ISO 19115

Geographic information — Metadata

Workbook

Guide to Implementing ISO 19115:2003(E), the North American Profile (NAP), and ISO 19110 Feature Catalogue

January 2012

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National Oceanographic Data Center
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This workbook is not intended to replace the ISO standards but is meant to act as an educational and implementational guide to be used in conjunction with ISO 19115 Geographic information — Metadata ISO 19115:2003(E).

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Acknowledgments

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## INTRODUCTION

**ISO 19115:2003(E)**  
**Geographic information — Metadata**

### Main Sections of ISO Metadata

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<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metadata</td>
<td>Root element that contains information about the metadata itself.</td>
</tr>
<tr>
<td>(MD_Metadata)</td>
<td></td>
</tr>
<tr>
<td>Spatial Representation Information</td>
<td>Information about the geospatial representation of a resource.</td>
</tr>
<tr>
<td>(gmd:spatialRepresentationInfo)</td>
<td></td>
</tr>
<tr>
<td>Reference System Information</td>
<td>Information about the spatial and temporal reference systems used in the resource.</td>
</tr>
<tr>
<td>(gmd:referenceSystemInfo)</td>
<td></td>
</tr>
<tr>
<td>Metadata Extension Information</td>
<td>Information about user specified extensions to the metadata standard used to describe the resource.</td>
</tr>
<tr>
<td>(gmd:metadataExtensionInfo)</td>
<td></td>
</tr>
<tr>
<td>Identification Information</td>
<td>Information required to uniquely identify a resource or resources.</td>
</tr>
<tr>
<td>(gmd:identificationInfo)</td>
<td></td>
</tr>
<tr>
<td>Content Information</td>
<td>Information about the physical parameters and other attributes contained in a resource.</td>
</tr>
<tr>
<td>(gmd:contentInfo)</td>
<td></td>
</tr>
<tr>
<td>Distribution Information</td>
<td>Information about who makes a resource available and how to get it.</td>
</tr>
<tr>
<td>(gmd:distributionInfo)</td>
<td></td>
</tr>
<tr>
<td>Data Quality Information</td>
<td>Information about the quality and lineage (including processing steps and sources) of a resource.</td>
</tr>
<tr>
<td>(gmd:dataQualityInfo)</td>
<td></td>
</tr>
<tr>
<td>Portrayal Catalogue Information</td>
<td>Information identifying portrayal catalogues used for the resource.</td>
</tr>
<tr>
<td>(gmd:portrayalCatalogueInfo)</td>
<td></td>
</tr>
<tr>
<td>Metadata Constraint Information</td>
<td>Information about constraints on the use of the metadata and the resource it describes</td>
</tr>
<tr>
<td>(gmd:metadataConstraints)</td>
<td></td>
</tr>
<tr>
<td>Application Schema Information</td>
<td>Information about the application schema used to build a dataset.</td>
</tr>
<tr>
<td>(gmd:applicationSchemaInfo)</td>
<td></td>
</tr>
<tr>
<td>Metadata Maintenance Information</td>
<td>Information about maintenance of the metadata and the resource it describes</td>
</tr>
<tr>
<td>(gmd:metadataMaintenanceInfo)</td>
<td></td>
</tr>
</tbody>
</table>
Comparing FGDC and ISO Standards

The content of ISO 19115 strongly resembles the sections of the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM). The following information is new with ISO/NAP:

- Is far more flexible.
- Depicts relationships between datasets and collection level (parent/child relationships).
- Standardizes descriptors through the use of codelists.
- Accommodates new technologies (such as the ability to document services).
- Accommodates international scope.

The CSDGM is the core, or base, of the FGDC standards for documenting geospatial data. Profiles and extensions to the core standard can shorten or extend the main standard and can change conditionality. The Biological Profile (BIO) extends the CSDGM in order to properly document biological information. The Remote Sensing Extensions (RSE) extends the CSDGM in order to document information about imagery and other remotely sensed data.

The core ISO standard for documenting geospatial data is ISO 19115 Geographic information – Metadata. ISO 19115-2 Geographic information – Metadata – Part 2: Extensions for imagery and gridded data extend ISO 19115 in order to properly document information about imagery, gridded data, and remotely sensed data. The North American Profile (NAP) is a profile of ISO 19115. The NAP shortened the core and changed conditionality and multiplicity on several elements. ISO 19110 Geographic information – Methodology for feature cataloguing is a separate standard and separate document that ISO 19115 will reference if it exists. ISO 19110 is similar to
Section 5, Entity and Attribute Information, of the CSDGM. The ISO 19111 Geographic information – Spatial referencing by coordinates is also a separate standard and separate document that may be referenced from ISO 19115. ISO 19111 is much like Section 4, Spatial Reference Information, of the CSDGM. ISO 19139 defines the XML encoding of the ISO metadata standards. ISO 19139 provides the structure and rules to which the validation should be set.

How ISO is Organized

The ISO workbook is organized in sections and packages. A section is a grouping of similar information (similar to FGDC sections). The main sections are listed in the Main Sections of ISO Metadata table above. A section may contain several packages. A package is a logical grouping of elements that can be found in multiple locations within the main sections (similar to the “supporting sections” of the FGDC CSDGM). You might notice that some XML elements have a two-letter code followed by an underscore. These are packages.

Ex:  
CI_ResponsibleParty

The package abbreviations are identified in the following table.

<table>
<thead>
<tr>
<th>Package Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
</tr>
<tr>
<td>DQ</td>
</tr>
<tr>
<td>DS</td>
</tr>
<tr>
<td>EX</td>
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<tr>
<td>FC</td>
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<tr>
<td>GM</td>
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<tr>
<td>LE</td>
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<tr>
<td>LI</td>
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<tr>
<td>MD</td>
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<tr>
<td>MI</td>
</tr>
<tr>
<td>RS</td>
</tr>
<tr>
<td>SV</td>
</tr>
<tr>
<td>QE</td>
</tr>
</tbody>
</table>

XML Basics

Note: All elements, punctuation, and attributes preserve the European spellings. Do not change (Americanize) them.

Example: ‘organisation’ is correct in these instances; ‘organization’ is not.

Various views of metadata standards are text, HyperText Markup Language (HTML), and eXtensible Markup Language (XML).

The FGDC metadata that many are accustomed to seeing are the HTML or Text views. Text views are simple and easy to read, but are more of a legacy type of view. Text documents can often be easily corrupted. HTML views can be customized for web viewing and other applications. Text and HTML views can be derived from the XML by applying a stylesheet, XSL or XSLT, over the base XML to display as you want.

XML is a set of rules for encoding documents in machine-readable form. XML’s use emphasizes simplicity, interoperability, and usability over the Internet. XML consists of three main parts, tags, elements, and attributes.
Tag
A markup construct that begins with ‘<’ and ends with ‘>’.

- start-tags: `<section>`
- end-tags: `</section>` or `/>`

Element
An element is a logical component of a document that either begins with a start-tag and ends with a matching end-tag, or consists only of an empty-element tag. The characters between the start- and end-tags, if any, are the element’s content, and may contain markup, including other elements, which are called child elements.

```
<Greeting>Hello, world.</Greeting>
```

Attribute
An attribute is a markup construct consisting of a name/value pair that exists within a start-tag or empty-element tag. In the example (below), the element img has two attributes, `src` and `alt`:

```
<img src="madonna.jpg" alt='Foligno Madonna, by Raphael'/>
```

Another example would be `<step number="3">Connect A to B.</step>` where the name of the attribute is ‘number’ and the value is ‘3’. For more information about attributes, see Using Attributes.

Namespaces
You may notice in the XML that the element names have a three-letter code followed by a colon.

Ex:
```
gco:CharacterString
```

These codes are called namespaces. The namespace is a container providing context and rules for elements. A definition of a term may change, depending on what namespace is applied. The namespace abbreviation table identifies namespaces that may be found in the XML.

<table>
<thead>
<tr>
<th>Namespace Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>gco</td>
</tr>
<tr>
<td>gfc</td>
</tr>
<tr>
<td>gmd</td>
</tr>
<tr>
<td>gmx</td>
</tr>
<tr>
<td>gss</td>
</tr>
<tr>
<td>gsr</td>
</tr>
<tr>
<td>gts</td>
</tr>
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<td>gml</td>
</tr>
<tr>
<td>xlink</td>
</tr>
<tr>
<td>xs</td>
</tr>
</tbody>
</table>
Using Attributes

XML elements can have attributes, as previously discussed. These attributes provide additional information about an element. Often, the additional information is not part of the data. Attribute values must contain either single or double quotes. Attributes tend to be "grouped" by certain types. Elements that are ISO roles (xml tags that start with lower case) will often allow XLinks, uuidref, and nilReason attributes. Elements that are ISO objects (xml tags that start with two upper case package abbreviations) will often allow ids and uuids. The frame, calendarEraName, and indeterminatePosition are gml attributes and found within time positions.

Ex:

```xml
<MD_Keywords>
    will allow the id and uuid attributes
</MD_Keywords>
```

```xml
<gmd:thesaurusName>
    will allow the XLink attributes type, href, role, arcole, title, show, and actuate as well as the uuidref and nilReason attributes.
</gmd:thesaurusName>
```

```xml
<gml:beginPosition>
    will allow the gml attributes of frame, calendarEraName, and indeterminatePosition.
</gml:beginPosition>
```

id

An identifier for the element, if specified, must be unique within the XML document. The value of the identifier must always start with a letter, an underline (_), or a colon (:). An XML element can have only one attribute of type ID. The identifiers used in the id attribute are XML Names that have significant restrictions. They must begin with a letter, an underline (_), or a colon (:), and, after the first character, be composed only of letters, digits, underlines, and hyphens (-). This attribute is often mandatory for such items as units and extents.

Ex:

```xml
<gml:BaseUnit gml:id="lengthUnit">
    <gml:identifier codeSpace="SI">meters</gml:identifier>
</gml:BaseUnit>
```

idref

A reference to an XML element in the XML document. The value must correspond to an attribute value of type ID in an existing XML element. The idref attribute allows an XML element to refer to another XML element within the same document that has a corresponding id attribute.

