International Association of Oil & Gas Producers

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EPSG Guidance Note 373-07-6

EPSG Dataset - Policies and procedures for data management

EPSG
GEODETIC PARAMETER DATASET
https://epsg.org

Acknowledgements

This Report was written by the Geodesy Subcommittee of the IOGP Geomatics Committee.

About

This document collates all policies and procedures followed by the IOGP Geodesy Subcommittee for the management of data within the EPSG Dataset. Each chapter describes a separate policy or procedure. Most chapters first provide background information to introduce the topic and to give a historic context. Next, the actual procedural steps or policy items are listed. Some chapters end with a discussion section, elaborating on the dilemmas or consequences of the choices made.

Where a policy is defined in another document the text is copied here and reference given.

The main purpose of this document is to serve as the collective memory for the IOGP Geodesy Subcommittee. Hence, the main audience for this document is the IOGP Geodesy Subcommittee members. It is made publicly available for reasons of transparency, such that users of the Dataset and correspondents that request changes to the Dataset can understand the rules which are followed during data population. Policies that have evolved over time are placed in historic context.

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Revision history

VERSION	DATE	AMENDMENTS
1.0	December 2022	First release, collating policies previously within GN 373-07-1.
1.1	June 2025	Minor updates.

Contents

Introduction

The EPSG Geodetic Parameter Dataset, abbreviated to the **EPSG Dataset**, is a repository of parameters required to:

- define a *coordinate reference system* (CRS) which ensures that coordinates describe position unambiguously;
- define transformations and conversions that allow coordinates to be changed from one CRS to another CRS. Transformations and conversions are collectively called *coordinate operations*.

The EPSG Dataset is maintained by the IOGP. It conforms to ISO 19111:2019 – *Referencing by coordinates*. It is distributed in three ways:

i. the **EPSG Registry**, in full the *EPSG Geodetic Parameter Registry*, a web-based delivery platform with a graphic user interface (GUI) and an application programming interface (API). From this repository descriptions of CRSs and transformations may be output in well-known text (WKT) conformant to ISO 19162 or as GML documents
ii. the **EPSG Database**, in full *the EPSG Geodetic Parameter Database*, an MS Access relational database with content derived from the online registry
iii. in a relational data model as **SQL scripts** which enable a user to create an Oracle, MySQL, PostgreSQL, or other relational database and populate that database with the EPSG Dataset

The terms of use of the EPSG Dataset are available here.

IOGP Reports 373-07-01 through 373-07-06 form a multi-part document for users of the EPSG Dataset

- IOGP Report 373-07-01 (EPSG Guidance Note 7-1) – *Understanding the EPSG Dataset*, sets out detailed information about the Dataset content and its maintenance.
- IOGP Report 373-07-02 (EPSG Guidance Note 7-2) – *Coordinate conversions and transformations including formulas*, provides a detailed explanation of formulas necessary for executing coordinate conversions and transformations using the coordinate operation methods supported in the EPSG Dataset. Geodetic parameters in the EPSG Dataset are consistent with these formulas.
- IOGP Report 373-07-03 (EPSG Guidance Note 7-3) – *EPSG Registry API user guide*, is primarily intended to assist computer application developers who wish to use the RESTful API of the EPSG Registry to query and retrieve entities and attributes from the Dataset.
- IOGP Report 373-07-04 (EPSG Guidance Note 7-4) – *EPSG Database and SQL Script user guide*, provides guidance for users of the EPSG Database and SQL Scripts; these may be obtained from the EPSG Registry's *Download Dataset* page.
- IOGP Report 373-07-05 (EPSG Guidance Note 7-5) – *EPSG null and copy transformations to WGS 84*, explains aspects of the policies for the inclusion in the EPSG Dataset of datum ensembles and so-called null coordinate transformations to WGS 84, including limitations in the description of WGS 84 through code EPSG:4326.
- IOGP Report 373-07-06 (EPSG Guidance Note 7-6) – *EPSG Dataset - Policies and procedures for data management*, (this document), documents strategy for populating the EPSG Dataset.

The complete texts may be found on the EPSG Registry web site under Support Documentation.

The Part 2 of the multi-part Guidance Note is primarily intended to assist computer application developers in using the coordinate operation methods supported by the EPSG Dataset. It may also be useful to other users of the data.

1. Requests to add or change data

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

1.1. Introduction

Guidance Note 373-07-1 describes how an interested party (the external "Correspondent") can submit a request to IOGP to add or amend data in the EPSG Dataset. The procedure for review of such requests is described here. The same procedure is followed for IOGP internal requests. This process for reviewing and adding data is to guarantee a consistent and reliable Dataset content.

1.2. Procedure for review of change requests

Upon receipt of a request:

1. An admin will be assigned who will be the single point of contact for the external Correspondent.
2. Admin will review the request for being within scope of the Dataset. For requests received that are within scope, a Change Request will be generated in the Registry.
3. Requests received will be acknowledged by the IOGP Geodetic Subcommittee, normally with one working week of receipt.
    a. The EPSG feedback email distribution list will be used for correspondence.
    b. The allocated Change Request number will be used in correspondence.
    c. Additional information may be requested from the Correspondent at this time.
4. The request will be reviewed by the Subcommittee during regular meetings.
    a. The Subcommittee aims to process all requests within one or two regular meeting cycles. Correspondents will be advised of the decision reached as soon as it has been made.
    b. The Subcommittee may require the Correspondent to provide supplementary information before reaching a decision.
5. Should a request that is within scope of the Dataset be rejected for policy reasons, this will be clearly annotated as such. The Change Request will not contain any data changes.
6. Once the request is clear and the Subcommittee has reached a decision the admin will enter the data in the Change Request (hidden from public view).When a Change Request contains new data, two QC parties will be assigned by the admin to check the data once entry has been completed. For minor changes and corrections (e.g. to amend spelling in a remark) a single QC party may be assigned.
7. After QC is accepted, the Change Request is moved to the "Pending Release" state by the admin. The admin chooses whether the data will be made public through a Dataset release immediately or held back for release with other Change Requests.

8. Where new data is added, the code(s) for this are made public only at the time of the next Dataset release.
9. Once a Change Request has been released the admin notifies the Correspondent that a release has been made and that the Change Request is closed.

1.2.1. Guideline criteria for acceptance/rejection

Generally accepted are requests for systems that:

- Are in official use or requested by and their definition published by authoritative bodies such as national geodetic agencies, state regulator, scientific organizations, and professional bodies, or
- Are demonstrated to be in current active use in professional practice across several IOGP members and contractors.

Requests for new definitions that may be rejected from inclusion in the Dataset (examples):

- Systems that cannot be described through the EPSG data model (e.g. the North American legal survey systems).
- Temporal and parametric CRSs, which are outside of the scope of EPSG content.
- Definitions that do not follow common geodetic practice or are not geodetically sound (e.g. obscure projection methods that are not widely implemented or transformations that significantly differ from others in the area).
- Definitions of conversions or transformations with undocumented projection method math formulas.
- Definitions that carry significant overlap with existing definitions (e.g. a CRS using the same projection but that covers a slightly shifted area vs. an existing entry, or custom definitions using a different false northing).
- Definitions of supporting data for component parts of coordinate reference systems (such as ellipsoids, map projections or units) that are not utilized by a CRS or a coordinate operation entry in the EPSG Dataset.
- Single-purpose CRSs or entities used by or within a single organization (e.g. basin-specific projections for internal studies, college research projects)
- CRSs used for small-scale mapping as these systems tend to be designed for one particular map or atlas, including continental scale maps.
- Change requests with incomplete submissions that cannot be clarified or for which no response has been received after two requests for information are generally closed without action and the submitter notified.

Exceptions to the above may be made on a case by case basis.

1.2.2. Appeal process

Should a request be rejected, and the Correspondent appeals to revisit the decision, this appeal will be discussed in the next regular Subcommittee meeting and the outcome communicated to the Correspondent.

1.3. Detailed work instruction

This section contains some Subcommittee internal work instructions.

Email correspondence:

1. CC: feedback@epsg.org on all correspondence.
2. Subject: Insert Change Request number at start and clarify the request.
   a. For example, a reply to a request with initial subject "EPSG Dataset" could become "Re: 2022.077 EPSG Dataset Saudi Arabia transformation".
3. Body: In initial response make reference to this CR code requesting it be included in further correspondence. For example:

   Dear <Correspondent Name>,

   Thank you for your message. We have allocated this to change request 2022.077 – please include this reference in any further correspondence on this issue.

   <optional initial questions or observations>

   Regards,

   <Full name>

   For IOGP Geodesy Subcommittee

4. Final notification. For example (in this case after the release of the data):

   Dear <Correspondent Name>,

   The Amtrak CS21 data has now been published in the EPSG Dataset v10.076 release. EPSG CRS code 20050.

   We cannot add the version based on NATRF2022 until we have included the new reference frame in the Dataset, and we will not do that until NGS officially release it. At that time you should submit a new request for ACS22 to be included in the EPSG Dataset (and which should be trivial for us to process).

   We now consider this request to be closed. Thank you for your interest in the EPSG Dataset.

   Regards,

   <Full name of change request administrator ("admin")>
   For IOGP Geodesy Subcommittee

Change Request record style:

1. Reporter Name: Use syntax “[name]; [institution]”. If no institution (company) or affiliation is given, then use “personal capacity” or leave this blank. Affiliation should be captured for official requests. No full stop (period).

