

BS ISO 19162:2015



BSI Standards Publication

Geographic information — Well-known text representation of coordinate reference systems

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

National foreword

This British Standard is the UK implementation of ISO 19162:2015.

The UK participation in its preparation was entrusted to Technical Committee IST/36, Geographic information.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2015. Published by BSI Standards Limited 2015

ISBN 978 0 580 81808 0

ICS 35.240.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2015.

Amendments issued since publication

Date	Text affected
------	---------------

INTERNATIONAL STANDARD

BS ISO 19162:2015

ISO
19162

First edition
2015-08-15

Geographic information — Well-known text representation of coordinate reference systems

Information géographique — Représentation textuelle bien lisible de systèmes de référence par coordonnées



Reference number
ISO 19162:2015(E)
Documents
Document Sharing Hub
© ISO 2015



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	vii
Introduction.....	viii
1 Scope	1
2 Conformance requirements	1
3 Normative references	2
4 Definitions and abbreviations	2
4.1 Definitions	2
4.2 Abbreviations.....	8
5 Backus-Naur Form notation and syntax	8
6 WKT string form	9
6.1 Overview.....	9
6.2 Encoding	9
6.3 Characters used in WKT	9
6.3.1 Basic characters.....	9
6.3.2 Numbers	11
6.3.3 Date and time	11
6.3.4 CRS WKT characters.....	12
6.3.5 Double quote.....	13
6.4 Delimiter	13
6.5 Case sensitivity	13
6.6 Reserved keywords.....	13
6.7 Backward compatibility	15
7 WKT representation of common attributes	15
7.1 Introduction.....	15
7.2 Name.....	15
7.3 Scope, extent, identifier and remark	15
7.3.1 Introduction.....	15
7.3.2 Scope	16
7.3.3 Extent.....	16
7.3.4 Identifier	18
7.3.5 Remark.....	19
7.4 Unit and unit conversion factor	20
7.5 Coordinate system	21
7.5.1 Syntax.....	21
7.5.2 Coordinate system type and dimension	22
7.5.3 Axis name and abbreviation.....	23
7.5.4 Axis direction	24
7.5.5 Axis order	25
7.5.6 Axis unit and coordinate system unit	25
7.5.7 Examples of WKT describing coordinate systems.....	26
8 WKT representation of geodetic coordinate reference systems.....	28
8.1 Overview.....	28
8.2 Geodetic datum	28
8.2.1 Ellipsoid.....	28
8.2.2 Prime meridian.....	29
8.2.3 Datum.....	30
8.3 Coordinate systems for geodetic CRSs.....	31
8.4 Examples of WKT describing a geodetic CRS	31

9	WKT representation of projected CRSs	32
9.1	Overview	32
9.2	Base CRS	32
9.2.1	General	32
9.2.2	Ellipsoidal CS unit	33
9.3	Map projection	33
9.3.1	Introduction	33
9.3.2	Map projection name and identifier	34
9.3.3	Map projection method	34
9.3.4	Map projection parameter	35
9.4	Coordinate systems for projected CRSs	35
9.5	Examples of WKT describing a projected CRS	35
10	WKT representation of vertical CRSs	36
10.1	Overview	36
10.2	Vertical datum	37
10.3	Vertical coordinate system	37
10.4	Example of WKT describing a vertical CRS	37
11	WKT representation of engineering CRSs	37
11.1	Overview	37
11.2	Engineering datum	38
11.3	Coordinate systems for engineering CRSs	38
11.4	Examples of WKT describing an engineering CRS	38
12	WKT representation of image CRSs	39
12.1	Overview	39
12.2	Image datum	39
12.3	Coordinate systems for image CRSs	40
13	WKT representation of parametric CRSs	40
13.1	Overview	40
13.2	Parametric datum	40
13.3	Parametric coordinate system	40
13.4	Example of WKT describing a parametric CRS	41
14	WKT representation of temporal CRSs	41
14.1	Overview	41
14.2	Temporal datum	41
14.3	Temporal coordinate system	41
14.4	Example of WKT describing a temporal CRS	41
15	WKT representation of derived CRSs	42
15.1	Overview	42
15.2	Derived CRS conversion	42
15.2.1	Introduction	42
15.2.2	Derived CRS conversion method	43
15.2.3	Derived CRS conversion parameter	43
15.2.4	Derived CRS conversion parameter file	44
15.2.5	Derived CRS conversion example	44
15.3	Derived CRS of type geodetic	44
15.3.1	Representation	44
15.3.2	Example of WKT describing a derived geodetic CRS	45
15.4	Derived CRS of type vertical	45
15.5	Derived CRS of type engineering	46
15.5.1	Representation	46
15.5.2	Examples of WKT describing a derived engineering CRS	47
15.6	Derived CRS of type parametric	48
15.7	Derived CRS of type temporal	48
16	WKT representation of compound coordinate reference systems	49
16.1	Overview	49
16.2	Examples of WKT describing a compound CRS	50

17	WKT representation of coordinate operations	51
17.1	Coordinate operations	51
17.2	Coordinate operation components.....	51
17.2.1	Source and target CRS	51
17.2.2	Coordinate operation name and identifier	51
17.2.3	Coordinate operation method.....	52
17.2.4	Coordinate operation parameter.....	52
17.2.5	Coordinate operation parameter file	53
17.2.6	Interpolation CRS	53
17.2.7	Coordinate operation accuracy	53
17.2.8	Other coordinate operation attributes.....	53
17.3	Examples of WKT describing a coordinate operation.....	54
18	WKT representation of CRS and coordinate operation couplets	55
18.1	Bound CRS.....	55
18.2	Bound CRS components	56
18.2.1	Abridged coordinate transformation.....	56
18.2.2	Coordinate operation method in abridged coordinate transformations	56
18.2.3	Abridged coordinate transformation parameter	57
18.2.4	Coordinate operation parameter file	57
18.3	Examples of WKT describing a Bound CRS.....	58
Annex A	(normative) Abstract test suite	59
A.1	Conformance of a WKT string describing a geodetic CRS.....	59
A.2	Conformance of a WKT string describing a projected CRS	59
A.3	Conformance of a WKT string describing a vertical CRS	60
A.4	Conformance of a WKT string describing an engineering CRS	60
A.5	Conformance of a WKT string describing an image CRS	61
A.6	Conformance of a WKT string describing a parametric CRS	61
A.7	Conformance of a WKT string describing a temporal CRS	62
A.8	Conformance of a WKT string describing a derived CRS.....	62
A.9	Conformance of a WKT string describing a compound CRS	63
A.10	Conformance of a WKT string describing a coordinate operation	63
A.11	Conformance of a WKT string describing a Bound CRS	64
Annex B	(informative) Recommended practice for implementation	65
B.1	Introduction.....	65
B.2	Keywords	65
B.2.1	Keyword case sensitivity.....	65
B.2.2	Alternative keywords	65
B.2.3	Handling of unrecognised keywords	65
B.3	Characters.....	65
B.3.1	Handling of unrecognised characters.....	65
B.3.2	String length	65
B.4	White space.....	66
B.4.1	Insertion of white space.....	66
B.4.2	Parsing of white space outside of quoted text.....	66
B.4.3	Parsing of white space within quoted text.....	66
B.5	Identifiers	66
B.5.1	Use of identifier	66
B.5.2	Using names to interpret identity	66
B.6	Numbers	67
B.6.1	Precision	67
B.6.2	Defining parameters for a sphere	67
B.6.3	Implied units	67
B.7	Attribute order	67
B.8	Version of CRS WKT	67
Annex C	(informative) Mapping of concepts from previous versions of CRS WKT	68
C.1	BNF	68
C.2	Backward compatibility of CRS common attributes.....	68
C.2.1	Name.....	68