Ex:

```xml
<idref="594D435F-954C-1022-78E7-D62F30CD0592"/>
```

idrefs

A reference to one or more XML elements. The values must be separated by spaces and must correspond to existing XML element ID’s.

uuid

Note: The uuid of any deleted object cannot be used again.
The uuids are Universally Unique Identifiers which also have special characteristics. A uuid is assigned to an object when it is created and is stable over the entire life span of the objects. uuids are required for long-term distributed data management and for realizing update mechanisms. These identifiers are also called persistent identifiers. A uuid is a 16-byte number that consists of 32 hexadecimal (0-9 and a-f) values. The values are split into five groups, separated by hyphens in the form 8-4-4-4-12 or 8-4-4-16 for a total of 36 characters (32 values and 4 hyphens).

Ex:

```xml
uuid="594D435F-954C-1022-78E7-D62F30CD0592"
```

uuidref

The uuidref attribute is used to refer to an XML element that has a corresponding uuid attribute.

Ex:

```xml
uuidref="594D435F-954C-1022-78E7-D62F30CD0592"
```
**uom**
The uom attribute provides an identifier of the unit of measure used. The uom attribute is often mandatory for the element that uses it.

Ex:
```xml
<gmi:groundResolution>
  <gco:Distance uom="meters">10.0</gco:Distance>
</gmi:groundResolution>
```

**frame**
The frame attribute is optional and allows the user to specify the temporal reference system to be used for interpretation of the value of the time position.

Ex:
```xml
<gml:timePosition frame="tcs.xml#geologyMA">-2500</gml:timePosition>
```

**calendarEraName**
The calendarEraName attribute is optional and provides the name of the calendar era to which the date is referenced (e.g. the Meiji era of the Japanese calendar).

Ex:
```xml
<gml:beginPosition calendarEraName="Seireki">1965</gml:beginPosition>
<gml:endPosition calendarEraName="Seireki">1990</gml:endPosition>
```

**indeterminatePosition**
The indeterminatePosition attribute is optional and is used in time positions and can be used alone or it can qualify a specific value for a temporal position. This attribute is often used to document unknown and present dates. The valid values for indeterminatePosition are “unknown”, “after”, “before”, and “now”. If indeterminatePosition = “now” the best practice is to put the date and time of the instance of metadata creation.

Ex:
```xml
<gml:TimePeriod gml:id="boundingTemporalExtent">
  <gml:description>ground condition</gml:description>
  <gml:beginPosition>1990-11-03T00:00:00</gml:beginPosition>
  <gml:endPosition indeterminatePosition="now"/>
</gml:TimePeriod>
```

**XLinks**
The XML Linking Language (XLink) allows elements to be inserted into XML documents for creating and describing links between resources, similar to HTML hyperlinks. Linking elements are recognized based on the use of a designated attribute named xml:link and a set of accompanying global attributes. The global attributes are type, href, role, arcrole, title, show, and actuate. If an XLink is used, the following ISO component is not used.

**type**
The type attribute indicates the XLink element type, such as simple, extended, locator, arc, resource or title.

**href**
The value of the href attribute in linking elements contains a locator that identifies a resource, e.g., by a URI reference or by an XPointer specification. The xlink href attribute is used to reference a component, and the xlink title attribute is used to apply a human understandable name to the component. Components are snippets of XML describing a specific piece of metadata content, such as information about people, websites, documents, archives,
A component is the finest level (atomic level) of granularity in a metadata record. Components are stored once and used as often as required within a metadata collection. Components provide significant storage and editing advantages over the traditional metadata management method of storing each record as a whole. XLinks can be used to reference a component from an unresolved metadata record (unresolved meaning that the metadata record contains xlinks). The xlink references a specific component by its unique identifier (UUID). During the resolve process, a component referenced via XLink is retrieved and embedded in the record (resolved metadata record).

Ex:

```xml
<gmd:contact xlink:href="http://www.ngdc.noaa.gov/docucomp/iso/8294BEE08AD7359FE040AC8C5AB460D1"/>
```

The role attribute specifies a part of the link's semantics. The value of this attribute indicates a property that the entire link has and identifies to the application software the meaning of the link. This allows the application to show different symbols for the different kinds of links.

**role**
The role attribute corresponds to the Resource Description Framework (RDF) notion of a property, where the role can be interpreted as stating that starting-resource HAS arc-role ending-resource. This contextual role can differ from the meaning of an ending resource when taken outside the context of this particular arc. For example, a resource might generically represent a ‘person’, but in the context of a particular arc it might have the role of ‘mother’ and in the context of a different arc it might have the role of ‘daughter’.

**title**
The title attribute indicates a human-readable description of the entire link.

Ex:

```xml
<gmd:contact xlink:href="http://www.ngdc.noaa.gov/docucomp/iso/8294BEE08AD7359FE040AC8C5AB460D1"
xlink:title="Anna Milan"/>
```

**Note**: Often, the best practice that has emerged is to add the role in parenthesis to the xlink:title if the component is a contact. This aids in providing more "human readable" content.

Ex:

```xml
<gmd:contact xlink:href="http://www.ngdc.noaa.gov/docucomp/component/7c7d17a0-4d66-11df-9879-0800200c9a66" xlink:title="DOC/NOAA/NESSDIS/NODC/NCDDC> National Coastal Data Development Center (pointOfContact)"/>
```

**show**
This attribute indicates the behavior policies to use when the link is traversed for the purpose of display or processing. The embed value indicates that the designated resource should be embedded in the body of the resource and at the location where the traversal started. The replace value indicates that the designated resource should replace the resource where the traversal started. The new value indicates that the designated resource should be displayed or processed in a new context.

**actuate**
The actuate attribute is used to express a policy as to when the traversal of a link should occur. The auto value indicates that the resource is automatically traversed. The user value indicates that the link is traversed only on the request of the user. The valid values for actuate are “onLoad”, “onRequest”, “other”, and “none”.

**nilReason**
The nilReason attribute is used to explain why an element is not included in the XML. This attribute allows a reason (explaining why the actual value cannot be provided) to exist in place of an actual value. It can have the values
‘inapplicable,’ ‘missing,’ ‘template,’ ‘unknown,’ and ‘withheld’. The example below shows how to use the nilReason to document and unknown date value.

Ex:

```xml
<gmd:date>
  <gmd:CI_Date>
    <gmd:date gco:nilReason="unknown"/>
    <gmd:dateType>
      <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication" codeSpace="002">publication</gmd:CI_DateTypeCode>
    </gmd:dateType>
  </gmd:CI_Date>
</gmd:date>
```

**Using CodeLists**

To standardize values for certain metadata elements, ISO metadata uses codelists. A codelist is an enumeration of values. It is a flexible mechanism allowing the extension of code lists as needed.

Use attributes to refer to a specific codelist value in a register. Codelists contain the attributes `codeList`, `codeListValue`, and `codeSpace`. The `codeList` attribute is mandatory and contains a URL that references a codelist definition within a registry or a codelist catalogue. The `codeListValue` attribute is also mandatory and contains the name of the selected value. The `codeSpace` attribute is optional and refers to the alternative expression of the `codeListValue`. See Annex C for more information about specific ISO codelists.

**CI_DateTypeCode** - identification of when a given event occurred

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>creation</td>
<td>001</td>
<td>date identifies when the resource was brought into existence</td>
</tr>
<tr>
<td>publication</td>
<td>002</td>
<td>date identifies when the resource was issued</td>
</tr>
<tr>
<td>revision</td>
<td>003</td>
<td>date identifies when the resource was examined or re-examined and improved or amended</td>
</tr>
</tbody>
</table>

Ex:

```xml
<gmd:dateType>
  <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication" codeSpace="002">publication</gmd:CI_DateTypeCode>
</gmd:dateType>
```

**Date and Time Formats**

The proper date formats correspond to ISO 8601, Data elements and interchange formats – Information interchange – Representation of dates and times. See Annex A for more information and examples. Calendar date is the most common date representation and is expressed as—
**YYYY-MM-DD**

where *YYYY* is the year in the Gregorian calendar, *MM* is the month of the year between 01 (January) and 12 (December), and *DD* is the day of the month between 01 and 31.

Ex: 2010-08-11 represents August 11, 2010.

Time of day, the time representation, uses the 24-hour timekeeping system and is expressed as—

*hh:mm:ss*

where *hh* is the number of complete hours that have passed since midnight, *mm* is the number of complete minutes since the start of the hour, and *ss* is the number of complete seconds since the start of the minute.

Ex: 23:59:59 represents the time one second before midnight.

Date and time represents a specified time of a specified day. When using the calendar date, the representation is—

*YYYY-MM-DDThh:mm:ss*,

where *T* is used to separate the date and time components.

Ex: 2010-08-11T13:31:01 represents 31 minutes and 1 second after 1 o’clock in the afternoon of August 11, 2010.

**Using the Workbook**

The workbook is a resource for applying the ISO metadata standard and its profiles. It provides names and definitions, describes domain values (valid values that can be assigned to the data element), and uses a graphic representation of the production rules.

The workbook is organized by main sections and supporting packages. The main sections are documented in the order in which they appear in the standard. The packages are referred to from various points within the main sections and other packages. The packages are documented in alphabetical order.

The workbook includes the selected geographic information metadata standard implementation guide as well as the feature catalogue standard implementation guide. The workbook also documents differences between the ISO standard and the NAP. NAP compliance is documented at ‘Multiplicity’. The workbook is structured as follows; the fileIdentifier is an example of that structure.

Tag: XML tag  
Definition: Definition of the tag  
Type: Type or package  
Domain: Format of the content  
Multiplicity: If something is repeatable and if it is required  
Attributes: XML attributes  
Best Practices: Recommended implementation
fileIdentifier – A unique phrase or string that uniquely identifies the metadata file
Type: gco:characterString
Domain: free text
Multiplicity: optional *This is NAP requirement*
Attributes: nilReason
Best Practices: Each metadata record shall have a universal unique identifier (UUID) to distinguish it from others.