2. Request: For example: "Review Saudi Arabia transformation."
   a. Start with a verb (“add”, “amend”, “review”, “change”, “correct”, “update”, etc).
   b. Then includes country name.
   c. Then state the entity that is being addressed (CRS, transformation, map projection, extent, etc. or data when there are multiple types).
   d. Finish with a full stop (period).
3. Comment: Optional. Example: “CT 9383 verified as being correct, units are milliarc-seconds.”
4. Action:
   a. Begins with new entries using an action verb (e.g. "Added datum xxxx, CRSs xxxx-xxxx"), or if the CR involves deprecations "Deprecated transformation xxxx and added replacement xxxx".
   b. Then follow with any records that have had minor update. For these syntax "For [entity type] [code], in [field] [action]".
   c. The construct is to tell users where to look for changes. For example: "For CT 9334, in remarks corrected unit from arcsec to milli-arcsec."
   d. In the Action field use CRS (not Coordinate Reference System) but write out other entity names in full (transformation not CT, coordinate system not CS), because these other abbreviations are not in general usage and CS in particular is subject to misinterpretation.
5. Tables Affected and Codes Affected:
   a. Only existing records that were modified (updated, superseded, deprecated) are listed. New records are mentioned only in the Action field.
   b. Tables refers only to main tables. If data in an intersection table is changed, then only the parent table is named.
   c. When there are multiple tables they are listed as semi-colon separated, and the codes are (i) in semi-colon-separated groups in the same order as the tables, (ii) space separated.
   d. When there are many sequential codes they may be abbreviated, e.g., 21346-50.
   e. This syntax was designed such that it can be parsed by machine. Example:

Tables affected:	Datum; Coordinate Reference System; Coordinate Operation
Codes affected:	1294; 9471 9529; 9305 9629

General style instructions:

1. **Punctuation**: Use a full stop (period) to terminate text strings (such as Remark, Information Source), except when the string ends with an URI/URL (this to tell the reader that they are seeing the full text).
2. **Hyperlinks**: Only give the root URI, e.g., https://datahub.admiralty.co.uk/, to avoid tracking volatile changes.

2. Data correction and deprecation

Version	Date	Amendments
1	July 2002	First release as EPSG Guidance Note Number 12.
2	August 2004	Rules for deprecation of Transformation Name clarified. Incorporated into GN7 part 1; GN12 withdrawn.
3	April 2006	CRS name removed from critical data.
4	January 2007	Rules for EPSG duplicate to WGS 84 of ITRF transformations clarified.
5	July 2008	Minor text changes to allow for both registry and relational implementations.
6	June 2011	Transformation variant removed from critical data.
7	June 2022	Transformation version removed from critical data.
8	June 2023	Added missing long-standing policy that when names are changed an alias is added with the old name. Added comment on Show field.

2.1. Introduction

If errors are found in data, these are corrected as soon as possible. A change record will be maintained.

The IOGP Geodesy Subcommittee has adopted two distinct strategies for error correction, the first used up to July 2001[1] (up to and including the release of version 5.21 of the data set) and the second brought into effect from July 2001 (effective from the release of version 6.1 of the data set).

In both strategies a distinction is made between critical and non-critical data. Critical data is anything that would significantly affect the result of a mathematical operation applied to coordinates through a coordinate transformation or coordinate conversion (map projection), in particular changes to parameter values[2].

Codes uniquely identify entities and are permanent identifiers and therefore critical (codes cannot be changed after an entity is created and assigned a code).

Critical data also includes information that are significant to geodetic understanding, e.g., an incorrect Source CRS in a Transformation, even if that does not lead to numeric differences.

All other information is non-critical. Non-critical data includes (but is not limited to) *extent* and *remarks* as well as *names* of coordinate reference systems, datums, ellipsoids, map projections (conversions) and transformations.

[1] Prior to July 2001, erroneous data were corrected either through amendment or deletion and replacement of the record. Changes to critical data were recorded in the change table, the change record identifier included in the amended data record, and the date of the record changed to the date that the change was implemented. If non-critical data was amended the action may have been recorded in the change table, but regardless of this a change record identifier was not included in the amended data record.
[2] As a guide, changes in parameter values that lead to coordinate changes of more than 1mm or 0.1mm per year over a 10-year period might be used in contexts as suitable criteria in the evaluation of 'significant'.

2.2. EPSG policy for data correction and deprecation

From July 2001 (effective version 6.1 of the Dataset) the following rules have been adhered to:

1. No record will be deleted from the database.
2. If critical data is in error:
    i. The erroneous record will have its *deprecated* flag set to *true*. No other change will be made to the deprecated record.
    ii. The error will be corrected through the introduction of a replacement record. This replacement record will have a new code allocated but will carry the same name as the original (except when the name in the deprecated record is in error). The *revision_date* of this new record will be set to the date of the deprecation and replacement.
    iii. All records that are dependent upon the deprecated record (for example, projected coordinate reference systems using a deprecated projection) will themselves be deprecated and replaced as described in (a) and (b) above.
    iv. A change record will be entered into the Dataset.
    v. Details describing the reason for deprecation and the deprecation and replacement path will also be recorded in the Dataset.
3. Spurious or bogus records that are deprecated will not be replaced.
4. Records that are no longer valid will have their *deprecated* field set to “true” (or “yes” or "1"). Consequently, records with their *deprecated* field set to “false” (or “no” or “0”) are valid.
5. In many cases of deprecation and replacement, the name will be retained. For any one name, in any one entity type there will be no more than one valid record, i.e. no more than one record with the *deprecated* field set to “false”.
    - An exception to this rule is made within the CRS entity type where CRSs of type geocentric, geographic 3D and geographic 2D which are based on the same geodetic datum may carry identical names. Additionally, a name may be duplicated across different entity types.
6. Where non-critical data is amended:
    i. The *revision_date* in the affected data record will be updated.
    ii. A change record will be added to the Change table and this reference added to the *change_id* field of the affected record.
    iii. No change will be made to the record *code* or to any dependent records.
    iv. Where a transformation name has not been constructed according to the Naming Conventions in 6.2.8 of this document, it may be amended without deprecation to accord to those conventions.
    v. When the name of a CRS or CT is amended, the original name will be carried as an EPSG alias.

2.3. Discussion

In ISO 19135:2015, *Geographic information — Procedures for item registration* the action ‘invalidation’ and status ‘not valid’ are used in place of ‘deprecation’ and ‘deprecated’. The EPSG term ‘minor update’ is a ‘clarification’ in ISO 19135.

For coordinate operations utilising grid files, a change of grid file name is considered non-critical provided the file data format and grid content have not changed. If space permits, the previous name is added to the coordinate operation remarks.

For coordinate operations utilising grid files, should the information source change the file format in which the grid file is distributed, if the resultant coordinates do not change the EPSG record may be updated for change of the method and name through a minor update.

For null transformations, a record may be updated for a change of the method through a minor update, for example a 15-parameter Helmert transformation where all translation, rotation and scale parameter values are zero may be changed to a 7-parameter Helmert transformation. The change of method has no effect on coordinate transformation results.

3. Supersession

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

3.1. Introduction

Supersession is used to indicate that a technically-improved replacement is available. In the EPSG Dataset, the supersession state does not impact record validity: validity is shown through the deprecation indicator. Superseded data remains valid.

In v6.6 (October 2004), a "Supersession" entity (Access table) was added to the Dataset. Although in principle applicable to any entity, it has been populated mainly for transformations, specifically to assist automated selection of transformation variant.

In v6.6 three forms of supersession were recognized:

- Replacement. The information has been withdrawn and replaced by its information source.
- Retirement. The information has been withdrawn by its information source and not replaced.
- Supersession. The old and new run in parallel. Adoption of the newer system is generally encouraged, but for backward compatibility reasons the older system remains in use.

In v6.13 (July 2007), these forms of supersession were redefined to bring them into closer alignment with the ISO 19135, Geographic information - Procedures for item registration. ISO 19135 uses the terms 'supersede' and 'retire' as status flags for life cycle management of data, making the data no longer valid for current usage.

From EPSG Dataset version v6.13 two forms of supersession were recognized:

- Retirement: item deemed no longer suitable for use in production of new data. In the context of geodetic parameters, adoption of a newer system is generally encouraged, but for backward compatibility reasons the older system may remain in use in parallel with a new system.
- Supersession: deprecated by the information source (as opposed to IOGP) because there is a significant problem with the data. Such records may then also be deprecated in the EPSG Dataset.

However, of these, only supersession was used for data population. From version 10.0 (September 2020), retirement is not an option supported by the GUI registry management software.

3.2. EPSG policy for supersession

1. Supersession will be populated for transformations, specifically to assist automated selection of transformation variant.

2. CRS definitions do not become obsolete because external data may be referenced to them. As such, supersession will rarely be used for CRSs. However, when the CRS is *defined* by a transformation and that transformation has been marked as superseded, the CRS will also be marked as superseded.

4. Dataset releases

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

4.1. Introduction

This Section describes the policy for releasing completed Change Requests.

4.2. EPSG policy for Dataset releases

1. EPSG Dataset version numbering is of the form mm.nnn, for example, 10.123.
    a. The major version number (mm) will increment when a data model change is made (v10 was introduced to align with ISO 19111:2019).
    b. The minor version number increments with each release made in the Online Registry.
    c. Minor version values with trailing zeroes (e.g., 10.120) are not used.
2. Releases may be made as soon as data has been processed, although multiple change requests completed closely in time may be consolidated into batches and released together.
3. Notification of a release or group of releases will be sent to Registered users who subscribed to the EPSG Dataset distribution list.
4. A release information history table is maintained, summarizing the changes in the new release.
5. **Archive**: The relational implementations (Access and SQL scripts) will be generated from the published online registry Dataset content as part of the release of data online and made available for download. Earlier versions of these will be archived on the epsg.org website. The archive may omit some (interim) releases for which there is no benefit to be available (for example it may be required to make a release to edit an entity, and a next release immediately thereafter to deprecate it or supersede it, due to limitations of the Registry. In such cases only the later files are guaranteed to be archived).
6. Well-known text (WKT) conformant to ISO 19162 (so-called 'WKT2') for CRSs, transformations and point motion operations will be generated from the published online registry Dataset content as part of the release of data online and made available for download.

4.3. Discussion

Legacy policy prior to v10 (September 2020)

1. ‘Full release’ means data published through the online registry and derived formats, in particular the Access database and SQL scripts. ‘Interim release’ means data published only through the online registry.
2. Full releases will have a version number of the form x.y, for example 6.17. Interim release will have a version number of the form x.y.z, for example 6.17.2.
3. Full releases will be published approximately twice per year.
4. For the registry only, interim releases may be made as soon as data have been processed.
5. At each full release the relational implementations (Access and SQL scripts) will consolidate all data released through registry interim releases since the previous full release.
6. On publication of a new full release, the previous full release is moved to the Dataset archive.