C.2.2	ID (Authority)	68
C.3	Backward compatibility of coordinate reference system components	69
C.3.1	Ellipsoid	69
C.3.2	Prime meridian	69
C.3.3	Datum	69
C.3.4	Map projection	70
C.3.5	Coordinate system	71
C.4	Backward compatibility of coordinate reference systems	72
C.4.1	Geodetic CRS	72
C.4.2	Projected CRS	73
C.4.3	Vertical CRS and engineering (local) CRS	73
C.4.4	Compound CRS	74
C.4.5	Fitted CS	74
C.5	Backward compatibility of coordinate operations	74
C.6	Mapping of tokens and keywords from previous versions of CRS WKT to this International Standard	75
Annex D	(informative) Triaxial ellipsoid	79
Annex E	(informative) Identifiers for coordinate operation methods and parameters	80
E.1	Introduction	80
E.2	Map projection methods	81
E.3	Map projection parameters	81
E.4	Coordinate transformation methods	83
E.5	Coordinate transformation parameters	83
Bibliography		85

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. 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. 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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 211, jointly with the Open Geospatial Consortium (OGC).

Introduction

Well-known Text (WKT) offers a compact machine- and human-readable representation of geometric objects. WKT may also be used for succinctly describing the critical elements of coordinate reference system (CRS) definitions.

WKT was described in the Open Geospatial Consortium implementation specifications 99-036 through 06-103r4 and International Standard ISO 19125-1:2004, "Geographic information – Simple feature access – Part 1: Common architecture". The WKT representation of coordinate reference systems was subsequently extended in Open Geospatial Consortium implementation specification 01-009 "Coordinate Transformation Services" and this extension was later adopted in the Open Geospatial Consortium GeoAPI 3.0 implementation standard 09-083r3 and GeoPackage 1.0 implementation standard 12-128r10. The WKT representation of coordinate reference systems as defined in ISO 19125-1:2004 and OGC specification 01-009 is inconsistent with the terminology and technical provisions of ISO 19111:2007 and OGC Abstract Specification topic 2 (08-015r2), "Geographic information – Spatial referencing by coordinates".

This International Standard provides an updated version of WKT representation of coordinate reference systems that follows the provisions of ISO 19111:2007 and ISO 19111-2:2009. It extends earlier WKT to allow for the description of coordinate operations. This International Standard defines the structure and content of well-known text strings. It does not prescribe how implementations should read or write these strings.

Geographic information — Well-known text representation of coordinate reference systems

1 Scope

This International Standard defines the structure and content of a text string implementation of the abstract model for coordinate reference systems described in ISO 19111:2007 and ISO 19111-2:2009. The string defines frequently needed types of coordinate reference systems and coordinate operations in a self-contained form that is easily readable by machines and by humans. The essence is its simplicity; as a consequence there are some constraints upon the more open content allowed in ISO 19111:2007. To retain simplicity in the well-known text (WKT) description of coordinate reference systems and coordinate operations, the scope of this International Standard excludes parameter grouping and pass-through coordinate operations. The text string provides a means for humans and machines to correctly and unambiguously interpret and utilise a coordinate reference system definition with look-ups or cross references only to define coordinate operation mathematics. Because it omits metadata about the source of the data and may omit metadata about the applicability of the information, the WKT string is not suitable for the storage of definitions of coordinate reference systems or coordinate operations.

2 Conformance requirements

This International Standard defines eleven classes of conformance (see Annex A) in three groups:

- 1) Any WKT string claiming conformance of coordinate reference system definition shall satisfy the requirements in Annex A as shown in Table 1.

Table 1 — Conformance requirements for coordinate reference systems

Coordinate reference system type	Conformance requirements given in
geodetic	A.1
projected	A.2
vertical	A.3
engineering	A.4
image	A.5
parametric	A.6
temporal	A.7
derived geodetic derived vertical derived engineering derived parametric derived temporal	A.8
compound	A.9

- 2) Any WKT string claiming conformance of coordinate operation definition shall satisfy the requirements given in A.10.
- 3) Any WKT string claiming conformance of coordinate transformation bound to a coordinate reference system definition shall satisfy the requirements given in A.11.

Conformance is applicable to the WKT string. Recommended practices for implementations writing or reading coordinate reference system WKT strings are given in Annex B.

3 Normative references

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

ISO 8601:2004, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO/IEC 9075-1:2011, *Information technology — Database languages — SQL — Part 1: Framework (SQL/Framework)*

ISO/IEC 9075-2:2011, *Information technology — Database languages — SQL — Part 2: Foundation (SQL/Foundation)*

ISO/IEC 10646:2012, *Information technology — Universal Coded Character Set (UCS)*

ISO 19111:2007, *Geographic information — Spatial referencing by coordinates*

ISO 19111-2:2009, *Geographic information — Spatial referencing by coordinates — Part 2: Extension for parametric values*

4 Definitions and abbreviations

4.1 Definitions

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

4.1.1

affine coordinate system

coordinate system (4.1.8) in Euclidean space with straight axes that are not necessarily mutually perpendicular

[SOURCE: ISO 19111:2007, 4.1]

4.1.2

bearing

horizontal angle at a point relative to a specified direction

Note 1 to entry: The direction is usually specified to be north. In some communities the term bearing refers specifically to grid north and directions relative to true north are then termed 'azimuth'; in other communities a bearing refers specifically to true north. In this International Standard bearing is used for any specified reference direction. The angle may be reckoned positive clockwise or positive counter-clockwise depending upon the application.

4.1.3

Cartesian coordinate system

coordinate system (4.1.8) which gives the position of points relative to n mutually perpendicular axes that each has zero curvature

Note 1 to entry: n is 2 or 3 for the purposes of this International Standard.