Reading the Graphics

The graphics were generated automatically from the actual ISO schemas using Altova’s XMLSpy software. The graphics were then cleaned up to provide easier to read graphical representations of the standard. The legend of symbols required to read the graphics is provided below. Additional symbols are the result of the automating software and are not considered necessary to the understanding of the standard. The actual Unified Modeling Language (UML) diagrams can be found in Annex E.

<table>
<thead>
<tr>
<th>Graphic Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="sequence.png" alt="Sequence" /></td>
</tr>
<tr>
<td><img src="choice.png" alt="Choice" /></td>
</tr>
<tr>
<td><img src="mandatory.png" alt="Mandatory" /> Or <img src="mandatory.png" alt="Mandatory" /></td>
</tr>
<tr>
<td><img src="optional.png" alt="Optional" /> Or <img src="optional.png" alt="Optional" /></td>
</tr>
<tr>
<td><img src="conditional.png" alt="Conditional" /></td>
</tr>
<tr>
<td><img src="repeatability.png" alt="Repeatability" /></td>
</tr>
<tr>
<td><img src="closed.png" alt="Closed but expands further" /></td>
</tr>
<tr>
<td><img src="opened.png" alt="Opened to show expansion" /></td>
</tr>
</tbody>
</table>
Metadata

0  MD_Metadata – Root entity that defines information about metadata.
   Type: compound
   Multiplicity: optional
   Attributes: id, uuid
   Best Practices: MD_Metadata refers to ISO19115, MI_Metadata refers to ISO19115-2.

0.1  fileIdentifier – A unique phrase or string which uniquely identifies the metadata file.
    Type: gco:characterString
    Domain: free text
    Multiplicity: optional *this is a NAP requirement*
    Attributes: nilReason
    Best Practices: Each metadata record shall have a universal unique identifier (UUID) to
distinguish it from others.

0.2  language – Language of the metadata composed of an ISO639-2/T three-letter language code and an
    ISO3166-1 three-letter country code.
    Type: gco:characterString
    Domain: free text
    Multiplicity: optional *this is a NAP requirement*
    Attributes: nilReason
    Best Practices: The language code and country code are documented in the following manner:
<ISO639-2/T three letter language code>;<blank space><ISO3166-1 three letter country code>
Country code is given in uppercase. See Annex B.

FAQ:  How would you populate the element ‘language’ for a dataset composed in English from the United
   States?

   eng; USA

0.3  characterSet – Character coding standard in the metadata.
    Type: MD_CharacterSetCode
    Domain: ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2, 8859part3, 8859part4, 8859part5,
    8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13, 8859part14,
    8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii, ebcdic, eucKR, big5, GB2312
    Multiplicity: optional *this is a NAP requirement*
    Attributes: nilReason
    Best Practices: The character set for the metadata is set to ‘utf8’ by default.

0.4  parentIdentifier – The unique name of the file or associated fileIdentifier, related in higher hierarchy to
    the file.
    Type: gco:characterString
    Domain: free text
    Multiplicity: conditional
    Attributes: nilReason
    Best Practices: parentIdentifier is documented when the hierarchy of a higher level exists. If
there is more than one parent, see Aggregation Information.

0.5 hierarchyLevel – Level to which the metadata applies.
  Type: MD_ScopeCode
  Domain: attribute, attributeType, collectionHardware, collectionSession, dataset, series,
  nonGeographicDataset, dimensionGroup, feature, featureType, propertyType, fieldSession,
  software, service, model, tile
  Multiplicity: optional, repeatable *this is a NAP requirement*
  Attributes: nilReason
  Best Practices: Default repeatability is 1. If hierarchy is unknown, default value is ‘dataset’.

0.6 hierarchyLevelName – Name of the hierarchy levels for which the metadata is provided
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: optional, repeatable *this is not in NAP*
  Attributes: nilReason

0.7 contact – The responsible party for the metadata content.
  Type: CI_ResponsibleParty
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrol, title, show, actuate, uuidref, nilReason
  Best Practices: The organisation directly responsible for the metadata maintenance. Contact
  information shall be provided.

**FAQ:** Where are the data elements for ‘contact’?

Because the ‘contact’ elements are required by another section, the elements were grouped in the citation package
(CI) at CI_ResponsibleParty.

0.8 dateStamp – Metadata creation date.
  Type: choice of gco:Date or gco:DateTime
  Domain: date
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: Date of the metadata creation or the last metadata update. Refer to
date format information.

0.9 metadataStandardName – Name of the metadata standard/profile used.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional *this is a NAP requirement*
  Attributes: nilReason
  Best Practices: ISO 19115 Geographic information – Metadata *reference NAP if NAP is used*

0.10 metadataStandardVersion – Version of the metadata standard/profile used.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
Attributes: nilReason  
Best Practices: ISO 19115:2003(E) *reference NAP if NAP is used*

0.11  dataSetURI – Uniform Resource Identifier (URI) of the dataset to which the metadata applies.  
Type: gco:characterString  
Domain: free text  
Multiplicity: optional  
Attributes: nilReason  
Best Practices: This is NOT the place to link to the dataset. This should be the link to the metadata.

FAQ:  Why is the dataSetURI a link to the metadata vs. the data?  
The dataSetURI is found within MD_Metadata, defining information about the metadata. Because of where this element is contextually, it should describe the location of the metadata record, not the data set. This is similar to the way in which the CSDGM is used. Online Linkage gets you the URL for a Citation, for the publication of which the data may be a part, because it is part of the Citation Information. A link to the dataset should be found within the Distribution Information. For ISO, to document the URL to the data, document so in the Distribution OnlineResource. Similarly, within the CSDGM, Network Resource Name is for the URL that gets you the data package, because it is part of the Standard Order Process.

0.12  locale  - Other languages used in metadata free text descriptions.  
Type: PT_Locale  
Multiplicity: conditional, repeatable  
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason  
Best Practices: locale is mandatory when more than one language is used in free text descriptions
spatialRepresentationInfo – Digital representation of spatial information in the dataset.
Type: MD_VectorSpatialRepresentation or MD_GridSpatialRepresentation or MD_Georectified or MD_Georeferenceable
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
referenceSystemInfo – Identification of the spatial and temporal reference systems used.

Type: MD_ReferenceSystem
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: Mandatory if spatialRepresentationType in dataIdentification is vector, grid, or tin.
metadataExtensionInfo – Information describing metadata extensions

Type: MD_MetadataExtensionInformation

Multiplicity: optional, repeatable *this is not in NAP*

Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Identification Information

identificationInfo – Basic information about the dataset.
Type: MD_DataIdentification or SV_ServiceIdentification
Multiplicity: mandatory, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: There must be one occurrence of MD_DataIdentification or SV_ServiceIdentification
contentInfo – Characteristics describing the feature catalogue, the coverage, and the image data.

Type: MD_FeatureCatalogueDescription or MD_CoverageDescription or MD_ImageDescription

Multiplicity: optional, repeatable

Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Best Practices: Must have MD_FeatureCatalogueDescription or MD_CoverageDescription or MD_ImageDescription
Distribution Information

6  distributionInfo – Information about acquiring the dataset.
   Type: MD_Distribution
   Multiplicity: optional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

FAQ:  When do you use Distribution Information vs. Service Information?

   If computers read it, the information goes in Services. If humans read it, the information goes in Distribution.
Data Quality Information

7 dataQualityInfo – Information on the quality of the data that is specified by a data quality scope.
  Type: DQ_DataQuality
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
8 portrayalCatalogueInfo – A portrayal catalogue is a collection of defined symbols used to depict, to humans, features on a map.
   Type: MD_PorrayalCatalogueReference
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
metadataConstraints – The limitations or constraints on the use of or access of the metadata.
Type: MD_Constraints or MD_LegalConstraints or MD_SecurityConstraints
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
applicationSchemaInfo – Information about the conceptual schema of the dataset.
Type: MD_ApplicationSchemaInformation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Metadata Maintenance Information

metadataMaintenance – Information about metadata updates.
Type: MD_MaintenanceInformation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
CI PACKAGE
Cl_Address – Physical and email address at which the organisation or individual may be contacted.

  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid

deliveryPoint – Address line for the location.

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable *this is not repeatable in NAP*
  Attributes: nilReason

city – City of the address

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

administrativeArea – State or province of the address.

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
postalCode – Administrative spatial code which assists mail and parcel delivery.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

country – Country of the physical address.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
  Best Practices: Refer to ISO3166. See Annex B.

electronicMailAddress – The electronic mailbox address of the responsible organisation or individual.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

Ex:
  <gmd:CI_Address>
    <gmd:deliveryPoint>
      <gco:CharacterString>Building 1100; Rm 101</gco:CharacterString>
    </gmd:deliveryPoint>
    <gmd:city>
      <gco:CharacterString>Stennis Space Center</gco:CharacterString>
    </gmd:city>
    <gmd:administrativeArea>
      <gco:CharacterString>MS</gco:CharacterString>
    </gmd:administrativeArea>
    <gmd:postalCode>
      <gco:CharacterString>39529</gco:CharacterString>
    </gmd:postalCode>
    <gmd:country>
      <gco:CharacterString>USA</gco:CharacterString>
    </gmd:country>
    <gmd:electronicMailAddress>
      <gco:CharacterString>ncddcmetadata@noaa.gov</gco:CharacterString>
    </gmd:electronicMailAddress>
  </gmd:CI_Address>
CI_Citation – Bibliographic information to reference the resource.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

title – Name by which the cited resource is known.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory

alternateTitle – Short name or other language name by which the cited information is known.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable

FAQ: Where is an example of ‘alternateTitle’?
If the dataset titled ‘Digital Chart of the World’ was also known as ‘DCW’, then ‘DCW’ would be the alternateTitle.

date – Reference date for the cited resource; reference date and event used to describe it.
Type: CI_Date
Multiplicity: mandatory, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: Whenever possible, include both creation date and revision date.

Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

editionDate – Reference date for the cited resource.
Type: choice of gco:Date or gco:DateTime
Domain: date
Multiplicity: optional
Attributes: nilReason

identifier – A unique value that identifies an object in a given namespace.
Type: MD_Identifier or RS_Identifier
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

citedResponsibleParty – Identification of the contact for the resource.
Type: CI_ResponsibleParty
Multiplicity: optional, repeatable *this is a NAP requirement*
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
presentationForm – The form in which the resource is available.
   Type: CI_PresentationFormCode
   Multiplicity: optional, repeatable
   Attributes: nilReason
   Best Practices: See Annex C.

series – Information about the series or collection of which the resource is a part.
   Type: CI_Series
   Multiplicity: optional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

otherCitationDetails – Other information to complete a citation.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

collectiveTitle – Information about the combined resource of which the dataset is a part. The description may include information on other volumes which are also available.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

ISBN – The international standard book number (ISBN) assigned by an ISBN authority to a publication such as a book, a pamphlet, an educational kit, a microform, a CD-ROM or another digital or electronic publication.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

ISSN – The international standard serial number (ISSN) assigned by an ISSN authority to a serial publication, such as a periodical, a newspaper, an annual, a journal, or a monographic series.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason
CI_Contact – Information which assists one to contact an individual or organisation.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid
Best Practices: one of phone, address, or onlineResource shall be provided.

phone – Telephone numbers to contact the organisation or individual.
Type: CI_Telephone
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: one of phone, address, or onlineResource shall be provided.

address – Physical and email address to contact the organisation or individual.
Type: CI_Address
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: one of phone, address, or onlineResource shall be provided.

onlineResource – Information about Internet hosted resources: availability; URL; protocol used; resource name; resource description, and resource function.
Type: CI_OnlineResource
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: one of phone, address, or onlineResource shall be provided.

hoursOfService – Time period (including time zone) when individuals can contact the organisation or individual.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
  Best Practices: Refer to ISO 8601 for the representation of time.

contactInstructions – Supplemental instructions on how or when to contact the individual or organisation.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
Cl_Date – The date in which the event or action occurred.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

date – The date in which the event or action occurred.
Type: choice of gco:Date or gco:DateTime
Domain: date
Multiplicity: mandatory
Attributes: nilReason
Best Practices: Date is represented minimally as a four digit representation for year- YYYY. Refer to FAQ for further format information.

dateType – Identification of the event used for the temporal aspects in the resource.
Type: Cl_DateTypeCode
Domain: creation, publication, revision
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C.

FAQ: What is the proper date format for gco:Date and gco:DateTime?
The proper date formats correspond to ISO 8601, Data elements and interchange formats – Information interchange – Representation of dates and times.

Calendar date is the most common date representation. It is—

```
YYYY-MM-DD
```

where YYYY is the year in the Gregorian calendar, MM is the month of the year between 01 (January) and 12 (December), and DD is the day of the month between 01 and 31.
Ex:

2010-08-11 represents August 11, 2010.

Time of the day is the time representation, using the 24-hour timekeeping system. It is—

\[ hh:mm:ss \]

where \( hh \) is the number of complete hours that have passed since midnight, \( mm \) is the number of complete minutes since the start of the hour, and \( ss \) is the number of complete seconds since the start of the minute.

Ex:

23:59:59 represents the time one second before midnight.

Date and time represents a specified time of a specified day. When use is made of the calendar date the representation is—

\[ YYYY-MM-DDThh:mm:ss \]

where \( T \) is used to separate the date and time components.

Ex:

2010-08-11T13:31:01 represents 31 minutes and 1 second after 1 o’clock in the afternoon of August 11, 2010.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

linkage – Internet location (address) for on-line access which uses a Uniform Resource Locator address or similar addressing scheme.
Type: URL
Domain: any valid URL
Multiplicity: mandatory
Attributes: nilReason

protocol – The connection protocol to be used, such as http, ftp, etc.
Type: gco:characterString
Domain: free text
Multiplicity: optional *this is a NAP requirement*
Attributes: nilReason
Best Practices: The protocol should be taken from an official controlled list, such as the Official Internet Protocol Standards or the Internet Assigned Numbers Authority (IANA).

applicationProfile – Name of an application profile that can be used with the online resource.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

name – Name of the online resource.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

description – Description of the online resource that provides the resource sought.
  Type: gco:characterString
  Domain: free text
  Multiplicity: mandatory
  Attributes: nilReason

function – Code for function performed by the online resource.
  Type: CI_OnlineFunctionCode
  Domain: download, information, offlineAccess, order, search
  Multiplicity: optional
  Best Practices: See Annex C.
CI_ResponsibleParty

- The identification of those responsible for the resource and the party's role in the resource.
  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid
  Best Practices: Must have one occurrence of either individualName, organisationName, and/or positionName.

individualName – The name of the responsible individual.
  Type: gco:characterString
  Domain: free text
  Multiplicity: conditional
  Attributes: nilReason
  Best Practices: individualName shall be provided if organisationName and/or positionName are not provided.

organisationName – Name of the responsible organisation.
  Type: gco:characterString
  Domain: free text
  Multiplicity: conditional
  Attributes: nilReason
  Best Practices: organisationName shall be provided if individualName and/or positionName are not provided.
positionName – Position of the responsible person.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: positionName shall be provided if individualName and/or organisationName are not provided.

FAQ: What should I do if I have information about a responsible party, such as contact information but I do not know the name of the individual, organisation, or position?

Document the information that you do know. To have a valid CI_ResponsibleParty, there must be one occurrence of either individualName, organisationName, and/or positionName. In this case, use the nilReason attribute.

Ex:
<gmd:CI_ResponsibleParty>
  <gmd:organisationName gco:nilReason="unknown"/>
  <gmd:contactInfo>
    <gmd:CI_Contact>
      <gmd:phone>
        <gmd:CI_Telephone>
          <gmd:voice>
            <gco:CharacterString>111-222-3333</gco:CharacterString>
          </gmd:voice>
        </gmd:CI_Telephone>
      </gmd:phone>
      <gmd:address>
        <gmd:CI_Address>
          <gmd:deliveryPoint>
            <gco:CharacterString>123 ABC Road</gco:CharacterString>
          </gmd:deliveryPoint>
          <gmd:city>
            <gco:CharacterString>City</gco:CharacterString>
          </gmd:city>
          <gmd:administrativeArea>
            <gco:CharacterString>State</gco:CharacterString>
          </gmd:administrativeArea>
          <gmd:postalCode>
            <gco:CharacterString>90210</gco:CharacterString>
          </gmd:postalCode>
          <gmd:country>
            <gco:CharacterString>United States</gco:CharacterString>
          </gmd:country>
        </gmd:CI_Address>
      </gmd:address>
    </gmd:CI_Contact>
  </gmd:contactInfo>
  <gmd:role>
  </gmd:role>
contactInfo – Information required enabling contact with the responsible person and/or organisation.
   Type: CI_Contact
   Multiplicity: optional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

role – Function performed by the responsible party.
   Type: CI_RoleCode
   Domain: resourceProvider, custodian, owner, user, distributor, originator, pointOfContact, principalInvestigator, processor, publisher, author
   Multiplicity: mandatory
   Attributes: nilReason
   Best Practices: See Annex C.
Cl_Series

Cl_Series – Information about a Series publication or dataset aggregation.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

name – Name of the publication series or aggregate dataset of which the referenced dataset is a part.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: name will be provided if issuelfntification is not provided.

issuelntification – Identification of the series’ issue information.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: issuelfntification will be provided if name is not provided.

page – Identification of the articles’ page number(s).
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
Cl_Telephone – Information on the telephone numbers used to contact the responsible individual or organisation.
   Type: compound
   Multiplicity: mandatory
   Attributes: id, uuid
   Best Practices: At least one occurrence of voice or facsimile is required.

voice – Telephone number of an organisation or individual.
   Type: gco:characterString
   Domain: free text
   Multiplicity: conditional, repeatable
   Attributes: nilReason
   Best Practices: voice is mandatory if facsimile is not documented.

facsimile – Facsimile telephone number of an organisation or individual.
   Type: gco:characterString
   Domain: free text
   Multiplicity: conditional, repeatable
   Attributes: nilReason
   Best Practices: facsimile is mandatory if voice is not documented.
DQ PACKAGE
**DQ_ConformanceResult**

- **DQ_ConformanceResult** – Information which describes the outcome from evaluating the value(s) against a set acceptable quality level.
  - Type: compound
  - Multiplicity: conditional
  - Attributes: id, uuid

- **specification** – citation for the specification or user requirement used to evaluate the data.
  - Type: CI_Citation
  - Multiplicity: mandatory
  - Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

- **explanation** – An explanation of the conformance result.
  - Type: gco:characterString
  - Domain: free text
  - Multiplicity: mandatory
  - Attributes: nilReason

- **pass** – Notification of whether the data passed or failed the conformance test.
  - Type: Boolean
  - Domain: 0, 1 (0 = failed, 1 = passed)
  - Multiplicity: mandatory
  - Attributes: nilReason
DQ_DataQuality – Information on the quality of the data that is specified by a data quality scope.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid
Best Practices: The must be one occurrence of either report or lineage.

scope – The extent of characteristics for which data quality information is reported.
Type: DQ_Scope
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: When the attribute level of scope is set to ‘dataset’, Report OR Lineage is mandatory. Both may be reported.

report – A statement of the quality of the resource specified by the scope.
Type: DQ_CompletenessCommission or DQ_CompletenessOmission or DQ_ConceptualConsistency or DQ_DomainConsistency or DQ_FormatConsistency or DQ_TopologicalConsistency or DQ_AbsoluteExternalPositionalAccuracy or DQ_GriddedDataPositionalAccuracy or DQ_RelativeInternalPositionalAccuracy or DQ_ThematicClassificationCorrectness or DQ_NonQuantitativeAttributeAccuracy or DQ_QuantitativeAttributeAccuracy or DQ_AccuracyOfATimeMeasurement or DQ_TemporalConsistency
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: report is mandatory if lineage is missing.