Release Notification

An example of a typical release notification is as follows:

> **EPSG ver 10.074 release and EPSG API User Guide release**
>
> This message is to inform you about recent releases of the EPSG Dataset and the publication of the EPSG Registry API User Guide.
>
> **EPSG v10.072, 2022-07-24**, includes change requests 2022.064 through 2022.067 with the data changes outlined below:
>
> - Correction to bounding box for an extent in each of Argentina, Ireland, Portugal (Azores), St Lucia and United Kingdom (UK).
> - Minor correction to several other extent bounding boxes.
>
> **EPSG v10.074, 2022-07-29**, includes change requests 2022.056, 2022.061, 2022.062, 2022.063 and 2022.069 with the data changes outlined below:
>
> - New data for Chile and Indonesia.
> - Minor changes to data for Canada and Saudi Arabia.
> - Removal of spurious datum code from approximately 40% of projected CRS records.
>
> Newly published EPSG Registry API User Guide [https://epsg.org/API_UsersGuide.html] provides assistance to computer application developers who wish to use the RESTful API of the EPSG Registry to query and retrieve entities and attributes from the Dataset.
>
> All recent changes to the EPSG Dataset can be viewed in Release Information History Table [https://epsg.org/whatsnew.html]. For previous EPSG versions see Archives [https://epsg.org/archives.html].
>
> To suggest data additions or modification of existing EPSG data, follow instructions from EPSG Data Contact [https://epsg.org/dataset-change-requests.html].
>
> Thank you,
>
> IOGP Geodesy Subcommittee

5. Entity codes

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
1.1	February 2007	Deprecation rules updated. Policy on code uniqueness clarified. (Rev. 2.1 within GN 373-07-1).
1.2	August 2012	Corrected code range for deprecated geographic CRSs with coordinates in explicitly described degree representations (Rev. 8 within GN 373-07-1).
3	June 2022	Transferred from GN 373-07-1 and updated.

5.1. Introduction

In the EPSG Dataset codes are assigned to CRSs, coordinate transformations, and their component entities (datums, projections, coordinate systems, etc.). Within each entity type, every record has a unique code. An exception is that for the two 'top level' entity types – CRSs and coordinate operations – codes are unique across both of these entity types.

Whilst EPSG codes are unique within any one entity type, the same code value may be used for multiple entities of different types. For example, the code value "1234" is used to identify an extent as well as a transformation, code "2345" is used for both a CRS and an extent.

The corollary is that for an EPSG code to be unique it is necessary to identify both the entity type and the code, for example CRS 2345 or extent 2345.

For most entity types, codes are integers but for change records codes are real numbers. In very early versions of the Dataset codes embodied a meaning, for example codes for coordinate operations began with the digit 1, the EPSG codes of US State Plane projections were related to the FIPS code, etc. However, this quickly broke down through lack of code range available and it is unsustainable when entities may be deprecated and replaced. Now codes are assigned sequentially and no meaning should be interpreted.

With effect from EPSG Dataset version 6.3 (February 2003), the integer range from 60,000,000 to 69,999,999 was used for codes of geographic CRSs with coordinates in explicitly described degree representations. Support for this mechanism was withdrawn from Dataset v6.4 (January 2004). The records have been deprecated, but they remain in the Dataset.

5.2. EPSG policy for entity codes

1. Codes for primary entity types are within the range 1024 to 32766 inclusive[3].

[3] Code for intersection tables have dual keys consisting of the codes of the primary entities which they join together. In these tables the 'EPSG code' is not accessible through the registry API and is considered not to be an EPSG code. These codes, in particular those for aliases, do not follow the policy and may have values outside of the reserved range.

2. No overlap of code values within the union of coordinate reference system and coordinate operation entity types.
3. Codes for deprecated records have not been and will not be reused[4].

5.3. Comment

Users who wish to augment the EPSG data with their own information should utilize codes greater than 32767. This will prevent conflict with future additions to the EPSG Dataset. IOGP does not monitor codes used by third parties. To avoid clashes between potentially overlapping codes of third parties the codespace should additionally be used to uniquely identify the entity (where codespace is also known as Issuer or Authority in various software).

[4] The EPSG deprecation policy came into effect in - versions 5.3 and 6.1 of the Dataset (February 2002). From that time significantly erroneous data is not removed from the Dataset but retained in the registry tables and flagged as deprecated.

6. Naming conventions

Version	Date	Amendments
0.1	August 2000	Geodesy working group internal draft
1	January 2002	First release as EPSG Guidance Note Number 9.
2	January 2003	Added provisions for degree representations.
3	January 2004	Withdraw provisions for degree representations and amend provisions for geographic 3D systems.
4	August 2004	Incorporated into GN7 part 1; GN9 withdrawn.
5	March 2008	Convention for Vertical CRS amended to include suffix.
6	October 2017	Convention for Vertical CRS amended to include unit.
7	June 2022	Reviewed.

6.1. Introduction

This section documents the strategy and style adopted for the systematic allocation of names of records included in the EPSG Dataset.

To assist users who wish to use names rather than codes as keys, with two exceptions described below the IOGP Geodesy Subcommittee endeavours to retain uniqueness within each entity across the names of coordinate reference systems, coordinate operations and other primary entities.

Although there is no global standard for naming geodetic entities, as far as is possible the IOGP Geodesy Subcommittee adopts the official or popular name or its English language equivalent, if necessary modified to remain unique within the EPSG Dataset. The conventions adopted for naming in the EPSG Dataset are detailed below.

Exceptions:

- Deprecated records: Replacement records may, indeed often will, carry the same name as that of the record that has been deprecated. However, within any one entity type names should be unique across valid records (that is, records that have not been deprecated).
- Geodetic Coordinate Reference Systems: Where geographic CRSs are derived from a geocentric CRS and based on the same geodetic datum, they will generally have the same name as each other. But the combination of name and geodetic CRS subtype will be unique across valid records.

6.2. EPSG policy for naming conventions

6.2.1. General

1. **Names** are limited to 80 characters. Where names exceed 24 characters, or if an abbreviation is in common usage, an abbreviation is constructed (as an alias).

2. **Abbreviations** are normally limited to 32 characters (raised from 24 characters with effect from the v8.9.1 release of May 2016).
3. Names will use characters from the standard 128-character ASCII code set. There are two exceptions:
   (i) the degree symbol (ISO/IEC 10646:2012 character identifier U+00B0 [do not use other very similar characters from other character-set planes]
   (ii) country names in which the ISO 3166 English short name includes accented Latin characters, e.g., Côte d'Ivoire
4. Other text fields such as remarks may use additional UTF-8 characters.
5. Names and abbreviations can be changed – see Data Correction and Deprecation Policy.
6. Within any one entity type (corresponding to database table), names shall be unique except when:
   (i) the entity is a direct replacement for a deprecated record, or
   (ii) the entity is a 2- or 3-dimensional geographic CRS based on a geodetic (geocentric) CRS having the same datum.

The following sub-sections provide specific examples and conventions for various records.

6.2.2. Datums (reference frames)

Datums and reference frames are allocated a name, usually in English, which corresponds to the local naming of the reference frame. This may be the name of the fundamental point, network adjustment, etc. Long names may also be allocated an abbreviation. For example:

European Datum 1950	datum name
ED50	datum abbreviation

6.2.3. Geodetic coordinate reference systems

Geodetic CRSs are allocated a name which is the abbreviation (if it exists) of the related geodetic datum else the geodetic datum full name, followed by the prime meridian name in parentheses. However, when the prime meridian is Greenwich, it is omitted from the Geodetic CRS name. For example:

NGO 1948 (Oslo)	prime meridian is Oslo, i.e., not Greenwich.
NGO 1948	prime meridian is Greenwich by implication.
ED50	prime meridian is Greenwich by implication.

In choosing the Geodetic CRS name, consideration should be given to its use as a succinct part of a projected coordinate reference system name.

Where geodetic CRSs have geocentric, geographic 3D and geographic 2D subtypes, three CRS entries will be included in the Dataset. All three will have unique CRS codes but will carry the same CRS name. (Note: for settings requiring unique names, see discussion below).

6.2.4. Map projections

Map projections are allocated a name, usually in English, which corresponds to the local naming convention. A country prefix may be added when local naming might result in ambiguity in a global database.

For projections in non-metric units, and metric projections with a non-metric equivalent, the name includes the unit in parentheses as a suffix, and the abbreviation includes the unit abbreviation in parentheses as a suffix. Examples:

Congo Transverse Mercator zone 14	name (metric, no non-metric exists)
Congo TM zone 14	abbreviation (metric, no non-metric)
SPCS83 Idaho West zone (US Survey feet)	name (non-metric)
Idaho West (ftUS)	abbreviation (non-metric)
SPCS83 Idaho West zone (meters)	name (metric when non-metric exists)
Idaho West (m)	abbreviation (when non-metric exists)

UTM zones include a hemisphere suffix. For example:

UTM zone 31N

In abbreviations the word 'zone' may be omitted.

For a Transverse Mercator projection which takes UTM parameter values other than central meridian and has no local name, the name assigned in the EPSG Dataset comprises TM, space, longitude of natural origin value, space, two characters to indicate hemisphere quadrant. For example:

TM 56 SW	a projection with origin at 0°N, 56°W, scale factor of 0.9996, false easting of 500,000m and false northing of 10,000,000m.

Zoned Gauss-Kruger projections are found with and without a zone prefix to the false easting value. In some areas both 3-degree and 6-degree wide zones are encountered. In the absence of a given naming convention, in the EPSG Dataset the 6-degree zone is considered standard and the 3-degree wide zone explicitly named. :

Gauss-Kruger CM 111E	a 6-degree-wide projection without prefix to FE, i.e. FE = 500,000m, with the longitude of natural origin being 111ºE.
Gauss-Kruger zone 19	a 6-degree-wide zone with zone number 19 prefix to FE, i.e. FE = 19,500,000m.
3-degree Gauss-Kruger zone 19	a 3-degree-wide zone with zone number 19 prefix to FE, i.e. FE = 19500000.

6.2.5. Projected coordinate reference systems

Projected coordinate reference systems (ProjCRS) are usually allocated a name comprising the base CRS abbreviation (if it exists) else base CRS name, space/space, projection abbreviation (if it exists) else projection name, for example:

PSAD56 / TM 56 SW
Pulkovo 1942 / Gauss-Kruger zone 19

Universal Transverse Mercator (UTM)

For projected CRSs using a UTM projection there is no internationally accepted convention for coordinate and axis order, or for prefixing the easting coordinate with zone number. In the EPSG Dataset a UTM CRS with easting coordinate before northing coordinate and no zone prefix to the easting is considered ‘standard’ and the projection part of the CRS name assigned will be 'UTM', space, ‘zone’, space, zone number (1 through 60), one character to indicate northern or southern hemisphere, for example:

ETRS89 / UTM zone 33N	EPSG UTM standard, CS axes easting-northing.

