-1, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO 8601-2, *Date and time — Representations for information interchange — Part 2: Extensions*



ISO/IEC 10646:2020, *Information technology — Universal coded character set (UCS)*

ISO 19111, *Geographic information — Referencing by coordinates*

ISO 19162, *Geographic information — Well-known text representation of coordinate reference systems*

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**accuracy**
closeness of agreement between a test result or measurement result and the true value

[SOURCE: ISO 3534-2:2006, 3.1.1, modified — Notes to entry have been removed.]

**3.2**
**altitude**
height where the chosen reference surface is mean sea level

**3.3**
**compound coordinate reference system**
coordinate reference system using at least two independent coordinate reference systems

Note 1 to entry: Coordinate reference systems are independent of each other if coordinate values in one cannot be converted or transformed into coordinate values in the other.

[SOURCE: ISO 19111:2019, 3.1.3]

**3.4**
**coordinate**
one of a sequence of numbers designating the position of a point

Note 1 to entry: In a spatial coordinate reference system, the coordinate numbers are qualified by units.

[SOURCE: ISO 19111:2019, 3.1.5]

**3.5**
**coordinate reference system**
coordinate system that is related to an object by a datum

Note 1 to entry: Geodetic and vertical datums are referred to as reference frames.

Note 2 to entry: For geodetic and vertical reference frames, the object will be the Earth. In planetary applications, geodetic and vertical reference frames may be applied to other celestial bodies.

[SOURCE: ISO 19111:2019, 3.1.9]



**3.6**
**coordinate set**
collection of coordinate tuples referenced to the same coordinate reference system and if that coordinate reference system is dynamic also to the same coordinate epoch



[SOURCE: ISO 19111:2019, 3.1.10]

**3.7**
**coordinate system**
set of mathematical rules for specifying how coordinates are to be assigned to points

[SOURCE: ISO 19111:2019, 3.1.11]

**3.8**
**coordinate tuple**
tuple composed of coordinates

Note 1 to entry: 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.

[SOURCE: ISO 19111:2019, 3.1.13]

**3.9**
**datum**
reference frame
parameter or set of parameters that realize the position of the origin, the scale, and the orientation of a coordinate system

[SOURCE: ISO 19111:2019, 3.1.15]

**3.10**
**depth**
distance of a point from a chosen vertical reference surface downward along a line that is perpendicular to that surface

Note 1 to entry: The line direction may be straight or be dependent on the Earth's gravity field or other physical phenomena.

Note 2 to entry: A depth above the vertical reference surface will have a negative value.

[SOURCE: ISO 19111:2019, 3.1.17]

**3.11**
**ellipsoidal height**
geodetic height
*h*
distance of a point from the reference ellipsoid along the perpendicular from the reference ellipsoid to this point, positive if upwards or outside of the reference ellipsoid

Note 1 to entry: Only used as part of a three-dimensional ellipsoidal coordinate system or as part of a three-dimensional Cartesian coordinate system in a three-dimensional projected coordinate reference system, but never on its own.

[SOURCE: ISO 19111:2019, 3.1.24]

**3.12**
**geographic point location**
well defined geographic place described by one coordinate tuple



[SOURCE: ISO 19145:2013, 4.1.11]

**3.13**
**geographic point location representation**
syntactic description of a geographic point location in a well known format



[SOURCE: ISO 19145:2013, 4.1.12]

**3.14**
**gravity-related height**
*H*
height that is dependent on the Earth’s gravity field

Note 1 to entry: This refers to, amongst others, orthometric height and Normal height, which are both approximations of the distance of a point above the mean sea level, but also may include Normal-orthometric heights, dynamic heights or geopotential numbers.

Note 2 to entry: The distance from the reference surface may follow a curved line, not necessarily straight, as it is influenced by the direction of gravity.

[SOURCE: ISO 19111:2019, 3.1.37]

**3.15**
**height**
distance of a point from a chosen reference surface positive upward along a line perpendicular to that surface

Note 1 to entry: A height below the reference surface will have a negative value.

Note 2 to entry: Generalisation of ellipsoidal height (h) and gravity-related height (H).

[SOURCE: ISO 19111:2019, 3.1.38]

**3.16**
**measurement precision**
precision
closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects under specified conditions

Note 1 to entry: Measurement precision is usually expressed numerically by measures of imprecision, such as standard deviation, variance, or coefficient of variation under the specified conditions of measurement.

Note 2 to entry: The "specified conditions" can be, for example, repeatability conditions of measurement, intermediate precision conditions of measurement, or reproducibility conditions of measurement (see ISO 5725-1:1994).

Note 3 to entry: Measurement precision is used to define measurement repeatability, intermediate measurement precision, and measurement reproducibility.

Note 4 to entry: Sometimes "measurement precision" is erroneously used to mean measurement accuracy.

[SOURCE: ISO/IEC Guide 99:2007, 2.15]

**3.17**
**metadata**
information about a resource

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

**3.18**
**resolution (of a coordinate)**
unit associated with the least significant digit of a coordinate

Note 1 to entry: Coordinate resolution may have linear or angular units depending on the characteristics of the coordinate system.

**3.19**
**sexagesimal degree**
angle represented by a sequence of values in degrees, minutes, and seconds

Note 1 to entry: In the case of latitude or longitude, it may also include a character indicating hemisphere.

EXAMPLE 50.0795725 decimal degrees is represented as 50°04'46.461"

**3.20**
**tuple**
ordered list of values

Note 1 to entry: The number of values in a tuple is immutable.

[SOURCE: ISO 19136-1:2020, 3.1.60]

# 4 Abbreviated terms and character code notations

## 4.1 Abbreviated terms

CRS coordinate reference system

CRScsd coordinate reference system character string delimiter

EPSG EPSG geodetic parameter dataset

GML Geography Markup Language

| | |
|---|---|
| GPL | geographic point location |
| HTML | HyperText Markup Language |
| ISOGR | ISO Geodetic Registry |
| JSON | JavaScript Object Notation |
| lat | latitude |
| lon | longitude |
| OGC | Open Geospatial Consortium |
| UCS | Universal Coded Character Set |
| URL | Uniform Resource Locator |
| WKT | well-known text |
| XML | eXtensible Markup Language |

### 4.2 Character code notations

Character string delimiters required in this document are represented in accordance with notation from ISO/IEC 10646. Character names and code points are specified in Annex F, Table F.1.



## 5 Conformance

To conform to this document, representations of GPL shall satisfy the conditions specified in the abstract test suite (Annex A).



## 6 Geographic point location (GPL) representation

### 6.1 Overview

This edition of ISO 6709 revises and expands the representation of geographic point location (GPL), while maintaining an option (Annex B) for backwards compatibility with the previous edition (ISO 6709:2008).

ISO 19111 defines the elements required to describe a CRS. A coordinate tuple represents a location unambiguously only if the CRS to which it is referenced is identified and if that CRS is dynamic the epoch of the coordinates is also identified. Without this identification, uncertainty in position can result in the location being as much as several hundred metres distant (see Annex C).

In this document, CRS identifiers shall accompany all GPL representations. Identification may be through:

— a complete URL notation [6.5 a)],

— an abbreviated notation [6.5 b)] or

— a complete CRS definition as specified in ISO 19111, [6.5 c)].

ISO 19111 specifies several CRS types, of which the following are supported in this document. Any one, or a combination of these, shall accompany all GPL representations:

— geodetic CRS — three-dimensional,