4.1.4

compound coordinate reference system

coordinate reference system (4.1.7) 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 19111:2007, 4.3]

4.1.5

coordinate conversion

coordinate operation (4.1.6) in which both *coordinate reference systems* (4.1.7) are based on the same *datum* (4.1.11)

EXAMPLE Conversion from an ellipsoidal coordinate reference system based on the WGS 84 datum to a Cartesian coordinate reference system also based on the WGS 84 datum, or change of units such as from radians to degrees or feet to metres.

Note 1 to entry: A coordinate conversion uses parameters which have specified values that are not determined empirically.

[SOURCE: ISO 19111:2007, 4.6]

4.1.6

coordinate operation

change of coordinates, based on a one-to-one relationship, from one *coordinate reference system* (4.1.7) to another

Note 1 to entry: Supertype of *coordinate transformation* (4.1.9) and *coordinate conversion* (4.1.5).

[SOURCE: ISO 19111:2007, 4.7]

4.1.7

coordinate reference system

coordinate system (4.1.8) that is related to an object by a *datum* (4.1.11)

Note 1 to entry: For *geodetic* and *vertical datums* (4.1.19, 4.1.39), the object will be the Earth.

[SOURCE: ISO 19111:2007, 4.8]

4.1.8

coordinate system

set of mathematical rules for specifying how coordinates are to be assigned to points

[SOURCE: ISO 19111:2007, 4.10]

4.1.9

coordinate transformation

coordinate operation (4.1.6) in which the two *coordinate reference systems* (4.1.7) are based on different *datums* (4.1.11)

Note 1 to entry: A coordinate transformation uses parameters which are derived empirically by a set of points with known coordinates in both coordinate reference systems.

[SOURCE: ISO 19111:2007, 4.11]

4.1.10

cylindrical coordinate system

three-dimensional *coordinate system* (4.1.8) with two distance and one angular coordinates

[SOURCE: ISO 19111:2007, 4.13]

4.1.11

datum

parameter or set of parameters that define the position of the origin, the scale, and the orientation of a *coordinate system* (4.1.8)

[SOURCE: ISO 19111:2007, 4.14]

4.1.12

ellipsoid

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

Note 1 to entry: In this International Standard, ellipsoids are always oblate, meaning that the axis of rotation is always the minor axis.

[SOURCE: ISO 19111:2007, 4.17]

4.1.13

ellipsoidal coordinate system

geodetic coordinate system

coordinate system (4.1.8) in which position is specified by *geodetic latitude* (4.1.20), *geodetic longitude* (4.1.21) and (in the three-dimensional case) *ellipsoidal height* (4.1.14)

[SOURCE: ISO 19111:2007, 4.18]

4.1.14

ellipsoidal height

geodetic height

h

distance of a point from the *ellipsoid* (4.1.12) measured along the perpendicular from the ellipsoid to this point, positive if upwards or outside of the ellipsoid

Note 1 to entry: Only used as part of a three-dimensional *ellipsoidal coordinate system* (4.1.13) and never on its own.

[SOURCE: ISO 19111:2007, 4.19]

4.1.15

engineering coordinate reference system

coordinate reference system (4.1.7) based on an *engineering datum* (4.1.16)

EXAMPLES Local engineering and architectural grids; coordinate reference system local to a ship or an orbiting spacecraft.

[SOURCE: ISO 19111:2007, 4.20]

4.1.16

engineering datum

local datum

datum (4.1.11) describing the relationship of a *coordinate system* (4.1.8) to a local reference

Note 1 to entry: Engineering datum excludes both *geodetic* and *vertical datums* (4.1.19, 4.1.39).

EXAMPLE A system for identifying relative positions within a few kilometres of the reference point.

[SOURCE: ISO 19111:2007, 4.21]

4.1.17
flattening
f

ratio of the difference between the *semi-major axis* (*a*) (4.1.32) and *semi-minor axis* (*b*) (4.1.33) of an *ellipsoid* (4.1.12) to the semi-major axis; $f = (a - b)/a$

Note 1 to entry: Sometimes inverse flattening $1/f = a/(a-b)$ is given instead; $1/f$ is also known as reciprocal flattening.

[SOURCE: ISO 19111:2007, 4.22, modified – The first occurrence of the words “semi-major” have been expanded to “semi-major axis”.]

4.1.18
geodetic coordinate reference system
coordinate reference system (4.1.7) based on a *geodetic datum* (4.1.19)

[SOURCE: ISO 19111:2007, 4.23]

4.1.19
geodetic datum

datum (4.1.11) describing the relationship of a two- or three-dimensional *coordinate system* (4.1.8) to the Earth

[SOURCE: ISO 19111:2007, 4.24]

4.1.20
geodetic latitude
ellipsoidal latitude

φ

angle from the equatorial plane to the perpendicular to the *ellipsoid* (4.1.12) through a given point, northwards treated as positive

[SOURCE: ISO 19111:2007, 4.25]

4.1.21
geodetic longitude
ellipsoidal longitude

λ

angle from the *prime meridian* (4.1.30) plane to the meridian plane of a given point, eastward treated as positive

[SOURCE: ISO 19111:2007, 4.26]

4.1.22
image coordinate reference system
coordinate reference system (4.1.7) based on an *image datum* (4.1.23)

[SOURCE: ISO 19111:2007, 4.30]

4.1.23
image datum

engineering datum (4.1.16) which defines the relationship of a *coordinate system* (4.1.8) to an image

[SOURCE: ISO 19111:2007, 4.31]

4.1.24

linear coordinate system

one-dimensional *coordinate system* (4.1.8) in which a linear feature forms the axis

EXAMPLES Distances along a pipeline; depths down a deviated oil well bore.

[SOURCE: ISO 19111:2007, 4.32]

4.1.25

map projection

coordinate conversion (4.1.4) from an *ellipsoidal coordinate system* (4.1.13) to a plane

[SOURCE: ISO 19111:2007, 4.33]

4.1.26

parametric coordinate reference system

coordinate reference system (4.1.7) based on a *parametric datum* (4.1.28)

[SOURCE: ISO 19111-2:2009, 4.2]

4.1.27

parametric coordinate system

one-dimensional *coordinate system* (4.1.8) where the axis units are parameter values which are not inherently spatial

[SOURCE: ISO 19111-2:2009, 4.1]

4.1.28

parametric datum

datum (4.1.11) describing the relationship of a *parametric coordinate system* (4.1.27) to an object

Note 1 to entry: The object is normally the Earth.

[SOURCE: ISO 19111-2:2009, 4.3]

4.1.29

polar coordinate system

two-dimensional *coordinate system* (4.1.8) in which position is specified by distance and direction from the origin

Note 1 to entry: For the three-dimensional case, see *spherical coordinate system* (4.1.35).