UTM CRSs used locally with northing coordinate before easting coordinate and/or with easting coordinate prefixed with zone number may be added to the Dataset on demand. These will be given a different name to that just described. This may be as known locally, or the projection part of the CRS name given a suffix indicating the ‘non-standard’ axis order and false eating value. For example:

ETRS89 / UTM zone 33N (N-E)	axis order northing, easting.
ETRS89 / UTM zone 33N (zE-N)	axis order easting (with zone prefix), northing.
ETRS89 / UTM zone 33N (N-zE)	axis order northing, easting with zone prefix.

In these ‘non-standard’ UTM projected CRSs an alias added using the conventional EPSG naming convention as described in the previous paragraph is added. In the three examples above each will have the alias *ETRS89 / UTM zone 33N*.

Non-metric units

When projected CRSs are encountered in different units, for example metres and feet, unit names or abbreviations will be appended to the map projection names and unit abbreviation appended to the non-metric projected CRS name. To minimize string lengths, unit abbreviations will not be appended to the metric projected CRS, or to projected CRSs found only in one non-metric unit. For example:

NAD83 / Tennessee	is metric.
NAD83 / Tennessee (ftUS)	is non-metric.

but

NAD27 / Tennessee	is non-metric because no metric version exists.

6.2.6. Vertical coordinate reference systems

Vertical coordinate reference systems (VertCRS) are allocated the name of the related vertical datum abbreviation (if it exists) else the vertical datum name, space, height or depth, followed by the unit abbreviation in parentheses. However, if the unit is metre the unit abbreviation is omitted. Examples:

CD Norway depth	is metric.
NAVD88 height	is metric.
NAVD88 height (ftUS)	is non-metric.
CBVD61 height (ft)	is non-metric although no metric version exists.

6.2.7. Compound coordinate reference systems

Compound coordinate reference systems are allocated a name comprising the GeogCRS or ProjCRS abbreviation (if one exists) else name, space+space, VertCRS abbreviation (if one exists) or name, for example:

NAD83 + NAVD88 height
NAD83 / UTM zone 15N + NAVD88 height

6.2.8. Coordinate transformations

Transformations are allocated a name comprising source GeogCRS abbreviation (if one exists) else name, space, “to”, space, target GeogCRS abbreviation (if one exists) or name, space, (transformation variant). For example:

ED50 to ETRS89 (10)

Transformation version (maximum string length 24 characters) is given with a format of: information source abbreviation, hyphen, ISO 3-character country code (first character capitalized, last two lower case) followed by a cryptic string, the whole being unique across that source-target pairing. For example:

IGM-Ita Sic	Transformation from Italian Istituto Geografico Militare (IGM) for Sicily.
DMA-Ita Sic	Transformation from Defense Mapping Agency (DMA) for Sicily.
DMA-Ita Sar	Transformation from DMA for Sardinia.

6.2.9. Extents

Extent Description should begin with country name (using the spelling in English from ISO 3166, Country Codes) followed by a hyphen (character code 002D) and subdivision(s) including onshore and offshore. If the country name is frequently abbreviated then an abbreviation in parentheses should immediately follow the name. Subdivisions are usually given in alphabetical order. When the extent covers multiple countries, each is given in alphabetical order. The description should end with a full stop (period). Maximum string length is 4000 characters. Examples:

Germany - onshore and offshore.
United States (USA) - Texas onshore.
Austria - Lower Austria. Czechia - Moravia and Silesia.
Uruguay - east of 54°W, onshore and offshore.

Extent Name is a cryptic summary limited to 80 characters and ideally significantly less than this, used only in look-up boxes. For extents covering multiple countries it should begin with the region. For countries with well-known abbreviations only the abbreviation is used. For maritime states the country name implies both onshore and offshore. The string should not have a full stop (period) at its end. Examples (for the same extent descriptions above):

Germany
USA - Texas
Europe - Lower Austria and Moravia
Uruguay - east of 54°W

6.3. Discussion

6.3.1. Geodetic CRSs

Where EPSG Dataset data is mapped into a setting requiring unique names as the record key, the following strategy is followed. Where the entry in the EPSG Dataset includes an alias for ISO geodetic register name, use that. For EPSG entries without an ISO geodetic registry name alias, use the construct from ISO 19127 which the ISO geodetic registry follows: the EPSG name should be replaced by a name consisting of the EPSG name followed by a space-hyphen-space and the ISO GR acronym for the CS type, for example:

EPSG Code	EPSG Name	CRS subtype	Recommended unique name
7789	ITRF2014	geocentric	ITRF2014 - XYZ
7912	ITRF2014	geographic 3D	ITRF2014 - LatLonEht
9000	ITRF2014	geographic 2D	ITRF2014 - LatLon

Prior to the introduction of the ISO geodetic registry, the recommendation in EPSG documentation for when there was a requirement for unique names of geodetic CRSs was to use CRS subtype in parentheses as the suffix, i.e., ITRF2014 (geocentric), ITRF2014 (3D), and ITRF2014 (2D).

6.3.2. Vertical CRSs

The suffix "height" or "depth" as appropriate was added from Dataset version 6.15 (April 2008).

From Dataset version 9.2 (October 2017) a unit abbreviation has been suffixed to all non-metric vertical CRS names even when no metric equivalent exists. In this respect the naming convention for vertical CRSs differs from that for projected CRSs.

6.3.3. Bound CRSs

The EPSG Dataset does not contain Bound CRSs. It is recognized that it is useful to know which combination of CRS and transformation version should be used in a specified operational area, but the EPSG view is that it is for end users to make their individual decision in this respect.

Many applications (incorrectly) require that a coordinate reference system definition includes a transformation to a standard CRS, usually WGS 84. Where this practice exists, it is recommended that the transformation version is appended to the GeogCRS name, separated by space*space. For example:

*ED50 * IGN-Fra*
*ED50 * EPSG-Nor N62 2001*
*ED50 * NMA-Nor 6265W 1997*

This guarantees a unique Bound CRS name. For applications that do not expose the EPSG codes this name may be extended by the CRS EPSG code and the CT EPSG code in square brackets, separated by a comma, for example:

*ED50 * IGN-Fra [4230,1275]*
*ED50 * EPSG-Nor N62 2001 [4230,1612]*
*ED50 * NMA-Nor 6265W 1997 [4230,1590]*

For projected CRSs the GeogCRS element of the projCRS name may be modified, or the transformation version appended, depending on preference. For example:

*ED50 / UTM zone 32N * EPSG-Nor N62 2001*

or

*ED50 * EPSG-Nor N62 2001 / UTM zone 32N*

A characteristic of the first convention is that the EPSG names remain intact which may be easier to understand for users, and it is easy to implement. The second convention sorts the projected CRSs by transformation (area). However, note that not all EPSG names contain a solidus (/) and hence one might want to add this in the Bound CRS name under this convention.

As for the Bound Geographic CRSs, for applications that do not expose the EPSG codes to end users this name may be extended by the CRS EPSG code and CT EPSG code in square brackets, separated by a comma. For example:

*ED50 / UTM zone 32N * EPSG-Nor N62 2001 [23032,1612]*

or

*ED50 * EPSG-Nor N62 2001 / UTM zone 32N [23032,1612]*

Names are for human end-users. Codes (not names) should be used by computers to identify the CRS. Some systems use a convention to create an integer code for Bound CRSs using the following formula:

*(BoundCRS code = CRS code * 1000 + CT variant)*

where the CT variant is that for the transformation to WGS 84. This formula is used to avoid integers outside of the 4B signed integer range (2^31= 2,147,483,648). In the above examples, the transformation IGN-Fra to WGS 84 is variant 17, so the code for the Bound CRS would be 4230017, and the EPSG-Nor N62 2001 CT is variant 23, leading to the Bound CRS code 23032023.

Note that the same transformation version name *IGN-Fra* is used for transformation *ED50 to ETRS89 (10)* as for *ED50 to WGS 84 (17).*

7. Units and their symbols

Version	Date	Amendments
1	November 2022	Initial version, parts moved from former GN 373-07-1.

7.1. Introduction

This section provides policy for units in EPSG Dataset reports and forms.

7.2. EPSG Policy for formatting of units and their symbols in forms and reports

1. **Symbols for sexagesimal degrees**: Following ISO 6709:2022, *Standard representation of geographic point location by coordinates*, following symbols should be used also for parameter values:
    a. U+00B0 for degree: ° (degree symbol)
    b. U+0027 for arcminute: ' (apostrophe)
    c. U+0022 for arcsecond: " (quotation mark)

2. **Negative values**:
    a. U+002D for negative: - (hyphen/minus)

3. **Whitespace**: Add a space for legibility when reporting angles in DMS, e.g., 33° 45' 08" N (note: this deviates from ISO 6709).

4. **Reporting projected CRS ellipsoid parameters**: When showing the values of ellipsoid parameters as part of a projected CRS, the semi-major axis is given in the same unit of measure (UoM) as used by the projected CRS CS axes, i.e., to convert it from the unit stored in the EPSG Dataset to the unit of the map projection if these are not the same.

    For example, for projected CRS code 2919 [NAD83(HARN) / Texas South Central (ftUS)] the CS axis unit of measure is "US survey foot" (UoM code 9003). The ellipsoid used is GRS 1980 (code 7019) for which the ellipsoid axis UoM is "metre" (code 9001). Hence in reports it is recommended to convert the value of the ellipsoid semi-major axis of 6378137.0 m to 20925604.474 ftUS.

8. Data population of extents

Version	Date	Amendments
1	October 2008	Initial version, within GN 373-07-1.
1.1	August 2012	Added discussion of area polygons (Rev. 8 within GN 373-07-1).
2	September 2020	Modelling aligned with ISO 19115-1. 'Area' replaced by 'Extent'.
2.1	June 2022	Transferred from GN 373-07-1 and updated.
2.2	June 2023	Added missing policy that extent of a CT must be within the overlap of source and target CRS.

8.1. Introduction

Data supplied by IOGP is not an authority on the location of political boundaries. Polygons are generalized and may exclude detail, and are not intended to serve as basemap vector layers. They are provided to facilitate search and selection of geodetic entities appropriate for data in that location, and to avoid selection of inappropriate entities.