lineage – Information or lack of information on the events and source data used to construct the dataset within the specified Scope
Type: LI_Lineage
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: Lineage shall be provided when Report is not reported.
DQ_QuantitativeResult – Information on the value(s) resulting from applying a data quality measure.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

valueType – The class or classes used for the value type(s).
Type: gco:RecordType
Multiplicity: optional
Attributes: nilReason

valueUnit – Any system devised to quantify a value, such as length, time, angle, area, volume, velocity, or scale.
Type: BaseUnit or ConventionalUnit or DerivedUnit
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: See Annex D.

errorStatistic – The statistical method used to estimate error in the value.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

value – The quantitative value(s) for the object measured.
Type: gco:Record
Multiplicity: mandatory, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Ex:
<gmd:DQ_QuantitativeResult>
  <gmd:valueUnit>
    <gml:BaseUnit gml:id="meters">
      <gml:identifier codeSpace="SI">meters</gml:identifier>
    </gml:BaseUnit>
  </gmd:valueUnit>
  <gmd:value>
    <gco:Record>2</gco:Record>
  </gmd:value>
</gmd:DQ_QuantitativeResult>
DQ_Scope – The extent of characteristics for which data quality information is reported.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

level – The data or application level for which data quality is described.
Type: MD_ScopeCode
Domain: attribute, attributeType, collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, feature, featureType, propertyType, fieldSession, software, service, model, tile
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C. When ‘dataset’ is selected, report or lineage is mandatory.

extent – The spatial (horizontal and/or vertical) and the temporal delineation of the resource.
Type: EX_Extent
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

levelDescription – Description of the level of the dataset.
Type: MD_ScopeDescription
Multiplicity: conditional, repeatable
Attributes: nilReason
Best Practices: When level is not ‘dataset’ or ‘series’, then levelDescription is mandatory.
DQ_CompletenessCommission
DQ_CompletenessOmission
DQ_ConceptualConsistency
DQ_DomainConsistency
DQ_FormatConsistency
DQ_TopologicalConsistency
DQ_AbsoluteExternalPositionalAccuracy
DQ_GriddedDataPositionalAccuracy
DQ_RelativeInternalPositionalAccuracy
DQ_ThematicClassificationCorrectness
DQ_NonQuantitativeAttributeAccuracy
DQ_QuantitativeAttributeAccuracy
DQ_AccuracyOfATimeMeasurement
DQ_TemporalConsistency

*NOTE* Each of the compounds below share the same elements pictured above and detailed below.

DQ_CompletenessCommission – Notification of excess data present in the dataset beyond the extent defined in Scope.
Type: compound
Multiplicity: optional
Attributes: id, uuid

DQ_CompletenessOmission – Notification of data absent from the dataset as defined by Scope.
Type: compound
Multiplicity: optional
Attributes: id, uuid
**DQ_ConceptualConsistency** – The level to which the dataset adheres to the conceptual schema. For example, conceptual consistency might describe to which level the resource complies with the data structure and attributing of the conceptual schema – i.e., feature types, feature attributes, relationships between features, etc.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_DomainConsistency** – The adherence of resource attribute values to conceptual schema specified values.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_FormatConsistency** – The level of data storage agreement with the dataset physical structure as described by the attribute Scope.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_TopologicalConsistency** – The testing for topological correctness of encoded characteristics in the dataset as delimited by Scope.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_AbsoluteExternalPositionalAccuracy** – Description of the methods, procedures, conformance results or quantitative results and date stamp of the positional measurement in the dataset.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_GriddedDataPositionalAccuracy** – The degree to which gridded data positions compare to values accepted as being true.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_RelativeInternalPositionalAccuracy** – The degree to which all features in a given set meet a defined proximity threshold.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_ThematicClassificationCorrectness** – Comparison of classes or attributes assigned to features or feature attributes respectively with respect to a recognized repository of features that pertain in a particular context.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid

**DQ_NonQuantitativeAttributeAccuracy** – Degree to which qualitative attributes reflect the stated requirements.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid
DQ_QuantitativeAttributeAccuracy – Degree to which quantitative attributes reflect the stated requirements.
  Type: compound
  Multiplicity: optional
  Attributes: id, uuid

DQ_AccuracyOfATimeMeasurement - Report on the accuracy or error in time measurement.
  Type: compound
  Multiplicity: optional
  Attributes: id, uuid

DQ_TemporalConsistency – The correctness of reported ordered events or sequences.
  Type: compound
  Multiplicity: optional
  Attributes: id, uuid

nameOfMeasure – Name of the test applied to the data to assure data quality.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

measureIdentification – Code which identifies a registered standard data quality procedure.
  Type: MD_Identifier or RS_Identifier
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

measureDescription – Description of the measure applied to the dataset to assure quality.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

evaluationMethodType – Method type used to evaluate data quality in the dataset.
  Type: DQ_EvaluationMethodTypeCode
  Domain: directInternal, directExternal, indirect
  Multiplicity: optional
  Attributes: nilReason
  Best Practices: See Annex C.

evaluationMethodDescription – Description of the evaluation method applied to the dataset.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

evaluationProcedure – Citation for the evaluation procedure.
  Type: CI_Citation
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

dateTime – Date and Time at which the test was completed.
Type: gco:DateTime
Domain: date
Multiplicity: optional, repeatable
Attributes: nilReason

result — Value(s) obtained from data quality test or outcome from applying data quality measure against a specified/acceptable quality conformance level.
Type: DQ_QuantitativeResult or DQ_ConformanceResult
Multiplicity: mandatory, repeatable twice
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
EX PACKAGE
EX_BoundingPolygon – Boundary enclosing the dataset, expressed as the closed set of (x,y) coordinates of the polygon (last point replicates the first point).
- Type: compound
- Multiplicity: conditional
- Attributes: id, uuid
- Best Practices: EX_BoundingPolygon is mandatory if EX_GeographicExtent or EX_GeographicBoundingBox or EX_GeographicDescription are not documented. The first point must equal the last point.

extentTypeCode – Indication of whether the bounding polygon encompasses an area covered by the data or an area where data is not present.
- Type: gco:Boolean
- Domain: 0, 1 (0 – exclusion, 1 – inclusion)
- Multiplicity: optional
- Attributes: nilReason

polygon – Coordinates defining the outline of an area covered by a dataset.
- Type: Point or Polygon
- Multiplicity: mandatory, repeatable
- Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Point – A point is defined by a single coordinate tuple. The direct position of a point is specified by the pos element.
- Type: pos or coordinates
- Multiplicity: mandatory
- Attributes: id, srsName, srsDimension, axisLabels, uomLabels
- Best Practices: The id attribute is mandatory.
Polygon – A special surface that is defined by a single surface patch. The elements exterior and interior describe the surface boundary of the polygon.

Type: exterior and/or interior
Multiplicity: mandatory
Attributes: id, srsName, srsDimension, axisLabels, uomLabels

exterior – The exterior boundary of a ring.
Type: LinearRing
Multiplicity: optional

LinearRing – A LinearRing is defined by four or more coordinate tuples, with linear interpolation between them; the first and last coordinates shall be coincident.
Type: coordinates or pos or posList
Domain: coordinate tuple
Multiplicity: mandatory

interior – The interior area enclosed by the rings.
Type: LinearRing
Multiplicity: optional, repeatable

LinearRing – A LinearRing is defined by four or more coordinate tuples, with linear interpolation between them; the first and last coordinates shall be coincident.
Type: coordinates or pos or posList
Domain: coordinate tuple
Multiplicity: mandatory

Ex:

```xml
<gmd:EX_BoundingPolygon id="boundingPolygon">
  <gmd:Polygon>
    <gml:interior>
      <gml:LinearRing>
        <gml:coordinates decimal="156.86274,71.34815 -156.87389,71.33893 -
156.88004,71.33883 -156.89144,71.33259 -156.89982,71.33182 -156.86274,71.34815 ">
        ...
      </gml:LinearRing>
    </gml:interior>
  </gml:Polygon>
</gmd:EX_BoundingPolygon>
```

Ex:

```xml
<gmd:EX_BoundingPolygon>
  <gmd:polygon>
    <gml:LineString gml:id="leg1" srsName="EPSG:4326">
      <gml:posList>1.0 1.0 2.0 2.0 3.0 3.0</gml:posList>
    </gml:LineString>
  </gmd:Polygon>
</gmd:EX_BoundingPolygon>
```
FAQ: What is the srsName attribute and how is it used?

A srsName attribute attached to a geometry object specifies the object’s coordinate reference system (CRS). The value of the srsName attribute is a Uniform Resource Identifier (URI). It refers to a definition of the CRS that is used to interpret the coordinates in the geometry. The CRS definition may be in a document or in an online web service. Values of EPSG codes can be resolved by using the CRS Registry Service operated by the Oil and Gas Producers Association available at http://www.epsg-registry.org. The srsName URI may also be a Uniform Resource Name (URN) for referencing a common CRS definition.