[SOURCE: ISO 19111:2007, 4.37]

4.1.30

prime meridian

zero meridian

meridian from which the longitudes of other meridians are quantified

[SOURCE: ISO 19111:2007, 4.38]

4.1.31

projected coordinate reference system

coordinate reference system (4.1.7) derived from a two-dimensional *geodetic coordinate reference system* (4.1.18) by applying a *map projection* (4.1.25)

[SOURCE: ISO 19111:2007, 4.39]

4.1.32
semi-major axis

a
semi-diameter of the longest axis of an *ellipsoid* (4.1.12)

Note 1 to entry: This equates to the semi-diameter of the ellipsoid measured in its equatorial plane.

[SOURCE: ISO 19111:2007, 4.40]

4.1.33
semi-minor axis

b
semi-diameter of the shortest axis of an *ellipsoid* (4.1.12)

Note 1 to entry: The shortest axis coincides with the rotation axis of the ellipsoid and therefore contains both poles.

[SOURCE: ISO 19111:2007, 4.41]

4.1.34
spatio-parametric coordinate reference system

compound coordinate reference system (4.1.4) in which one constituent *coordinate reference system* (4.1.7) is a *parametric coordinate reference system* (4.1.26) and one is a spatial coordinate reference system

Note 1 to entry: Normally the spatial component is “horizontal” and the parametric component is “vertical”.

[SOURCE: ISO 19111-2:2009, 4.4]

4.1.35
spherical coordinate system

three-dimensional *coordinate system* (4.1.8) with one distance measured from the origin and two angular coordinates, commonly associated with a *geodetic coordinate reference system* (4.1.18)

Note 1 to entry: Not to be confused with an *ellipsoidal coordinate system* (4.1.13) based on an *ellipsoid* (4.1.12) ‘degenerated’ into a sphere.

[SOURCE: ISO 19111:2007, 4.44]

4.1.36
spheroid

closed surface that differs only slightly from that of a sphere

4.1.37
vertical coordinate reference system

one-dimensional *coordinate reference system* (4.1.7) based on a *vertical datum* (4.1.39)

[SOURCE: ISO 19111:2007, 4.47]

4.1.38
vertical coordinate system

one-dimensional *coordinate system* (4.1.8) used for gravity-related height or depth measurements

[SOURCE: ISO 19111:2007, 4.48]

4.1.39
vertical datum

datum (4.1.11) describing the relation of gravity-related heights or depths to the Earth

Note 1 to entry: In most cases, the vertical datum will be related to mean sea level. *Ellipsoidal heights* (4.1.14) are treated as related to a three-dimensional *ellipsoidal coordinate system* (4.1.13) referenced to a *geodetic datum* (4.1.19).

Vertical datums include sounding datums (used for hydrographic purposes), in which case the heights may be negative heights or depths.

[SOURCE: ISO 19111:2007, 4.49]

4.1.40

white space

consecutive sequences of one or more characters that have no glyphs

[SOURCE: ISO/IEC 9075-2:2011, 3.1.6.48]

4.2 Abbreviations

BNF	Backus-Naur form
CRS	coordinate reference system
CS	coordinate system
EPSG	European Petroleum Survey Group geodetic parameter dataset now maintained at www.epsg-registry.org by the International Association of Oil and Gas Producers
IRM	international reference meridian
OGC	Open Geospatial Consortium, www.opengeospatial.org
UTC	Coordinated Universal Time
WKT	Well-known text

5 Backus-Naur Form notation and syntax

The WKT representation of coordinate reference systems and coordinate operations is defined in this International Standard using the extended version of Backus-Naur form (BNF) notation that is defined in ISO/IEC 9075-1:2011, 6.2. The BNF provides the mechanism for generating a WKT string. The production rules in ISO/IEC 9075-1:2011, 6.2 apply.

In this extended version of BNF the characters have the meaning:

- A character string enclosed in angle brackets "< >" is a syntactic element.
- A vertical bar "|" indicates alternatives.
- Braces "{}" group elements.
- Square brackets "[" "]" denote optional elements.

NOTE This use of square brackets within BNF notation should not be confused with the use of square brackets as delimiters in WKT strings.

- Ellipsis after an element "< >..." allows the use of multiple instances of that element.
- Ellipsis after braces "{}..." applies the multiplicity to all elements within the braces.
- Ellipsis after square brackets "["]..." means that the content inside the square brackets may occur zero to many times.
- Double exclamation marks "!!" introduce normal English text. This is used when the definition of a syntactic element is supplemented by constraints not in the BNF definition but given later in the text.

In the BNF notation spaces are used to separate syntactic elements. Multiple spaces and line breaks are treated as a single space. These spaces do not form part of the resulting WKT string. All other characters in the BNF stand for themselves. The order of syntactic elements in the BNF is significant; it defines the format of the WKT string.

6 WKT string form

6.1 Overview

The WKT string is a representation of the definition of a CRS or coordinate operation. A string describes one CRS or coordinate operation object. Each object is represented by a token comprised of a keyword followed by a set of attributes of the object, the set enclosed by delimiters. Some objects are composed of other objects so the result may be a nested structure. Nesting may continue to any depth.

EXAMPLE KEYWORD1[attribute1,KEYWORD2[attribute2,attribute3]]

Keywords are case-insensitive. Where human readability of the string is important, as in this International Standard, keywords are normally in upper case.

The delimiters are normally <left bracket> and <right bracket>. Implementations are free to substitute parentheses for brackets.

Attributes may be from an enumeration, be numbers or be text. Text is enclosed in double quotes. Two forms of text are defined, one restricted to the Latin1 character set and the other permitting any Unicode character set. Attributes are separated by a comma.

A WKT string contains no white space outside of double quotes. However padding with white space to improve human readability is permitted; the examples of WKT that are included in this document have spaces and line feeds inserted to improve clarity. Any padding is stripped out or ignored by parsers – refer to Annex B.

6.2 Encoding

All WKT strings are realized as a sequence of characters, or a character string. It is not the goal of this standard to specify any encoding used in a given implementation. The only restriction is that the same encoding shall be used throughout the entire WKT definition.

Requirements:

- i) A WKT string shall use one encoding throughout the entire string.
- ii) The characters used in a WKT string shall be wholly contained within the domain of a specific character set. This character set shall exist as a subset of the repertoire of the Universal Character Set specified by ISO 10646:2012.