Datum, coordinate reference system, and coordinate operation entities are associated with one or more Usages where each Usage consists of a Scope and an Extent.

The EPSG Dataset implements the model from ISO 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals* for Extent. ISO 19115-1 defines the components of Extent to be:

- **Description**: A text field describing the extent, for example "New Zealand - North Island". In the EPSG Dataset this text field is considered to be the primary element of an extent, being used in text searches. The text should contain geographic names only within the valid extent and not include other geographical names, for example "Germany ... excluding Brandenburg state west of 12°E".
- **Geographic Bounding Box**: With effect from v6.6 (October 2004), bounding geographic maximum and minimum coordinates were added to the Dataset. Four fields giving the approximate (0.01 degree = 1 mile or 1.5 km precision) latitude and longitude limits for the area. The values are referenced to the WGS 84 geographical 2D CRS and are given in decimal degrees.
  - For areas straddling the 180° meridian, the "west" longitude will have a higher absolute value than the "east" longitude.
  - These bounding boxes can be used for searches, but the nature of bounding boxes means that as well as the area over which a geodetic entity is used they include much spurious territory. A better representation of area is given by the area polygon (see below).
  - Since Dataset v8.0 (August 2012) bounding box coordinates have been generated from the bounding polygons.
- **Bounding polygon**: This data was first populated in Dataset v8.0 from August 2012. The polygons are also made available in Shapefile and GML formats through the EPSG website. The polygons have been prepared for use at a nominal map scale of about 1:15,000,000. The international and administrative area boundary data included has been taken from several publicly available sources.
- **Vertical extent**: This data was first populated in Dataset v10.0 from September 2020.
- **Temporal extent**: This data was first populated in Dataset v10.0 from September 2020.

In addition to these ISO 19115-1 attributes, an EPSG extent includes:

- **Extent name**: A short cryptic text field. This field should not be confused with or used as a substitute for the extent description. Although this name often summarizes the extent description it is not an abbreviation and may contain other data.
- **Country codes**: Taken from ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country code*. These fields are populated only for extent records which are complete single countries. In ISO 3166, a "country" is a landmass. In the EPSG Dataset a "country" includes the offshore limits of maritime states. For most EPSG extent records – subdivisions of a country or regions including multiple countries – the country code fields are not populated. The presence of ISO 3166 country codes indicates that the extent represents a country.

8.2. EPSG policy for population of extents

1. **Extent description**
   a. A description is mandatory. It will always include country name (using the spelling in English from ISO 3166) and may also include administrative divisions within a country or other geographical constraints such as longitude limits of a projection zone.
2. **Extent name**
   a. The extent name field is used only to list extent records in a compact manner for selection purposes in a graphic user interface.
3. **Bounding box coordinates**
   a. Latitudes are in the range ($-90° \leq \varphi \leq +90°$) and longitudes are in the range ($-180° \leq \lambda \leq +180°$).
   b. Coordinates are stored in decimal degrees to a resolution of 2 decimal places.
   c. Coordinates are computed from the extent's bounding polygon, rounded outwards such that the extent's bounding polygon will always be contained within the bounding box. For example, if the westernmost and easternmost vertices in a bounding polygon have longitudes of 48.01234° and 55.01234° respectively, the bounding box westBoundLongitude will be 48.01° and the eastBoundLongitude will be 55.02°.
4. **Bounding polygon**
   a. The bounding polygons supporting the EPSG Dataset are maintained outside of the registry in a GIS application as a Shapefile.
   b. The polygon is densified if neighbouring nodes are more than 1/3 of a degree apart. The maximum spacing between vertices is 1/3 of a degree.
   c. GML exported from the Registry follows ISO 19136-1:2020, *Geographic information – Geography Markup Language (GML) – Part 1: Fundamentals* and the Simple Feature geometry provisions of ISO 19125-1:2004, *Geographic information – Simple feature access – Part 1: Common architecture* in which a polygon may consist of one closed ring, or multiple exterior and/or interior rings. The coordinates of the vertices are ordered anti-clockwise such that the area is to the left of an exterior ring and to the right of an interior ring. (This is the opposite convention to that used for Shapefiles).
   d. Latitudes are in the range ($-90° \leq \varphi \leq +90°$). For polygons that do not cross the 180° meridian longitudes are in the range ($-180° \leq \lambda \leq +180°$). For polygons which cross the 180° meridian, longitude values to the east of the 180° meridian are always greater than longitude values to the west of the 180° meridian, with longitudes in one of the ranges ($-180° \leq \lambda \leq +360°$) or ($-360° \leq \lambda \leq +180°$), using whichever range minimizes the extent beyond the range ($-180° \leq \lambda \leq +180°$).

e. Adjacent polygons are consistent along their common border.
f. For maritime states, onshore polygons are taken out to the 3NM line unless there is some legal reason to make this not to, e.g., Texas is 3 leagues = 12NM. Offshore polygons are taken in to the coastline.
g. The extent of a geodetic, vertical or engineering CRS must be within the extent of its datum.
h. The extent of a projected CRS must be within the union [overlap] of the extents of the projected CRS's base geographic CRS and map projection.
i. The extent of a compound CRS must be within the union [overlap] of the extents of the compound CRS's horizontal and vertical components.
j. The extent of a coordinate transformation (CT) should be within the union [overlap] of the extents of the CT's source and target CRSs. Exceptions include CTs between onshore height and offshore depth systems
k. The extent of a point motion operation (PMO) must be within the extent of the PMO's source CRS
l. The extent of a concatenated operation must be within union [overlap] of the extents of the concatenated operation's component operations.

5. **World extent**
   a. There are two extent records for the whole world, code 2830 includes, and code 1262 excludes the names of all countries. The description for 2830 is lengthy – over 3000 characters. It is used for entities that might be wanted from a text search using country name. Code 1262 is used when a short description is appropriate.
6. **ISO country codes**
   a. Are populated only for those extents which represent a complete single country.
   b. In the EPSG Dataset, ISO 3166 codes are considered to include the offshore parts of maritime states.
7. **Multiple usages**
   a. IOGP assigns multiple Usages to a single entity when it has multiple scopes with different extents, e.g., a zoned projected CRS is used for both large scale mapping within a zone as well as for country wide small scale mapping.

8.3. Discussion

Extent name and description

The presence of these two fields is a consequence of limitations in the Access v2 database first used for publicly distributing the EPSG Dataset. A character string data type was limited to 255 characters. Descriptions often exceed that limit. Longer strings were held in a ‘memo’ field which, in early versions of Access, was not searchable. To overcome this limitation the Name field was created in parallel with the Description field.

Geographic bounding box coordinates

The generation of bounding box coordinates using outward rounding from the bounding polygon may produce some odd-looking effects. For example, a polygon for UTM zone 31 (0°E to 6°E) created through digitising might have imprecision in the eastern boundary vertex with a value of 6.00001°. After rounding outwards this will show as a zone boundary value of 6.01°.

Bounding polygon

Onshore polygons are extended out to the three nautical mile line for two reasons. Firstly, most jurisdictions include the littoral zone in what is defined as their land territory. Secondly, the quality of the polygons used in the initial framework of national polygons was from a coarse 1:2,500,000 dataset and a buffer ensured that promontories would be included in point in polygon searches.

Initial storage of polygon vertex coordinates was to a resolution of five decimal places of a degree. From v10.0 (September 2020) new polygon vertex coordinates have been stored to full double precision resolution. The polygon data remains as a coarse indication of appropriate extent.

9. Data population of geodetic CRSs

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

9.1. Introduction

In historic geodetic practice, the only geodetic CRSs defined were horizontal two dimensional with an ellipsoidal coordinate system (geographic 2D CRSs). These had no related geographic 3D or geocentric CRS. In modern geodetic practice, geometric CRSs are three-dimensional. When a geodetic system is 3-dimensional, in geodetic practice it is the geocentric CRS which is defined. The geographic 3D CRS is then derived from the geocentric CRS by conversion. Similarly, the geographic 2D CRS is derived from the geographic 3D CRS. From v6.6 of the EPSG Dataset, this chain of conversions has been included in the Dataset.

9.2. EPSG policy for population of geodetic CRSs

1. For classic (astro-geodetic) geographic 2D CRSs, no geographic 3D or geocentric CRS will be created unless explicitly requested by the authoritative information source.
2. For modern three-dimensional geometric reference frames, all three of geocentric, geographic 3D and geographic CRSs will be created.
   a. The geographic 3D CRS will be created as derived with the geocentric CRS as its base.
   b. The geographic 2D CRS will be created as derived with the geographic 3D CRS as its base.
   c. All three subtypes will be associated with the same geodetic datum. The EPSG viewpoint is that all three subtypes are treated as independent principal CRSs and the deriving conversions in (a) and (b) are ancillary metadata linking the subtypes together for use in implicit concatenated operations (refer to Part 1 of this Guidance Note). This permits applications to obtain datum and ellipsoid information without having to mine down through the deriving conversion structure.
   d. All three subtypes will have unique codes but have the same name (refer to Naming Conventions).
3. For geographic CRSs with axes in degrees, the axis unit shall be “Degree (supplier to define representation)”.
4. For geographic CRSs, records in the EPSG Dataset shall have coordinate system with axis order latitude-longitude. Because of safety of life issues discussed below, entries with axis order longitude-latitude will only be entered at the request of the national mapping agency or similar authoritative information source, and then only in addition to CRSs having the conventional latitude-longitude axis order.

The longitude-latitude CRSs shall be derived from the latitude-longitude CRSs having the same dimensions using an axis reversal conversion method.

Geocentric CRS
↓
Geog3D CRS lat/lon → Geog3D CRS lon/lat
↓
Geog2D CRS lat/lon → Geog2D CRS lon/lat

5. For WGS 84, IGS and ITRF, the policy is to use extent code 1262 "World" for all realizations (we do this to avoid every subtype of every realization being returned in searches by country name), except that
    a. The geocentric CRS for the latest realization of ITRFyyyy
    b. The geocentric CRS for the latest realization of IGSyy (IGbyy)
    c. The geographic 3D CRS for the latest version of WGS 84 (Gxxxx)
    d. The geographic 2D CRS of WGS 84 (EPSG:4326)

   should use extent code 2830 "World (by country)" so that these CRSs will be returned in searches by country name.