Ex:
An object is located at the point 45.67 and 88.56 on a map and is referenced to WGS 84.

```xml
<gmd:geographicElement>
    <gmd:EX_BoundingPolygon>
        <gmd:polygon>
            <gml:Point gml:id="boundingPoint">
                <gml:pos srsName="http://www.opengis.net/def/crs/EPSG/0/4326">45.67 88.56</gml:pos>
            </gml:Point>
        </gmd:polygon>
    </gmd:EX_BoundingPolygon>
</gmd:geographicElement>
```
EX_Extent – Information about horizontal, vertical, and temporal extent
   Type: compound
   Multiplicity: mandatory
   Attributes: id, uuid
   Best Practices: If EX_Extent exists, there must be one occurrence of gmd:description or gmd:geographicElement or gmd:temporalElement or gmd:verticalElement.

description – Spatial and temporal extent for the referring object.
   Type: gco:characterString
   Domain: free text
   Multiplicity: conditional
   Attributes: nilReason
   Best Practices: gmd:description is mandatory if gmd:geographicElement or gmd:temporalElement or gmd:verticalElement are not present.

geographicElement – Provides geographic component of the extent of the referring object.
   Type: EX_GeographicExtent or EX_BoundingPolygon or EX_GeographicBoundingBox or EX_GeographicDescription
   Multiplicity: conditional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: gmd:geographicElement is mandatory if gmd:description or gmd:temporalElement or gmd:verticalElement are not present.

temporalElement – Provides temporal component of the extent of the referring object.
   Type: EX_TemporalExtent
   Multiplicity: conditional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: gmd:temporalElement is mandatory if gmd:description or gmd:geographicElement or gmd:verticalElement are not present.
verticalElement – Provides vertical component of the extent of the referring object.
Type: EX_VerticalExtent
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: gmd:verticalElement is mandatory if gmd:description or gmd:geographicElement or gmd:temporalElement are not present.
EX_GeographicBoundingBox – Geographic position of the dataset.
Type: compound
Multiplicity: conditional
Attributes: id, uuid
Best Practices: EX_GeographicBoundingBox is mandatory if EX_GeographicExtent or EX_BoundingPolygon or EX_GeographicDescription are not documented.

extentTypeCode – Indication of whether the bounding polygon encompasses an area covered by the data or an area where data is not present.
Type: gco:Boolean
Domain: 0, 1 (0 – exclusion, 1 – inclusion)
Multiplicity: optional
Attributes: nilReason

westBoundingLongitude – Westernmost coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees.
Type: gco:Decimal
Domain: any decimal number
Multiplicity: mandatory
Attributes: nilReason

eastBoundingLongitude – Easternmost coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees.
Type: gco:Decimal
Domain: any decimal number
Multiplicity: mandatory
Attributes: nilReason
southBoundingLatitude – Southernmost coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees.
  Type: gco:Decimal
  Domain: any decimal number
  Multiplicity: mandatory
  Attributes: nilReason

northBoundingLatitude – Northernmost coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees.
  Type: gco:Decimal
  Domain: any decimal number
  Multiplicity: mandatory
  Attributes: nilReason
EX_GeographicDescription – Description of the geographic area using identifiers.
Type: compound
Multiplicity: conditional
Attributes: id, uuid
Best Practices: EX_GeographicDescription is mandatory if EX_GeographicExtent or EX_BoundingPolygon or EX_GeographicBoundingBox are not documented.

extentTypeCode – Indication of whether the bounding polygon encompasses an area covered by the data or an area where data is not present.
Type: gco:Boolean
Domain: 0, 1 (0 – exclusion, 1 – inclusion)
Multiplicity: optional
Attributes: nilReason

geographicIdentifier – Identifier used to represent a geographic area.
Type: MD_Identifier or RS_Identifier
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
EX_GeographicExtent – Geographic area of the dataset.
  Type: compound
  Multiplicity: conditional
  Attributes: id, uuid
  Best Practices: EX_GeographicExtent is mandatory if EX_BoundingPolygon or
  EX_GeographicBoundingBox or EX_GeographicDescription are not documented.

extentTypeCode – Indication of whether the bounding polygon encompasses an area covered by the data
or an area where data is not present.
  Type: gco:Boolean
  Domain: 0, 1 (0 – exclusion, 1 – inclusion)
  Multiplicity: optional
  Attributes: nilReason
EX_TemporalExtent – Time period covered by the content of the dataset
Type: Compound
Multiplicity: mandatory
Attributes: id, uuid

extent – Date and time for the content of the dataset
Type: choice of TimeInstant or TimePeriod
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

TimeInstant – Single date and Time
Type: compound
Multiplicity: conditional
Attributes: id, frame
Best Practices: TimeInstant is mandatory if TimePeriod is not documented. The TimeInstant attribute id is mandatory. Each TimeInstant id attribute must be unique within a record.

description – description of the date and time documented.
Domain: free text
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: The currentness reference (the basis on which the time period of content information is determined) is often documented here.

timePosition – single date and time
Domain: date
Multiplicity: mandatory
Attributes: frame, calendarEraName, indeterminatePosition
Best Practices: Use indeterminatePosition to document unknown dates and present dates. The valid values for indeterminatePosition are 'unknown', 'after', 'before', and 'now'.

Ex:
```xml
<gmd:EX_TemporalExtent id="boundingTemporalExtent">
  <gmd:extent>
    <gml:TimeInstant gml:id="tp_114854">
      <gml:description>ground condition</gml:description>
      <gml:timePosition>1990-11-03T00:00:00</gml:timePosition>
    </gml:TimeInstant>
  </gmd:extent>
</gmd:EX_TemporalExtent>
```

**TimePeriod** – Represents an identifiable extent in time.

Type: compound
Multiplicity: conditional
Attributes: id, frame
Best Practices: TimePeriod is mandatory if TimeInstant is not documented. The TimePeriod attribute id is mandatory. Each TimeInstant id attribute must be unique within a record.

description – description of the date and time documented.
Domain: free text
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: The currentness reference (the basis on which the time period of content information is determined) is often documented here.

beginPosition – The beginning date and time of the dataset’s content.
Domain: date
Multiplicity: mandatory
Attributes: frame, calendarEraName, indeterminatePosition
Best Practices: Use indeterminatePosition to document unknown dates and present dates. The valid values for indeterminatePosition are 'unknown', 'after', 'before', and 'now'.

dendDate – The ending date and time of the content of the dataset.
Domain: date
Multiplicity: mandatory
Attributes: frame, calendarEraName, indeterminatePosition

duration – Length of time.
Domain: date
Multiplicity: optional
Best Practices: Cannot document both duration and timeInterval.

timeInterval – Frequency between time events based on floating point values for temporal length.
Type: float
Domain: 32-bit floating point
Multiplicity: optional
Attributes: unit, radix, factor
Best Practices: Cannot document both timeInterval and duration. The attribute unit is mandatory to document units of time.

Ex:
<gmd:temporalElement>
  <gmd:EX_TemporalExtent id="boundingTemporalExtent">
    <gmd:extent>
      <gml:TimePeriod gml:id="tp_1234">
        <gml:description>ground condition</gml:description>
        <gml:beginPosition>1990-11-03T00:00:00</gml:beginPosition>
        <gml:endPosition indeterminatePosition="now"/>
      </gml:TimePeriod>
    </gmd:extent>
  </gmd:EX_TemporalExtent>
</gmd:temporalElement>

FAQ: How do I document multiple dates?
You must repeat at gmd:temporalElement
**EX_VerticalExtent**

**EX_VerticalExtent** – Vertical domain of a dataset.
Type: compound
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

- **minimumValue** – lowest vertical extent contained in the dataset.
  Type: gco:Real
  Domain: any number
  Multiplicity: mandatory
  Attributes: nilReason

- **maximumValue** – Highest vertical extent contained in the dataset.
  Type: gco:Real
  Domain: any number
  Multiplicity: mandatory
  Attributes: nilReason

- **verticalCRS** – Vertical coordinate reference system.
  Type: compound
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: A coordinate reference system (CRS) should be taken from a publicly available register or document such as the EPSG Geodetic Parameter Dataset (http://www.epsg-registry.org/) or Spatial Reference (http://spatialreference.org). An identifier or well known name with an authority is defined and referenced here. If a coordinate reference system (CRS) is not available from a publicly available register or document and as such has no identifier or well known name, then that CRS shall be described according to ISO 19111.
FAQ:  How do I document water depths and units? For example, water column samples taken between 3100 and 3600 meters?

```gml
<gmd:EX_VerticalExtent>
  <gmd:minimumValue>
    <gco:Real>3600</gco:Real>
  </gmd:minimumValue>
  <gmd:maximumValue>
    <gco:Real>3100</gco:Real>
  </gmd:maximumValue>
  <gmd:verticalCRS>
    <gml:VerticalCRS gml:id="verticalCRSforSamples">
      <gml:description>Definition of water depth in meters for marine geosamples.</gml:description>
      <gml:identifier codeSpace="NGDC">verticalCRSforSamples</gml:identifier>
      <gml:remarks>Minimum and maximum values represent the start and end time of sample collection.</gml:remarks>
      <gml:scope>water</gml:scope>
      <gml:usesVerticalCS>
        <gml:VerticalCS gml:id="verticalCSforSamples">
          <gml:identifier codeSpace="NGDC">verticalCSforSamples</gml:identifier>
          <gml:axis>
            <gml:CoordinateSystemAxis uom="#meters" gml:id="coordinateSystemAxisforSamples">
              <gml:identifier codeSpace="NGDC">coordinateSystemAxisforSamples</gml:identifier>
              <gml:axisAbbrev>Water Depth</gml:axisAbbrev>
              <gml:axisDirection>down</gml:axisDirection>
              <gml:minimumValue>0.0</gml:minimumValue>
            </gml:CoordinateSystemAxis>
          </gml:axis>
        </gml:VerticalCS>
      </gml:usesVerticalCS>
      <gml:verticalDatum>
        <gml:VerticalDatum gml:id="verticalDatumforSamples">
          <gml:identifier codeSpace="NGDC">verticalDatumforSamples</gml:identifier>
          <gml:scope>water</gml:scope>
          <gml:anchorPoint>water surface</gml:anchorPoint>
        </gml:VerticalDatum>
      </gml:verticalDatum>
    </gml:VerticalCRS>
  </gmd:verticalCRS>
</gmd:EX_VerticalExtent>
```

Or when there is something to reference in EPSG:

```gml
<gmd:verticalElement>
  <gmd:EX_VerticalExtent>
    <gmd:minimumValue>
      <gco:Real>3600</gco:Real>
    </gmd:minimumValue>
    <gmd:maximumValue>
      <gco:Real>3100</gco:Real>
    </gmd:maximumValue>
  </gmd:EX_VerticalExtent>
</gmd:verticalElement>
```
LI PACKAGE
LI_Lineage — Information or lack of information on the events and source data use to construct the dataset within the specified Scope.