6.3 Characters used in WKT

6.3.1 Basic characters

The basic characters in a CRS WKT string are taken directly from ISO 9075-2:2011, 5.1 and 5.3.

```
<simple Latin upper case letter> ::= A|B|C|D|E|F|G|H|I|J|K|L|M|
N|O|P|Q|R|S|T|U|V|W|X|Y|Z
!! ISO/IEC 10646:2012 character identifiers U+0041
through U+005A
```

<simple Latin lower case letter>	::=	a b c d e f g h i j k l m n o p q r s t u v w x y z !! ISO/IEC 10646:2012 character identifiers U+0061 through U+007A
<digit>	::=	0 1 2 3 4 5 6 7 8 9 !! ISO/IEC 10646:2012 character identifiers U+0030 through U+0039
<space>	::=	SP !! ISO/IEC 10646:2012 character identifier U+0020
<double quote>	::=	" !! ISO/IEC 10646:2012 character identifier U+0022
<number sign>	::=	# !! ISO/IEC 10646:2012 character identifier U+0023
<percent>	::=	% !! ISO/IEC 10646:2012 character identifier U+0025
<ampersand>	::=	& !! ISO/IEC 10646:2012 character identifier U+0026
<quote>	::=	' !! ISO/IEC 10646:2012 character identifier U+0027
<left paren>	::=	(!! ISO/IEC 10646:2012 character identifier U+0028
<right paren>	::=	) !! ISO/IEC 10646:2012 character identifier U+0029
<asterisk>	::=	* !! ISO/IEC 10646:2012 character identifier U+002A
<plus sign>	::=	+ !! ISO/IEC 10646:2012 character identifier U+002B
<comma>	::=	, !! ISO/IEC 10646:2012 character identifier U+002C
<minus sign> :- <hyphen>	::=	- !! ISO/IEC 10646:2012 character identifier U+002D
<period>	::=	. !! ISO/IEC 10646:2012 character identifier U+002E
<solidus>	::=	/ !! ISO/IEC 10646:2012 character identifier U+002F
<colon>	::=	: !! ISO/IEC 10646:2012 character identifier U+003A
<semicolon>	::=	; !! ISO/IEC 10646:2012 character identifier U+003B
<less than operator>	::=	< !! ISO/IEC 10646:2012 character identifier U+003C
<equals operator>	::=	= !! ISO/IEC 10646:2012 character identifier U+003D
<greater than operator>	::=	> !! ISO/IEC 10646:2012 character identifier U+003E
<question mark>	::=	? !! ISO/IEC 10646:2012 character identifier U+003F
<left bracket>	::=	[!! ISO/IEC 10646:2012 character identifier U+005B
<reverse solidus>	::=	\ !! ISO/IEC 10646:2012 character identifier U+005C
<right bracket>	::=	] !! ISO/IEC 10646:2012 character identifier U+005D
<circumflex>	::=	^ !! ISO/IEC 10646:2012 character identifier U+005E
<underscore>	::=	_ !! ISO/IEC 10646:2012 character identifier U+005F
<left brace>	::=	{ !! ISO/IEC 10646:2012 character identifier U+007B

<vertical bar>	::=		!! ISO/IEC 10646:2012 character identifier U+007C
<right brace>	::=	}	!! ISO/IEC 10646:2012 character identifier U+007D
<degree symbol>	::=	°	!! ISO/IEC 10646:2012 character identifier U+00B0

6.3.2 Numbers

<number>	::=	<signed numeric literal> <unsigned numeric literal>	
<signed numeric literal>	::=	[<sign>] <unsigned numeric literal>	
<unsigned numeric literal>	::=	<exact numeric literal> <approximate numeric literal>	
<approximate numeric literal>	::=	<mantissa> E <exponent>	
<mantissa>	::=	<exact numeric literal>	
<exponent>	::=	<signed integer>	
<signed integer>	::=	[<sign>] <unsigned integer>	
<exact numeric literal>	::=	<unsigned integer> [<period> [<unsigned integer>]] <period> <unsigned integer>	
<unsigned integer>	::=	<digit>...	
<sign>	::=	<plus sign> <minus sign>	

The integer and fractional parts of a number are separated by a <period>; a comma is not permitted. No other separator (e.g. for thousands or multiples thereof) is allowed.

6.3.3 Date and time

In this International Standard calendar dates and times are restricted to the Gregorian calendar, the 24-hour clock and UTC as defined in ISO 8601:2004. Only the ISO 8601 extended format (separators between date units and between sexagesimal time units) is permitted; truncation and extension is not catered for. Any precision is allowed. Other date formats such as geological eras or calendars other than Gregorian may be stated through a free format quoted text string.

NOTE 1 It is anticipated that a more exhaustive treatment of date and time may be made in a revision to this International Standard which could follow the deliberations of the OGC Temporal domain working group and/or an update of ISO 19108:2002.

<datetime>	::=	<Gregorian calendar datetime> <Gregorian ordinal datetime>	
<Gregorian calendar datetime>	::=	<Gregorian calendar date> [<24 hour clock>]	
<Gregorian calendar date>	::=	<year> [<hyphen> <month> [<hyphen> <day>]]	
<year>	::=	<unsigned integer>	!! four digits
<month>	::=	<unsigned integer>	!! two digits including leading zero if less than 10
<day>	::=	<unsigned integer>	!! two digits including leading zero if less than 10
<Gregorian ordinal datetime>	::=	<Gregorian ordinal date> [<24 hour clock>]	
<Gregorian ordinal date>	::=	<year> [<hyphen> <ordinal day>]	

<ordinal day>	::=	<unsigned integer> <i>!! three digits including leading zeroes if less than 100</i>
<24 hour clock>	::=	<time designator> <hour> [<colon> <minute> [<colon> <second>]] <time zone designator>
<time designator>	::=	T
<hour>	::=	<unsigned integer> <i>!! two digits including leading zero if less than 10</i>
<minute>	::=	<unsigned integer> <i>!! two digits including leading zero if less than 10</i>
<second>	::=	<seconds integer> [<period> [<seconds fraction>]] <i>!! In this International Standard the separator between the integer and fractional parts of a second value shall be a period. The ISO 8601 preference for comma is not permitted.</i>
<seconds integer>	::=	<unsigned integer> <i>!! two digits including leading zero if less than 10</i>
<seconds fraction>	::=	<unsigned integer>
<time zone designator>	::=	<utc designator> <local time zone designator>
<utc designator>	::=	Z
<local time zone designator>	::=	{ <plus sign> <minus sign> } <hour> [<colon> <minute>]

NOTE 2 In ISO 8601 time zone designator may be omitted, in which case local time is assumed but unspecified. In this International Standard a time zone designator is mandatory.