   On the addition of a new ITRFyyyy or IGSyy, the extent code for the previous realization's geocentric CRS is changed through a minor update from 2830 to 1262. On the addition of a new WGS 84 (Gxxxx) realization, the extent code for the previous realization's geographic CRS is changed through a minor update from 2830 to 1262

6. Geodetic CRSs referencing an unknown datum shall not be included in the Dataset.

9.3. Discussion

In early versions of the EPSG Dataset (prior to v6.0, November 2001), there was no distinction between geographic 2D, geographic 3D and geocentric CRS subtypes. All were implicitly included within the CRS type 'geographic', which is no longer used. That CRS type has been replaced by the CRS type geodetic which is subdivided into separate CRS types *geographic 2D*, *geographic 3D* and *geocentric*. When these separate geodetic CRS subtypes of geographic 2D, geographic 3D and geocentric were introduced, to minimize disruption to users all CRSs of type 'geographic' were changed to be of subtype 'geographic 2D' and their codes (and other attributes) were retained.

Geographic CRS axis unit

When latitude and longitude coordinate values are given in *degrees* (as opposed to other units such as grads), several representations are in use, for example decimal degrees or degrees, minutes and seconds (sexagesimal degrees). Hemisphere quadrant may be indicated by sign or by abbreviation, as suffix or prefix.

For geographic coordinate reference systems supporting coordinates in degrees, early versions of the EPSG Dataset gave the degree representation explicitly as degree, minute, second, hemisphere (DMSH). In v6.4 (January 2003) CRSs using other explicitly described degree representations were introduced. These CRSs were given codes that were created by concatenation of datum code and CS code in the range from 60,000,000 to 69,999,999. Effective Dataset v6.5 (January 2004) the strategy was changed. Support for CRSs with explicit degree representation given for the CS axes was withdrawn. CRSs with codes in the range from 60,000,000 to 69,999,999 were deprecated whilst geographic CRSs with codes in the range from 0 to 32767 had their explicit DMSH degree representation changed to "degree (supplier to define representation)". For geographic CRSs with units of degrees, the degree representation information is no longer explicitly provided as part of the CRS description in the EPSG Dataset. Coordinates are unambiguous only when the unit *and unit representation used* are identified. Geographic CRSs require the degree representation to be defined for the user by the coordinate data supplier.

IOGP recommends that real numbers are used for internal data processing but that for interfacing with human beings the preferred representation be sexagesimal degrees (DMSH).

Geographic CRS axis order

The global conventional standard applied to coordinate system (CS) attributes for geographic CRSs is latitude before longitude. In some communities, particularly those involving navigation with safety of life considerations such as the civil aviation and maritime industries, this axis order convention has been formalized. In emergency situations practitioners cannot tolerate ambiguity. To support this requirement, geographic CRSs in the EPSG Dataset are by default added only with CS axis order as latitude-longitude.

If longitude-latitude CRSs are added, the structure for doing so is described in 4 above. An alternative structure that was considered was:

```
                 Geocentric CRS
                 ↓              ↓
Geog3D CRS lat/lon     Geog3D CRS lon/lat
                 ↓              ↓
Geog2D CRS lat/lon     Geog2D CRS lon/lat
```

This was rejected. Using the deriving conversion "axis order change" in the adopted structure more directly links the lat/lon and lon/lat CRSs, whereas the alternative structure could cause software to do a null datum change. The adopted structure is also used for vertical CRSs but the axis change is "height to depth" (see section 11).

Unspecified datum

In older versions of the Dataset, geodetic CRSs referencing an unknown datum were included. These CRSs are no longer supported by EPSG because datum information is required for unambiguous spatial referencing and the old records have been deprecated.

10. Data population of ellipsoid parameters

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

10.1. Introduction

The EPSG Dataset includes the following biaxial ellipsoid parameters:

- Semi-major axis (a)
- A second defining parameter which shall be one of:
  - Semi-minor axis (b)
  - Inverse flattening (1/f)
- Ellipsoid shape indicator

10.2. EPSG policy for population of ellipsoid parameters

1. The semi-major axis is always populated.
2. The second ellipsoid parameter is the semi-minor axis for some old ellipsoids or inverse flattening for more modern ellipsoids, as given by the information source.
   a. For some very modern ellipsoids the inverse flattening value is derived from gravity and earth rotation parameters which should be given in the record remarks field.
   b. Occasionally an information source for an old ellipsoid may give both semi-minor axis and inverse flattening. In these cases, of these two defining parameters to avoid ambiguity in derived ellipsoid parameters only the preferred, conventionally-cited parameter will be given. The less preferred value may be included as a remark.
   c. If the ellipsoid record includes an entry in the semi-minor axis field, inverse flattening should be calculated from 1/f = [a / (a - b)] and in EPSG Registry reports quoted to seven decimal places.
3. Shape is indicated as “Ellipsoid” or “Sphere”. When the shape is sphere, the inverse flattening is infinite and the sphere’s radius value is entered into both the semi-major axis and semi-minor axis fields.

10.3. Discussion

When reporting ellipsoid information, the ellipsoid name, semi-major axis and inverse flattening should be provided.

11. Data population of vertical CRSs

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and 373-24 and updated.

See also IOGP Report 373-24 - *Vertical data in oil and gas applications*, from which this Section's text is taken.

11.1. Introduction

The EPSG Dataset contains coordinate operation methods that allow users to dynamically create vertical coordinate conversions (on-the-fly) to perform a height depth reversal or change the unit of measure while remaining referenced to the same vertical datum. These generic vertical CRS coordinate conversions can be concatenated with vertical datum transformations to perform the desired coordinate operation between any source and target vertical CRS.

For vertical CRS conversions (Height Depth Reversal or Change of Vertical Unit) present in the EPSG Dataset, these are added as specific, explicit conversions, and will not use the generic conversions that have been created for users or software developers to use for their generic cases (EPSG conversion codes 7812 and 7813). The explicit definitions that are populated in the EPSG Dataset use the same underlying methods (EPSG method codes 1068, and 1069) as the generic conversions

11.2. EPSG Policy for population of vertical CRSs

1. The EPSG Dataset is populated with one vertical CRS definition for each vertical datum (unless a valid request from a government entity is received to include additional vertical CRSs), with a terrestrial datum by default defined with height CRS and hydrographic datum by default defined with a depth CRS. Vertical CRS transformations are defined to that populated CRS.
    a. All other combinations including height/depth and unit of measure variants will not be added, unless used by a government entity or widely accepted practice in industry.
    b. Any other variants related to the same vertical datum with height/depth or unit of measure changes will be added as derived vertical CRSs.

11.3. Discussion

When multiple CRSs associated with a specific vertical datum are included in the Dataset, using the derived CRS construct ensures that these additional CRSs do not become orphaned systems (a CRS with no connection to any other entity in the Dataset)

12. Data population of projected CRSs

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

12.1. Introduction

For projected CRSs there is no global standard applied to coordinate system (CS) attributes. Many combinations of axis order and unit are theoretically possible, some of which may be more straightforward than others to manipulate within computer systems. Because these other combinations have no geodetic, conventional or legal usage, projected CRSs using them are not described in the EPSG Dataset.

12.2. EPSG policy for population of projected CRSs

1. Map projection latitude and longitude parameters when in degrees should be entered as either decimal degrees (UoM code 9102) or sexagesimal DMS (UoM code 9110), as given by the information source. When one parameter is in sexagesimal representation, any other parameters which happen to have integer degree values should also be given as sexagesimal DMS. For example, if latitude is 40°50'N and longitude is 74°W, enter both using UoM code 9110.
2. For projected CRSs, records in the EPSG Dataset shall have coordinate system with axis order and units as defined by local legal or conventional usage.
3. When projected CRSs are used with multiple units, to assist unambiguous conversion of unit the EPSG Dataset shall contain duplicate map projection entries in the appropriate units. Each shall be associated with separate projected CRSs.

13. Data population of compound CRSs

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

13.1. Introduction

For spatial coordinates, a number of constraints exist for the construction of compound CRSs. Coordinate Reference Systems that are combined shall not contain any duplicate or redundant axes.

13.2. EPSG policy for population of compound CRSs

1. Compound CRSs will be included in the EPSG Dataset on request from authoritative information sources.

14. Data population of datum ensembles

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

This text is identical to appendix A of IOGP Report 373-07-5 - *EPSG null and copy transformations to WGS 84*.

14.1. Introduction

Modern geodetic reference frames may be updated from time to time and the differences between successive realizations may be at the sub-decimetre level. For many users this is insignificant and dealing with multiple CRSs that are insignificantly different is an unwanted overhead. To address this issue, the EPSG data model supports the artificial concept of a datum ensemble.

A datum ensemble is a group of two or more closely related realizations of the same conventional reference system. It is modelled as a subtype of datum; the actual type of datum, whether geodetic or vertical, is inferred from the datum type of the ensemble members. Geodetic datums that are grouped within an ensemble all have identical ellipsoid and prime meridian attributes. A CRS may be associated with either a datum or with a datum ensemble.

14.2. EPSG policy for population of datum ensembles

1. Datum ensembles will be added to the EPSG Dataset on a case-by-case basis. In general a datum ensemble will be created only when the authoritative organization (e.g., the national geodetic survey or mapping agency) has expressed that individual realizations may be treated as an ensemble, for example as is the case for WGS 84 and ETRS89.
2. In a datum ensemble with members that are dynamic, there is no single set of station velocities. Therefore, in the EPSG Dataset, ensembles consisting of members that are themselves dynamic are treated as if they were static.[5]
3. When a datum ensemble exists in the EPSG Dataset, further realizations of the same conventional reference system issued by the authority will be added to the existing datum ensemble.

14.3. Discussion

Once data has been associated with a datum ensemble it may not be possible to identify the ensemble member to which the data would more accurately have been referenced. The inaccuracy introduced through the use of a datum ensemble is recorded as an ensemble accuracy value. This indicates the

[5] For information on dynamic and static CRSs refer to IOGP Geomatics Guidance Note 25 and IOGP's Introduction to dynamic CRSs video, ref [2] and [3].

difference in coordinate values (at the same epoch) between the various realizations grouped into the ensemble. Datum ensembles should not be used in geodesy or other high accuracy applications; the appropriate individual reference frame should be identified and used.