- **Type:** compound
- **Multiplicity:** mandatory
- **Attributes:** id, uuid
- **Best Practices:** There must be at least one occurrence of statement or source or processStep.

**statement** — General explanation of the data producer's knowledge of the dataset lineage.
- **Type:** gco:characterString
- **Domain:** free text
- **Multiplicity:** conditional
- **Attributes:** nilReason

**processStep** — The events in the development of the dataset.
- **Type:** LI_ProcessStep
- **Multiplicity:** conditional, repeatable
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**source** — Information on the sources used in the development of the dataset.
- **Type:** LI_Source
- **Multiplicity:** conditional, repeatable
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason
- **Best Practice:** source is provided when statement or processStep is not reported.
LI_ProcessStep – The events in the development of the dataset.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

description – Description of the processes performed on the data.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

rationale – Purpose for performing the process on the data.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

dateTime – The date and time when the process was completed.
Type: gco:DateTime
Domain: date
Multiplicity: optional
Attributes: nilReason

processor – Identification and means to contact the person or party that performed the process.
Type: CI_ResponsibleParty
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
source – Information about the source data related to the creation of the data within the scope.

Type: LI_Source

Multiplicity: optional, repeatable

Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
**LI_Source** — Information about the source data used in creating the data within the specified Scope.

Type: compound

Multiplicity: mandatory

Attributes: id, uuid

description — Statement that describes the source data.

Type: gco:characterString

Domain: free text

Multiplicity: conditional

Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Best Practices: description is mandatory if sourceCitation and sourceExtent are not provided.

description format is `<MD_MediumNameCode codeList>;<><blank space><free text>`

---

**FAQ:** How would you populate the description for a satellite image source that is on a DVD??

dvd; source satellite image
scaleDenominator – The number below the line in a proper fraction that the numerator is equal to 1.
Type: MD_RepresentativeFraction
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

sourceReferenceSystem – Information about the reference system.
Type: MD_ReferenceSystem
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

sourceCitation – Citation for the sources for the dataset.
Type: CI_Citation
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: sourceCitation is mandatory if description is not provided. This is NOT a citation to a document about the source data, but it is a dataset citation of the dataset.

sourceExtent – Describes the spatial, horizontal and/or vertical, and the temporal coverage in the source dataset.
Type: EX_Extent
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: sourceExtent is mandatory if description is not provided

sourceStep – Information about an event related to the creation process for the source data.
Type: LI_ProcessStep
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD PACKAGE
MD_AggregateInformation – The citation for or name of an aggregate dataset, the type of aggregate dataset, and optionally the activity which produced the dataset.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid
Best Practices: Either aggregateDataSetName or aggregateDataSetIdentifier shall be provided.

aggregateDataSetName – Citation information for the aggregate resource or initiative.
Type: CI_Citation
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: Strongly recommended to provide contact information under cited responsible party.

aggregateDataSetIdentifier – Identification of the aggregate dataset.
Type: MD_Identifier or RS_Identifier
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

associationType – Association type of the aggregate dataset.
Type: DS_AssociationTypeCode
Domain: crossReference, largerWorkCitation, partOfSeamlessDatabase, source, stereoMate
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C.
initiativeType – Type of initiative for which the dataset was developed.
Type: DS_InitiativeTypeCode
Domain: campaign, collection, exercise, experiment, investigation, mission, sensor, operation, platform, process, program, project, study, task, trial
Multiplicity: optional
Attributes: nilReason
Best Practices: See Annex C.
MD_ApplicationSchemaInformation – Information about the application schema used to develop the dataset.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid

name – Citation for the application schema.
Type: CI_Citation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

schemaLanguage – Identification of the schema language.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

constraintLanguage – Identification of the formal language used to describe constraints in the application schema.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason
schemaAscii – Full application schema given as an ASCII file.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

graphicsFile – Full application schema given as a graphics file.
   Type: gco:Binary
   Multiplicity: optional
   Attributes: nilReason

softwareDevelopmentFile – Full application schema given as a software development file.
   Type: gco:Binary
   Multiplicity: optional
   Attributes: nilReason

softwareDevelopmentFileFormat – Software dependent format used for the application schema software dependent file.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason
MD_Band – Range of wavelengths in the electromagnetic spectrum.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

sequenceIdentifier – Sensor band wavelengths.
Type: gco:MemberName
Multiplicity: conditional
Attributes: id, uuid
Best Practices: Either sequenceIdentifier or descriptor will be provided, or both.

descriptor – Description of cell value range.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: Either descriptor or sequenceIdentifier will be provided, or both.
maxValue – Longest wavelength the sensor is capable of collecting within the designated band.
   Type: gco:Real
   Domain: any number
   Multiplicity: optional
   Attributes: nilReason

minValue - Shortest wavelength the sensor is capable of collecting within the designated band.
   Type: gco:Real
   Domain: any number
   Multiplicity: optional
   Attributes: nilReason

units – Sensor wavelength units.
   Type: BaseUnit or ConventionalUnit or DerivedUnit
   Multiplicity: conditional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: Mandatory if maxValue or minValue is reported. See Annex D.

peakResponse – Highest wavelength response.
   Type: gco:Real
   Domain: any number
   Multiplicity: optional
   Attributes: nilReason

bitsPerValue - Maximum number of significant bits in the uncompressed representation for the value in each band of each pixel.
   Type: gco:Integer
   Domain: any whole number
   Multiplicity: optional
   Attributes: nilReason

toneGradation – Number of discrete numerical values in the grid data.
   Type: gco:Integer
   Domain: any whole number
   Multiplicity: optional
   Attributes: nilReason

scaleFactor – Scale factor applied to each cell value.
   Type: gco:Real
   Domain: any number
   Multiplicity: optional
   Attributes: nilReason

offset – The physical value corresponding to a cell value of zero.
   Type: gco:Real
   Domain: any number
   Multiplicity: optional
   Attributes: nilReason
MD_BrowseGraphic – The name, description, and file type of an illustration of the resource.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

filename – Name of the graphic file provided to illustrate the resource.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason
Best Practices: The filename shall include the path or URL to access the graphic file and the file
type extension.

fileDescription – Text description of the graphic file’s content.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

fileType – Description of the graphic file format.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
Best Practices: If the file type requires a non common viewer, also provide instructions on
acquiring that viewer.
MD_Constraints – The limitations, restrictions, or statements on the resource fitness for use.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

useLimitation – Statement on the fitness of use or limitations on the use of the resource or metadata.
Type: gco:characterString
Domain: free text
Multiplicity: conditional, repeatable
Attributes: nilReason
Best Practices: useLimitation is mandatory unless MD_LegalConstraints or MD_SecurityConstraints is used.
MD_CoverageDescription – Information about the content of grid data cells.
   Type: compound
   Multiplicity: conditional
   Attributes: id, uuid

attributeDescription – Description of the cell measurement.
   Type: gco:RecordType
   Multiplicity: mandatory
   Attributes: nilReason

contentType – Information represented by the cell.
   Type: MD_CoverageContentTypeCode
   Domain: image, thematicClassification, physicalMeasurement
   Multiplicity: mandatory
   Attributes: nilReason
   Best Practices: See Annex C.

dimension – Information on the dimension of the cell measurement value.
   Type: MD_RangeDimension or MD_Band
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_DataIdentification – Information which describes a dataset.
Type: compound
Multiplicity: conditional
Attributes: id, uuid
Best Practices: identificationInfo must have at least one occurrence of Data Identification or Service Identification.

citation – Citation for the dataset.
Type: CI_Citation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

abstract – Brief narrative summary of the dataset’s contents.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

purpose – Summary of the intentions for which the dataset was developed.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

credit – Recognition of those who contributed to the dataset.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

status – The development phase of the dataset.
Type: MD_ProgressCode
Domain: completed, historicalArchive, obsolete, ongoing, planned, required, underdevelopment
Multiplicity: optional, repeatable *this is a NAP requirement*
Attributes: nilReason

pointOfContact – Identification and means to contact people/organisations associated with the dataset.
Type: CI_ResponsibleParty
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceMaintenance – Describes the frequency, scope, and responsible party for the updating of the dataset.
Type: MD_MaintenanceInformation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

graphicOverview – The name of, description of, and file type of an illustration of the dataset.
Type: MD_BrowseGraphic
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
resourceFormat – Provides a description of the format of the resource(s).
  Type: MD_Format
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

descriptiveKeywords – Commonly used words or phrases which describe the dataset. Optionally, the
  keyword type and a citation for the authoritative or registered resource of the keywords are also
  provided.
  Type: MD_Keywords
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceSpecificUsage – Provides basic information about specific application(s) for which the resource(s)
  has been or is being used by different users.
  Type: MD_Usage
  Multiplicity: optional, repeatable *this is not in NAP*
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceConstraints – The limitations or constraints on the use of or access to the resource.
  Type: MD_Constraints or MD_LegalConstraints or MD_SecurityConstraints
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

aggregationInfo – The citation for the aggregate dataset or the name of the aggregate dataset, the type of
  aggregate dataset, and optionally the activity which produced the dataset.
  Type: MD_AggregateInformation
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

spatialRepresentationType – Object(s) used to represent the geographic information.
  Type: MD_SpatialRepresentationTypeCode
  Domain: vector, grid, textTable, tin, stereoModel, video
  Multiplicity: optional, repeatable
  Attributes: nilReason

spatialResolution – The level of detail of the dataset expressed as equivalent scale or ground distance.
  Type: MD_Resolution
  Multiplicity: optional, repeatable
  Attributes: nilReason

language – Languages of the dataset using standard ISO three-letter codes. See Annex B.
  Type: gco:characterString
  Domain: free text
  Multiplicity: mandatory, repeatable
  Attributes: nilReason

characterSet – Character coding standard in the dataset.
  Type: MD_CharacterSetCode
  Domain: ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2, 8859part3, 8859part4, 8859part5,
  8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13, 8859part14,
  8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii, ebcdic, eucKR, big5, GB2312