EXAMPLE 1	2014	(Precision = year)
EXAMPLE 2	2014-01	(Calendar date, precision = month)
EXAMPLE 3	2014-03-01	(Calendar date, precision = day)
EXAMPLE 4	2014-060	(Ordinal date, precision = day)
EXAMPLE 5	2014-05-06T23Z	(Calendar date, precision = hour)
EXAMPLE 6	2014-157T23Z	(Ordinal date, precision = hour)
EXAMPLE 7	2014-07-12T16:00Z	(Precision = minute, UTC)
EXAMPLE 8	2014-07-12T17:00+01	(Precision = minute, local time one hour ahead of UTC)
EXAMPLE 9	2014-09-18T08:17:56Z	(Precision = second)
EXAMPLE 10	2014-11-23T00:34:56.789Z	(Precision = 1/1000 second)

6.3.4 CRS WKT characters

The characters permitted in elements of a CRS WKT string formed from those in 6.3.1, 6.3.2 and 6.3.3 are:

<left delimiter>	::=	<left bracket> <left paren> <i>!! In this International Standard the preferred left delimiter is <left bracket>. <left paren> is permitted for backward compatibility. Implementations shall be able to read both forms.</i>
<right delimiter>	::=	<right bracket> <right paren> <i>!! See 6.4</i>
<wkt separator>	::=	<comma>
<quoted Latin text>	::=	<double quote> <wkt Latin text character>... <double quote>

<wkt Latin text character>	::=	<simple Latin upper case letter> <simple Latin lower case letter> <digit> <underscore> <left bracket> <right bracket> <left paren> <right paren> <left brace> <right brace> <less than operator> <equals operator> <greater than operator> <period> <comma> <colon> <semicolon> <plus sign> <minus sign> <space> <number sign> <percent> <ampersand> <quote> <asterisk> <circumflex> <solidus> <reverse solidus> <question mark> <vertical bar> <degree symbol> <doublequote symbol>
<quoted Unicode text>	::=	<double quote> { <wkt Unicode text character> }... <double quote>
<wkt Unicode text character>	::=	<nondoublequote character> <doublequote symbol>
<nondoublequote character>	::=	!! A <nondoublequote character> is any character of the source language character set other than a <double quote>.
<doublequote symbol>	::=	"" !! two consecutive <double quote> characters

6.3.5 Double quote

Requirement: If a double quote is required within a <quoted Latin text> or <quoted Unicode text> string, a <doublequote symbol> shall be used.

EXAMPLE "Datum origin is 30°25'20""N, 130°25'20""E."

6.4 Delimiter

In WKT strings the attributes for an item are included within a pair of left and right delimiters. The delimiters should normally be <left bracket> and <right bracket>. Implementations are free to substitute parentheses for brackets. If <left bracket> is used as a <left delimiter> then <right bracket> must be used as the corresponding <right delimiter>; if <left paren> is used as a <left delimiter> then <right paren> must be used as the corresponding <right delimiter>. A nested token must use the same type of delimiter as the token in which it is nested.

Requirement: A CRS WKT string shall include only one of the two forms of delimiter, brackets or parentheses, allowed in 6.3.4.

6.5 Case sensitivity

WKT keywords are case insensitive. KEYWORD is equivalent to keyword is equivalent to KeyWord and to kEYwORD. Where human readability is important (as in the examples in this International Standard) keywords should be written in only the <simple Latin upper case letter> set. KEYWORD is not equivalent to KEY_WORD; the underscore character is significant.

WKT enumerations are case insensitive. CARTESIAN is equivalent to cartesian is equivalent to Cartesian; NORTH is equivalent to north is equivalent to North.

Within quoted text, case is significant. "H" is not equivalent to "h".

Requirement: Outside of quoted text, characters in a WKT string shall not be case sensitive.

6.6 Reserved keywords

The keywords defined in Clauses 7 through 18 of this International Standard for coordinate reference systems, coordinate operations, their component elements and their attributes are summarised here. Those formed

from multiple words or abbreviations are given in camel case to aid understanding; see 6.5 for implementation in a WKT string.

Keyword	BNF element	Clause in which defined
abridgedTransformation	<abridged transformation keyword>	18
anchor	<datum anchor keyword>	8, 10, 11, 12 and 13
angleUnit	<angle unit keyword>	7
area	<area description keyword>	7
axis	<axis keyword>	7
baseEngCRS	<base engineering crs keyword>	15
baseGeodCRS	<base geodetic crs keyword>	9 and 15
baseParamCRS	<base parametric crs keyword>	15
baseProjCRS	<base projected crs keyword>	15
baseTimeCRS	<base temporal crs keyword>	15
baseVertCRS	<base vertical crs keyword>	15
bBox	<geographic bounding box keyword>	7
bearing	<bearing keyword>	7
boundCRS	<bound crs keyword>	18
citation	<citation keyword>	7
compoundCRS	<compound crs keyword>	16
conversion	<map projection keyword>	9
coordinateOperation	<operation keyword>	17
cs	<cs keyword> (coordinate system)	7
datum	<geodetic datum keyword>	8
derivingConversion	<deriving conversion keyword>	15
eDatum	<engineering datum keyword>	11
ellipsoid	<ellipsoid keyword>	8
engCRS	<engineering crs keyword>	11 and 15
engineeringCRS	Alternative keyword for engineering crs	11 and 15
engineeringDatum	Alternative keyword for engineering datum	11
geodCRS	<geodetic crs keyword>	8 and 15
geodeticCRS	Alternative keyword for geodetic crs	8 and 15
geodeticDatum	Alternative keyword for geodetic datum	8
id	<identifier keyword>	7
iDatum	<image datum keyword>	12
imageCRS	<image crs keyword>	12
imageDatum	Alternative keyword for image datum	12
interpolationCRS	<interpolation crs keyword>	17
lengthUnit	<length unit keyword>	7
meridian	<meridian keyword>	7
method	(i) <map projection method keyword> (ii) <operation method keyword>	9 15 and 17
operationAccuracy	<operation accuracy keyword>	17
order	<axis order keyword>	7
parameter	<parameter keyword>	9, 15 and 17
parameterFile	<parameter file keyword>	15 and 17
parametricCRS	<parametric crs keyword>	13 and 15
parametricDatum	Alternative keyword for parametric datum	13
parametricUnit	<parametric unit keyword>	7
pDatum	<parametric datum keyword>	13
primeM	<prime meridian keyword>	8
primeMeridian	Alternative keyword for prime meridian	8
projCRS	<projected crs keyword>	9
projectedCRS	Alternative keyword for projected crs	9
projection	Alternative keyword for map projection method	9
remark	<remark keyword>	7
scaleUnit	<scale unit keyword>	7
scope	<scope keyword>	7
sourceCRS	<source crs keyword>	17
spheroid	Alternative keyword for ellipsoid	8

Keyword	BNF element	Clause in which defined
targetCRS	<target crs keyword>	17
tDatum	<temporal datum keyword>	14
timeCRS	<temporal crs keyword>	14 and 15
timeDatum	Alternative keyword for temporal datum	14
timeExtent	<temporal extent keyword>	7
timeOrigin	<temporal origin keyword>	14
timeUnit	<temporal unit keyword>	7
unit	Alternative keyword for all units	7
uri	<uri keyword>	7
vDatum	<vertical datum keyword>	10
vertCRS	<vertical crs keyword>	10 and 15
verticalCRS	Alternative keyword for vertical crs	10 and 15
verticalDatum	Alternative keyword for vertical datum	10
verticalExtent	<vertical extent keyword>	7

6.7 Backward compatibility

This document makes several references to backward compatibility. Backward compatibility means that an implementation of the text strings in this International Standard would be able to read CRS WKT strings conforming to the old (ISO 19125-1:2004) syntax. It does not mean that a parser of a string compliant to ISO 19125-1:2004 could read WKT strings written in conformance with this International Standard. It also does not require an implementation of the text strings in this International Standard to be able to output an object according to the old syntax. Annex B.8 gives guidance on determining the version of a CRS WKT string. A mapping of older syntaxes to this International Standard is given in Annex C.