Common practice using such ensembles is to ignore coordinate epoch and to not apply the time-dependent corrections on coordinates necessary when working with dynamic CRSs. By ignoring the time-dependent nature of the coordinates, accuracy is degraded further. This additional inaccuracy is not reflected in the ensemble accuracy value. Its value depends on the plate motion at the project location and time span of coordinates mixed in the ensemble, if not corrected to a common epoch.

As an important example, the WGS 84 datum ensemble (EPSG datum code 6326) has multiple realizations as datum members. An ensemble accuracy of 2 metres has been assigned to cover the coordinate differences between these realizations. The offset of the original WGS 84 (Transit) realization accounts for much of this 2 m. The 2 m value is the three-dimensional offset at the centre of the Earth; at the surface of the Earth its horizontal component varies with location but is typically 1 to 1.5 metres. Differences between coordinates for modern acquired data (say after the year 2000 when positioning accuracy increased) are much smaller, say at decimetre level. However, to reiterate, this only accounts for differences in frame definition and assumes all coordinates are referenced to the same epoch.

Datasets that are referenced to datum ensemble members can be merged and co-visualized without transformation for low accuracy applications. Mathematically this is equivalent to performing a null transformation between the datum ensemble members. Datum ensembles are intended to avoid the creation of many null transformations between ensemble members, and between ensemble members and WGS 84 (and its ensemble members).

Caution! If data is associated with a CRS based on a datum ensemble, the use of the ensemble name or code is not sufficient to identify the individual ensemble member. Consequently, data referenced directly to such a CRS is approximate to the stated ensemble accuracy. The user will need to track the original ensemble member independently if they want to exit the ensemble in the future.

15. Data population of coordinate operations

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.
3	November 2023	Added policy associated with datum ensembles.

15.1. Introduction

Transformations are empirically determined and hence in general their application to a set of coordinates will degrade the quality of the coordinates. The degradation of a set of coordinates in the target CRS is described using the coordinate operation accuracy attribute. The lower the value, the less the degradation from the coordinate operation. Conversion (including map projection) parameter values are defined and therefore by definition the conversion is errorless. Conversions have a null coordinate operation accuracy (the field is not populated).

Within the EPSG Dataset, each transformation and conversion is related to a coordinate operation method. It is the method formula, not just the name, that fully identifies the coordinate operation method. Both formula and example are given in a more readable format in EPSG Guidance Note number 7, part 2, *Coordinate Conversions and Transformations including Formulas*.

In the EPSG Dataset most transformations that operate between geodetic CRSs have source and target CRSs of type *geographic 2D*, regardless of whether the method operates in the geographic or geocentric coordinate domain or in 2 or 3 dimensions. The reason is historic and briefly described in the introduction of Section 9 of this document: transformations retained their codes for the source and target CRS when these were clarified as geographic 2D CRSs.

For consistency with this older practice, most transformations in the EPSG Dataset that operate in the geographic or geocentric coordinate domain continue to be associated with the CRS subtype geographic 2D even when they operate between geocentric or geographic 3D CRSs. Applications using these data may need to make appropriate adjustments and use the implicit concatenated operation technique as discussed in Guidance Note 7-1.

An exception is for transformations between geodetic CRSs which only have a geocentric form, in which case the transformation will of necessity be between geocentric CRSs. Although the same transformation mathematics is used in the geocentric domain, the transformation method is given a different method code from the equivalent implicit concatenated transformation method.

A second exception is for transformations in the vertical domain.

15.2. EPSG policy for population of coordinate operations

1. Transformation variant is a sequential number for that source/target pair. Note that the sequence is that of loading to the EPSG Dataset and may not be the sequence in which transformations have been published by the information source.

2. Transformations are allocated a version. These are constrained to be unique within any particular pair of source and target CRSs (but may not be unique across different source/target pairs). The transformation version comprises a cryptic indication of the information source for the transformation (usually the organisations initials), - (hyphen), the ISO 3-character country code, and if the transformation is not applicable to a complete country a cryptic indication of its extent or scope. For example:

   IGN-Fra A transformation for all France from the Institut Géographique National.
   IGN-Fra NW A transformation for northwest France from the IGN.

3. EPSG policy is to document coordinate operation parameter values and units as given by the information source. Exceptions may be made in special cases, for example for continuity with past practice in a series of transformations between a specific pair of source and target CRSs.

4. Where transformations are reversible, EPSG preference is for the transformation to be entered in the direction from local CRS to global CRS and from older source CRS to newer target CRS. Exceptions may be made when these preferences clash with each other or with other policies (such as that immediately above).

5. Transformations representing geoid or hydroid models are 3D to 1D and considered non-reversible. EPSG policy is to add a second, reversible, transformation using a compound CRS comprising of the grid interpolation CRS and the vertical CRS. Exceptions may be made, for example when the interpolation CRS is not the 2D subset of the source 3D geographic CRS, when the geoid or hydroid model is already obsolete, or when transformation *from* vertical CRS coordinates using the model is most unlikely to ever be required. If the model defines the vertical CRS, an exception is unlikely to be considered appropriate.

6. **Parameter units**: Associated parameters within a method should use the same unit, for example all translations in meters, or all angles in degrees. When one parameter is in sexagesimal representation, any other associated parameters which happen to have integer degree values should also be given as sexagesimal DMS. For example, if latitude is 40°50'N and longitude is 74°W, both are entered using sexagesimal DMS (UoM code 9110).

7. **Parameter order**: Each method utilizes specific coordinate operation parameters. Each transformation or conversion has specific values for each of the parameters that its method utilizes. For each method there is a preferred order in which parameters should be listed.
   a. Each method will define a preferred sort order for the parameters by associating a number from 1 through *n*, where *n* is the number of parameters used by the method.
   b. Registry reports and EPSG user interface display will list the parameters in the defined order.

5. **Polynomial coefficients**
   a. For polynomial methods, for which the coefficients are considered to be parameters, provision is made for all coefficients to be ordered. However, those coefficients which have non-zero values in all *transformations* in the Dataset which use the method are not entered in the Dataset. Consequently, the sort order values for the polynomial methods of higher degree may be discontinuous. For example, at the time of writing the sort order values for method 9654 (Reversible polynomial of degree 13) are 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 14, 20, 34…
   b. Currently missing coefficients may be added to the Dataset, as needs arise.

6. **Transformation accuracy**
   a. Since Dataset v6.6 the approximate accuracy of a coordinate transformation is included in the coordinate operation's ACCURACY field.

b. Accuracy values are recorded in metres (smaller values indicating less loss of accuracy).
c. When the target CRS is defined by the transformation, the transformation's operation accuracy is given a coordinate operation accuracy value of 0.
d. A coordinate operation value of 999 is a flag to indicate that an accuracy estimate is not available.
e. The policies for assigning accuracy values to artificial EPSG null and copy transformations are described in Section 16.
f. EPSG's preferred statistical measure for accuracy is 2SD.
   - If the information source gives 1SD, the value entered into the EPSG Dataset will be double this.
   - If the information source gives uncertainty of each of three translation parameters, the value entered into the EPSG Dataset will be the root mean square of this.
   - When the statistical measure given by the information source is unclear, accuracy values will be as reported by the information source.
g. Accuracy of a concatenated operation may be computed by the residual sum of the squares (RSS) of the accuracies recorded for the individual steps.
h. EPSG may slightly manipulate the accuracy values to enforce a desired ranking order of multiple transformations between a given pair of source and target (for example if accuracies are overestimated, different information sources use different methods or levels of confidence to report accuracies, or to enforce that a direct transformation yields a better accuracy vs. a path using multiple steps)

7. **Transformations between CRSs associated with a datum ensemble**
   a. For polynomial methods, for which the coefficients are considered to be parameters, provision is made for all coefficients to be ordered. However, those coefficients which have non-zero values in all *transformations* in the Dataset which use the method are not entered in the Dataset. Consequently, the sort order values for the polynomial methods of higher degree may be discontinuous. For example, at the time of writing the sort order values for method 9654 (Reversible polynomial of degree 13) are 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 14, 20, 34…
   b. Missing coefficients may be added to the Dataset, as needs arise.

16. Null and copy transformations

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Verbatim copy of appendix B of IOGP Geomatics Guidance Note 373-07-5.

This text is identical to Appendix B of IOGP Report 373-07-5 - *EPSG null and copy transformations to WGS 84.*

16.1. Introduction

The strategy for population of the EPSG Dataset is to support:

1. Users who require high spatial accuracy such that they can reference the EPSG data without any degradation in their spatial referencing; and
2. Users who are able to work at low accuracy and wish to merge spatial data referenced to multiple coordinate reference systems are able to do so efficiently. Here 'low accuracy' means users who are able to ignore the secular motion of tectonic plates, so can accept 1-3m or worse spatial accuracy.

To assist this second group of users by ensuring that most CRSs can be related to each other, the policy is to introduce ‘null’ and ‘copy’ transformations into the EPSG Dataset, where appropriate.

EPSG strategy assumes that WGS 84 is the global hub CRS. No distinction is made between specific realizations of WGS 84.

16.2. EPSG policy for null and copy transformations

Specific policy items are:

1. An EPSG null transformation to WGS 84 will be created when:
    - A national or regional geodetic CRS is defined to be aligned with the ITRS at some specified epoch.
    - No other transformation to WGS 84 or ITRS is available.
    - The datum of the national or regional geodetic CRS is not a member of a datum ensemble in which the CRS of another member is already related to WGS 84.
2. An EPSG copy transformation to WGS 84 will be created when:
    - A transformation exists relating ITRS to the national or regional geodetic CRS; and
    - No other transformation to WGS 84 is available.
3. EPSG null and copy transformations will be identified in the EPSG Dataset.

4. EPSG null transformations to WGS 84 are given an accuracy that is sufficient to cover secular plate motion over a period of 30-40 years. For most tectonic plates this is a nominal 1 metre. For some faster-moving tectonic plates the operation accuracy value assigned will be higher (making the transformation less accurate), typically 2-3 metres.

    - Note: Prior to 2019 (EPSG Dataset v9.9) the accuracy assigned to EPSG null transformations was always a nominal 1m. For the faster-moving tectonic plates, over a protracted period of time this 1 metre nominal value has been inadequate. In some cases it has subsequently been increased. This policy of increasing the operation accuracy value (making the transformation less accurate) will be maintained where appropriate.

5. EPSG copy transformations are given an accuracy of the accuracy of the copied transformation or sufficient to cover 30-40 years of secular plate motion (usually 1 metre), whichever is the greater.