7 WKT representation of common attributes

7.1 Introduction

The WKT representation of attributes that are common to coordinate reference systems and coordinate operations is described in 7.2 to 7.4. Coordinate systems are described in 7.5. Attributes specific to coordinate reference systems and to coordinate operations are described in Clauses 8 to 17.

7.2 Name

From a computational perspective name is redundant information provided for human readability. For example an ellipsoid is defined by the values of the semi-major axis and inverse flattening, and the ellipsoid name is redundant information. However the name may be used to verify the defining values against those from an authoritative source. Comment on the comparison of text strings is given in Annex B.

NOTE Name is a required attribute for the CRS object as well as for some component objects. Depending upon the convention adopted for CRS naming, this may result in duplication of name within the CRS WKT string.

7.3 Scope, extent, identifier and remark

7.3.1 Introduction

The BNF element <scope extent identifier remark> is a collection of four optional attributes which may be applied to a coordinate reference system, a coordinate operation or a boundCRS. <scope> is described in 7.3.2, <extent> in 7.3.3, <identifier> in 7.3.4 and <remark> in 7.3.5. The <scope extent identifier remark> collection is to simplify the BNF through grouping; each of the four attributes may appear separately in a WKT string.

Requirement: The WKT representation of a <scope extent identifier remark> element shall be:

```
<scope extent identifier remark> ::= [ <wkt separator> <scope> ]  
                                [ { <wkt separator> <extent> } ]...  
                                [ { <wkt separator> <identifier> } ]...  
                                [ <wkt separator> <remark> ]
```

7.3.2 Scope

Scope is an optional attribute which describes the purpose or purposes for which a CRS or a coordinate operation is applied.

Requirement: The WKT representation of a <scope> shall be:

```
<scope> ::= <scope keyword> <left delimiter>  
          <scope text description> <right delimiter>  
  
<scope keyword> ::= SCOPE  
  
<scope text description> ::= <quoted Latin text>
```

EXAMPLE SCOPE["Large scale topographic mapping and cadastre."]

7.3.3 Extent

7.3.3.1 Introduction

Extent describes the spatial applicability of a CRS or a coordinate operation. Extent in this International Standard uses the concepts described in ISO 19115:2003, *Geographic information – Metadata*. However this International Standard permits horizontal extent to be described by description or geographic bounding box, but not by polygon because of string length considerations. It also allows for vertical and temporal extent. These extent attributes are all optional. Multiple extent attributes may be provided, but there is a constraint that these must be of different types.

Requirement: The WKT representation of an <extent> shall be:

```
<extent> ::= <area description> | <geographic bounding box> | <vertical extent> | <temporal extent>  
          !! Constraint: each extent type shall have a maximum occurrence of 1.
```

7.3.3.2 Area description

Area description is an optional attribute which describes a geographic area over which a CRS or coordinate operation is applicable.

Requirement: The WKT representation of an <area description> shall be:

```
<area description> ::= <area description keyword> <left delimiter>  
                     <area text description> <right delimiter>  
  
<area description keyword> ::= AREA  
  
<area text description> ::= <quoted Latin text>
```

EXAMPLE AREA["Netherlands offshore."]

7.3.3.3 Geographic bounding box

The geographic bounding box is an optional attribute which describes a "north up" area. Upper right latitude will be greater than the lower left latitude. Generally the upper right longitude will be greater than the lower left

longitude. However when the area crosses the 180° meridian, the value of the lower left longitude will be greater than the value of the upper right longitude.

The geographic bounding box is an approximate description of location. For most purposes a coordinate precision of two decimal places of a degree is sufficient. At this resolution the identification of the geodetic CRS to which the bounding box coordinates are referenced is not required.

Requirement: The WKT representation of a <geographic bounding box> shall be:

```
<geographic bounding box> ::= <geographic bounding box keyword> <left delimiter>
                             <lower left latitude> <wkt separator> <lower left longitude>
                             <wkt separator> <upper right latitude> <wkt separator>
                             <upper right longitude> <right delimiter>
```

<geographic bounding box keyword> ::= BBOX

```
<lower left latitude>      ::= <number>      !! See text
```

```
<lower left longitude>      ::= <number>      !! See text
```

```
<upper right latitude>      ::= <number>      !! See text
```

```
<upper right longitude>      ::= <number>      !! See text
```

Requirement: bounding box latitude coordinates shall be given in decimal degrees in the range -90 to +90, longitude coordinates shall be given in decimal degrees in the range -180 to +180 relative to the international reference meridian.

EXAMPLE BBOX[51.43,2.54,55.77,6.40] for a geographic bounding box enveloping offshore Netherlands.

7.3.3.4 Vertical extent

Vertical extent is an optional attribute which describes a height range over which a CRS or coordinate operation is applicable. Depths have negative height values. Vertical extent is an approximate description of location; heights are relative to an unspecified mean sea level.

Requirement: The WKT representation of a <vertical extent> shall be:

```

<vertical extent> ::= <vertical extent keyword> <left delimiter>
                    <vertical extent minimum height> <wkt separator>
                    <vertical extent maximum height>
                    [ <wkt separator> <length unit> ] <right delimiter>

```

<vertical extent keyword>	::=	VERTICALEXTENT
---------------------------	-----	----------------

<vertical extent minimum height> ::= <number>

$$\langle \text{vertical extent maximum height} \rangle ::= \langle \text{number} \rangle$$

Requirement: If vertical extent units are not stated they shall be assumed to be metres.

EXAMPLE 1 VERTICALEXTENT[-1000,0,LENGTHUNIT["metre",1.0]]

EXAMPLE 2 VERTICALEXTENT[-1000,0] (where the heights are implicitly in metres).

7.3.3.5 Temporal extent

Temporal extent is an optional attribute which describes a date or time range over which a CRS or coordinate operation is applicable. The format for date and time values is defined in ISO 9075-2. Start time is earlier than end time.