16.3. Discussion

Many modern reference frames and coordinate reference systems are defined by a national authority with respect to the global standard: a realization of the International Earth Rotation Service Terrestrial Reference System (ITRS). At a geodetic level of significance, these ITRS realizations and national CRSs are all discrete. But at a practical accuracy level of 1-3 m, often satisfactory for GIS and subsurface oil and gas industry requirements, the differences between these national CRSs and ITRS realizations are not considered significant.

IOGP recognizes that, at the lower level of accuracy requirement, in practice a direct transformation pathway is required “to WGS 84” in order to visualize data, for example for oil and gas subsurface applications that currently use the early-binding data model, and for many web mapping applications currently using WGS 84 (WGS 84 / Web Mercator). IOGP facilitates this by the creation of artificial EPSG null and copy transformations. Such EPSG created artificial transformations may not be condoned by the originator of the national CRS. It should also be recognized that CRSs other than WGS 84 may be more appropriate as a hub. For example, in Europe the adoption of ETRS89 as a hub meets INSPIRE regulations.

Typical scenarios for IOGP to create an EPSG null or copy transformation

Figure B.1 below illustrates the current (2022) typical creation of EPSG null transformations. Imagine that at some point in time, a new national or regional realization is published by the authority. At this juncture, it is not known that a subsequent realization may be made in future. This system is defined with respect to a specific realization of ITRS at a specified epoch (t1), for example an “ITRF snapshot” and densification. Therefore, a transformation between ITRFxx@yyyy.yy and the national realization is available. It may or may not be null.

- If it is null, *and if no transformation to WGS 84 is provided by the Information Source*, then IOGP will create EPSG null transformation #1. This is done to ensure that the national realization can be used in hub transformations and in low accuracy web mapping using WGS 84.
- If the national realization is defined through a not-null transformation from ITRFxx, EPSG creates a copy transformation.

In both cases, the epoch at which this relation is valid may be noted through remarks.

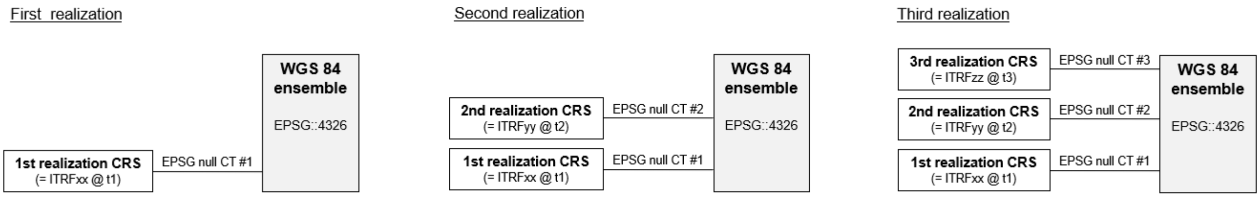

Figure B.1 – Creation of EPSG null transformations.

Later, a second realization of the national system is made. The ITRF realization and/or the epoch at which the national realization is coincident with ITRF will very likely differ from the first national realization. A new EPSG null or copy transformation, #2, will now be created, as shown in the middle panel. This is the general policy principle: the EPSG Dataset aims to include a direct pathway from each realization to the WGS 84 ensemble to accommodate pragmatic lower accuracy usage.

Note that these two EPSG null transformations provide an indirect path for transforming between (the first and second) realizations via the WGS 84 ensemble. However, this transformation pathway should not be used if a direct transformation between the two realizations is available. A transformation documented directly between the two CRSs should always take priority over an indirect transformation.

The same process is repeated for further realizations as shown in the panel on the right for the third realization.

Local datum ensembles

The process described above is modified if the national CRS's datums are members of a datum ensemble (which currently is not common). Note that the local ensemble can only be created by IOGP after the second national realization has been published (also see the EPSG policy on datum ensemble creation).

In some circumstances the local ensemble (rather than any of its members) may have a transformation to WGS 84 (see Figure B.2[6]). All realization CRSs that do not have a direct transformation to WGS 84 should use ("inherit") this.

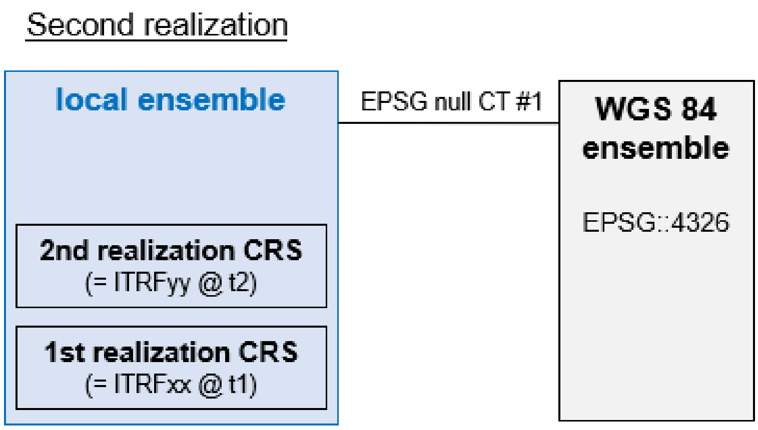

Figure B.2 - Local ensemble with transformation to WGS 84.

In these circumstances software applications need to:

- Verify that the realization has no direct transformation to WGS 84.

[6] For simplicity, Figures B.2 and B.3 conflate CRSs and datum ensembles. Transformations operate between CRSs but datum ensemble members are the datums to which the CRSs are referenced.

- Verify that the realization's datum is a member of a datum ensemble.
- Recognize that a transformation from the CRS with datum ensemble to WGS 84 is available.
- Then utilize the transformation between the CRS with datum ensemble and WGS 84 to transform coordinates between the national realizations and WGS 84.

A more usual scenario is sketched in Figure B.3. When the second national realization is defined, the local ensemble does not yet exist but the first realization does. EPSG may define a local ensemble at this time. In this case it is important to realize that a null or copy CT to WGS 84 from the second realization **will not be created by EPSG.**

To transform the national realization to WGS 84 for use in hub transformations, or in low accuracy using WGS 84 (e.g., web mapping), null or copy CT #1 should be assumed to also apply to realization #2.

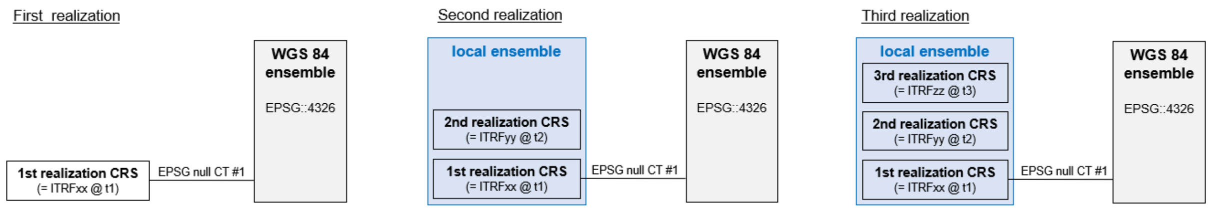

Figure B.3 - Local ensemble without transformation to WGS 84.

Software applications need to associate the #1 member transform to WGS 84 with the second realization by recognizing that:

- The second realization has no transformation to WGS 84.
- The second realization's datum is a member of a datum ensemble.
- Another member of that datum ensemble (that for the first realization) has a CRS for which a transformation to WGS 84 is available.

Then:

- If there is a direct transformation between the first and second realizations, use a concatenation of this and the null or copy transformation from the first realization to WGS 84.
- If there is not a direct transformation between the first and second realizations, assume a null transformation between the second and first realizations and concatenated that with the null or copy transformation from the first realization to WGS 84.

Operation method used for EPSG null and copy transformations

In any scenario that requires the creation of an EPSG null transformation, the three-parameter geocentric translations method (EPSG operation code 9603) will generally be used, with all translation parameters set to 0 metres. Because each national or regional CRS that will be assigned a null transformation is aligned to an ITRF realization and shares the same (or practically the same) ellipsoid as the target WGS 84 ensemble, the net result of applying any null transformation will be no modification to any input coordinate values. Using this simplest method fits within the goals set forth for this guidance note, a given accuracy within one to three metres, and has the benefit of being supported by all major geospatial software packages.

Before reaching a decision to usually use the geocentric translation method, using an eight-parameter time-specific Helmert method was considered. These have the benefit of noting a reference date of coincidence between the regional/national system and a given ITRF realization. However, the eight-parameter methods do not fit the purpose of this guidance note when considering the inherent lower accuracy use cases associated with the null transformation concept, nor do they specifically define any velocity model to use at other epochs for higher accuracy. Similar considerations were also made for using a fifteen-parameter time-dependent transformation method. This transformation method will generally not be used because such an operation would falsely imply that there is a velocity model with null parameter values defined between the national/regional system and the WGS 84 ensemble which is considered to be static. Users would then seemingly have a mechanism for providing a time-based update to a coordinate epoch value that does not exist. This would not be appropriate. As a further consideration, currently neither of these time-based methods are generally supported by legacy geospatial software packages used by IOGP Members.

For EPSG copy transformations, the transformation method used will be that which is used in the copied transformation.

17. Data model revisions

Version	Date	Amendments
1	October 2004	Initial version, within GN 373-07-1.
2	June 2022	Transferred from GN 373-07-1 and updated.

17.1. Introduction

Dataset versions 6.1 to 9.9.1 conform to the ISO 19111:2007 data model. From version 10 the Dataset conforms to the ISO 19111:2019 data model.

The strategy employed for the EPSG Dataset is to commit to retaining backward compatibility of the SQL table field structure, data type and field names, as described in Part 4 of this Guidance Note.

However, to facilitate product improvement IOGP reserves the right to supplement these by additional fields or tables when necessary. If there is perceived to be a need to include additional capability, this will be done such that the development will retain backward compatibility with the above structure. New fields might be inserted within existing tables: programmers should never rely on the order of fields in a table, but only on the names of the fields.

17.2. EPSG policy for data model revisions

1. Backward compatibility of the relational table structure is preserved by retaining tables, fields and field names and appending new fields to the end of tables.
2. If the data model is amended, the Dataset will carry a new major version value.

International Association of Oil & Gas Producers

This document is part of the IOGP Geomatics Guidance Note series 373-07 for users of the EPSG Dataset.

The complete texts may be found on the EPSG Registry web site under Support Documentation.

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