Requirement: The WKT representation of a <temporal extent> shall be:

<temporal extent> ::= <temporal extent keyword> <left delimiter>
<temporal extent start> <wkt separator>
<temporal extent end> <right delimiter>

<temporal extent keyword> ::= TIMEEXTENT

<temporal extent start> ::= <datetime> | <quoted Latin text>

<temporal extent end> ::= <datetime> | <quoted Latin text>

EXAMPLE 1 TIMEEXTENT[2013-01-01,2013-12-31]

EXAMPLE 2 TIMEEXTENT["Jurassic","Quaternary"]

7.3.4 Identifier

Identifier is an optional attribute which references an external description of the object and which may be applied to a coordinate reference system, a coordinate operation or a boundCRS. It may also be utilised for components of these objects although this is not recommended except for coordinate operation methods (including map projections) and parameters. Multiple identifiers may be given for any object.

When an identifier is given for a coordinate reference system, coordinate operation or boundCRS, it applies to the whole object including all of its components.

Should any attributes or values given in the cited identifier be in conflict with attributes or values given explicitly in the WKT description, the WKT values shall prevail.

Requirement: The WKT representation of an <identifier> shall be:

<identifier> ::= <identifier keyword> <left delimiter> <authority name>
<wkt separator> <authority unique identifier>
[<wkt separator> <version>] [<wkt separator> <authority citation>]
[<wkt separator> <id uri>] <right delimiter>

<identifier keyword> ::= ID

<authority name> ::= <quoted Latin text>

<authority unique identifier> ::= <number> | <quoted Latin text>

<version> ::= <number> | <quoted Latin text>

<authority citation> ::= <citation keyword> <left delimiter> <citation> <right delimiter>

<citation keyword> ::= CITATION

<citation> ::= <quoted Latin text>

<id uri> ::= <uri keyword> <left delimiter> <uri> <right delimiter> }

<uri keyword> ::= URI

<uri> ::= <quoted Latin text>

Version is an optional attribute indicating the version of the repository or object that is cited. Citation is an optional attribute that may be used to give further details of the authority. URI is an optional attribute that may be used to give reference to an online resource.

NOTE In previous specifications the authority object was defined more narrowly than is identifier in this International Standard. See Annex C.

EXAMPLE 1 ID["Authority name", "Abcd_Ef", 7.1]

EXAMPLE 2 ID["EPSG", 4326]

EXAMPLE 3 ID["EPSG", 4326, URI["urn:ogc:def:crs:EPSG::4326"]]

EXAMPLE 4 ID["EuroGeographics", "ES_ED50 (BAL99) to ETRS89", "2001-04-20"]

Further examples are included in Clauses 8 to 17.

7.3.5 Remark

<remark> an optional attribute. Any information contained in a <remark> is informative. It does not modify the defining parameters of an object.

A <remark> may be applied to a coordinate reference system, coordinate operation or boundCRS as a whole. A <remark> should not be included in the WKT for components of a coordinate reference system or coordinate operation, but a remark in the coordinate reference system or coordinate operation object may include information about these components.

NOTE A <remark> can be included within the descriptions of source and target CRS embedded within a coordinate transformation as well as within the coordinate transformation itself.

Any character other than a <wkt Latin text character> that is to be contained in a CRS WKT string may be included only as part of <quoted Unicode text> within a <remark>.

Requirement: The WKT representation of a <remark> shall be:

<remark> ::= <remark keyword> <left delimiter> <quoted Unicode text> <right delimiter>

<remark keyword> ::= REMARK

EXAMPLE 1 REMARK["A remark in ASCII"]

EXAMPLE 2 REMARK["Замечание на русском языке"]

EXAMPLE 3 GEODCRS["S-95",
DATUM["Pulkovo 1995",
ELLIPSOID["Krassowsky 1940", 6378245, 298.3,
LENGTHUNIT["metre", 1.0]]],
CS[ellipsoidal, 2],
AXIS["latitude", north, ORDER[1]],
AXIS["longitude", east, ORDER[2]],
ANGLEUNIT["degree", 0.0174532925199433],
REMARK["Система Геодезических Координат года 1995(СК-95)"]]

Further examples including remarks are included in Clauses 8 to 17.

7.4 Unit and unit conversion factor

Some attributes of coordinate reference systems and coordinate operations are numbers which require the unit to be specified.

Requirement: The WKT representation of a <unit> description shall be:

<unit>	::=	<angle unit> <length unit> <scale unit> <parametric unit> <time unit>
<angle unit>	::=	<angle unit keyword> <left delimiter> <unit name> <wkt separator> <conversion factor> [{ <wkt separator> <identifier> }]... <right delimiter>
<length unit>	::=	<length unit keyword> <left delimiter> <unit name> <wkt separator> <conversion factor> [{ <wkt separator> <identifier> }]... <right delimiter>
<scale unit>	::=	<scale unit keyword> <left delimiter> <unit name> <wkt separator> <conversion factor> [{ <wkt separator> <identifier> }]... <right delimiter>
<parametric unit>	::=	<parametric unit keyword> <left delimiter> <unit name> <wkt separator> <conversion factor> [{ <wkt separator> <identifier> }]... <right delimiter>
<time unit>	::=	<time unit keyword> <left delimiter> <unit name> <wkt separator> <conversion factor> [{ <wkt separator> <identifier> }]... <right delimiter>
<angle unit keyword>	::=	ANGLEUNIT UNIT <i>!! In this International Standard the preferred keyword is ANGLEUNIT. UNIT is permitted for backward compatibility. Implementations shall be able to read both forms.</i>
<length unit keyword>	::=	LENGTHUNIT UNIT <i>!! In this International Standard the preferred keyword is LENGTHUNIT. UNIT is permitted for backward compatibility. Implementations shall be able to read both forms.</i>
<scale unit keyword>	::=	SCALEUNIT UNIT <i>!! In this International Standard the preferred keyword is SCALEUNIT. UNIT is permitted for backward compatibility. Implementations shall be able to read both forms.</i>
<parametric unit keyword>	::=	PARAMETRICUNIT
<time unit keyword>	::=	TIMEUNIT
<unit name>	::=	<quoted Latin text>
<conversion factor>	::=	<unsigned numeric literal>

<conversion factor> is the number of SI standard units per unit.

<identifier> is described in 7.3.4.

Requirements: If the unit is linear its conversion factor shall be to metres and is the number of metres per unit. If the unit is angular its conversion factor shall be to radians and is the number of radians per unit. For other unit types the appropriate SI standard unit shall be used. For scale, unity shall be used.

EXAMPLE 1 LENGTHUNIT["metre",1]

EXAMPLE 2 LENGTHUNIT["German legal metre",1.0000135965]