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Multiplicity: optional, repeatable
Attributes: nilReason
Best Practices: The character set for the metadata is set to ‘utf8’ by default.

topicCategory – The main theme(s) of the dataset.
  Type: MD_TopicCategoryCode
  Domain: farming, biota, boundaries, climatologyMeteorologyAtmosphere, economy, elevation,
  environment, geoscientificInformation, health, imageryBaseMapsEarthCover,
  intelligenceMilitary, inlandWaters, location, oceans, planningCadastre, society, structure,
  transportation, utilitiesCommunication
  Multiplicity: conditional, repeatable
  Attributes: nilReason
  Best Practices: A topicCategory code shall be provided when hierarchyLevel is set to ‘dataset’.

environmentDescription – Describes the dataset’s processing environment. Includes information, such as
  software, computer operating system, filename, and dataset size.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

extent – Describes the spatial, horizontal and/or vertical, and the temporal coverage in the resource.
  Type: EX_Extent
  Multiplicity: conditional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: Either Geographic Bounding Box or Geographic Description is required when
  hierarchyLevel is set to ‘dataset’.

supplementalInformation – Other descriptive information about the dataset.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
**MD_DigitalTransferOptions**

Technical means and media by which a resource is obtained from the distributor.
- **Type:** compound
- **Multiplicity:** mandatory
- **Attributes:** id, uuid

**unitsOfDistribution** – Tiles, layers, geographic areas, etc. in which the data is available.
- **Type:** gco:characterString
- **Domain:** free text
- **Multiplicity:** optional
- **Attributes:** nilReason

**transferSize** – Estimated size of the transfer unit in the specified format, expressed in megabytes.
- **Type:** gco:Real
- **Domain:** any number
- **Multiplicity:** optional
- **Attributes:** nilReason
- **Best Practices:** Value greater than ‘0.0’.

**onLine** – Information about the online sources where the data/dataset may be obtained.
- **Type:** CI_OnlineResource
- **Multiplicity:** optional, repeatable
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**offLine** – Information about the offline distribution media.
- **Type:** MD_Medium
- **Multiplicity:** optional
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason
- **Best Practices:** Not sure why onLine is repeatable and offLine is not. This will be discussed at the next ISO review.
MD_Dimension – Information on the dimension name, size, and resolution used.
  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid

dimensionName – Axis name.
  Type: MD_DimensionNameTypeCode
  Domain: row, column, vertical, track, crossTrack, line, sample, time
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: See Annex C.

dimensionSize – Number of elements along the axes.
  Type: gco:Integer
  Domain: any whole number
  Multiplicity: mandatory
  Attributes: nilReason

resolution – Degree of detail in the grid dataset.
  Type: gco:Measure or Angle or Scale or Length or Distance
  Multiplicity: optional
  Attributes: nilReason
  Best Practices: Document the type attribute uom (unit of measure).
Ex:
<gmd:MD_Dimension>
  <gmd:dimensionName>
    <gmd:MD_DimensionNameTypeCode codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_DimensionNameTypeCode" codeListValue="row">
      <gco:Integer>1354</gco:Integer>
    </gmd:MD_DimensionNameTypeCode>
    <gmd:dimensionSize>
      <gco:Integer>1354</gco:Integer>
    </gmd:dimensionSize>
    <gmd:resolution>
      <gco:Measure uom="meter">2</gco:Measure>
    </gmd:resolution>
  </gmd:dimensionName>
</gmd:MD_Dimension>
MD_Distribution – Information about the data distributor and options to obtain the dataset.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

distributionFormat – Description of distribution format.
Type: MD_Format
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: distributionFormat is mandatory if distributor information is not provided.

distributor – Information about the data distributor.
Type: MD_Distributor
Multiplicity: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: distributor is mandatory if distributionFormat information is not provided.

transferOptions – The means and media by which the data/dataset is obtained from the distributor.
Type: MD_DigitalTransferOptions
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_Distributor – Information about the distributor.
   Type: compound
   Multiplicity: mandatory
   Attributes: id, uuid

   distributorContact – Information on the party responsible for distribution.
   Type: CI_ResponsibleParty
   Multiplicity: mandatory
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

   distributionOrderProcess – The process to follow when obtaining the data/dataset.
   Type: MD_StandardOrderProcess
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

   distributorFormat – Provides information about the format used by the distributor.
   Type: MD_Format
   Multiplicity: conditional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: Use if the distributionFormat is not documented.

   distributorTransferOptions – Provides information about the technical means and media used by the distributor.
   Type: MD_DigitalTransferOptions
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_ExtendedElementInformation

- gmd:name
- gmd:shortName
- gmd:domainCode
- gmd:definition
- gmd:obligation
  - gmd:MD_ObligationCode
- gmd:condition
- gmd:DataType
  - gmd:MD_DatatypeCode
- gmd:maxOccursSequence
- gmd:domainValue
- gmd:parentEntity
  - gmd:MD_ElementType
  - gmd:MD_Metadata
  - gmd:CI_Dataset
  - gmd:CI_DigitalObject
  - gmd:CI_SoftwareComponent
  - gmd:CI_Graphic
  - gmd:CI_Citation
  - gmd:CI_Figure
  - gmd:CI_Table
  - gmd:CI_Appearance
  - gmd:CI_TypeCode
  - gmd:CI_RestrictionLevel
  - gmd:CI_RestrictionCode
  - gmd:CI_RestrictionCode
- gmd:role
- gmd:roleAssignment
  - gmd:CI_RoleAssignment
  - gmd:CI_RestrictionLevel
  - gmd:CI_RestrictionCode
  - gmd:CI_RestrictionCode
- gmd:source
  - gmd:CI_ResponsibilityParty
  - gmd:CI_RestrictionLevel
  - gmd:CI_RestrictionCode
  - gmd:CI_RestrictionCode
MD_ExtendedElementInformation – New metadata element, not found in ISO 19115 or ISO 19115-2.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid

name – Name of the extended metadata element.
Type: gco:CharacterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

shortName – Short form suitable for use in an implementation method such as XML.
Type: gco:CharacterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: shortName is mandatory if dataType is not equal to codeListElement.

domainCode – Three-digit code assigned to the extended element.
Type: gco:Integer
Domain: any whole number
Multiplicity: conditional
Attributes: nilReason
Best Practices: domainCode is mandatory if dataType equals codelistElement.

definition – Definition of the extended element.
Type: gco:CharacterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

obligation – Obligation of the extended element.
Type: MD_ObligationCode
Multiplicity: conditional
Attributes: nilReason
Best Practices: obligation is mandatory if dataType is not codelist, enumeration, or codelistElement.

condition – Condition under which the extended element is mandatory.
Type: gco:CharacterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: condition is mandatory if obligation equals conditional

dataType – Code which identifies the kind of value provided in the extended element.
Type: MD_DatatypeCode
Domain: class, codelist, enumeration, codelistElement, abstractClass, aggregateClass, specifiedClass, datatypeClass, interfaceClass, unionClass, metaclass, typeClass, characterString, integer, association
Multiplicity: mandatory
Attributes: nilReason
maximumOccurrence – Maximum occurrence of the extended element.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: conditional
  Attributes: nilReason
  Best Practices: maximumOccurrence is mandatory if dataType is not codelist, enumeration, or codelistElement.

domainValue – Valid values that can be assigned to the extended element.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: conditional
  Attributes: nilReason
  Best Practices: domainValue is mandatory if dataType is codelist, enumeration, or codelistElement.

parentEntity – Name of the metadata entity(s) under which this extended metadata element may appear. The name(s) may be standard metadata elements or other extended metadata elements.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: mandatory, repeatable
  Attributes: nilReason

rule – Specifies how the extended element relates to other existing elements and entities.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: mandatory
  Attributes: nilReason

rationale – Reason for creating the extended element.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

source – Name of the person or organisation creating the extended element.
  Type: CI_ResponsibleParty
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**FAQ:** How would I document extended element information for biological information?

Ex:
<gmd:MD_MetadataExtensionInformation>
<gmd:extendedElementInformation>
<gmd:MD_ExtendedElementInformation>
<gmd:name>
<gco:CharacterString>Taxonomy System</gco:CharacterString>
</gmd:name>
<gmd:shortName>
<gco:CharacterString>taxonomy</gco:CharacterString>
</gmd:shortName>
Documentation of taxonomic sources, procedures, and treatments.

The set of data elements contained within this class element represents an attempt to provide better documentation of taxonomic sources, procedures, and treatments.

National Biological Information Infrastructure (NBII)
MD_FeatureCatalogueDescription

MD_FeatureCatalogueDescription – Identification of the feature catalogue or the conceptual schema.
Type: compound
Multiplicity: conditional
Attributes: id, uuid
Best Practices: Although features (attributes of the dataset) are normally documented in a Feature Catalogue (ISO 19110), they should be a part of this metadata record.

Type: gco:Boolean
Domain: 0, 1 (0 = not compliant and 1 = compliant)
Multiplicity: optional
Attributes: nilReason

language – Language and character coding standards of the feature catalogue. See Annex B.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

includedWithDataset – Is the feature catalogue included with the dataset?
Type: gco:Boolean
Domain: 0, 1 (0 = not included and 1 = included)
Multiplicity: mandatory
Attributes: nilReason
featureTypes – Feature type identifier and/or generic name of feature as listed in the feature catalogue.
   Type: LocalName
   Domain: free text
   Multiplicity: optional, repeatable * this is NAP requirement*
   Attributes: nilReason
   Best Practices: LocalName has an optional attribute ‘codeSpace’.

FAQ: How would the feature type ‘building’ be documented?

Ex:
<featureTypes>
   <LocalName codeSpace="http://www...">building</LocalName>
</featureTypes>

featureCatalogueCitation – Citation to reference the feature catalogue.
   Type: CI_Citation
   Multiplicity: mandatory, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: This citation should provide a link to the feature catalogue.
MD_Format — Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device, or transmission channel.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid

name — Name of the data transfer format.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

version — Version of the format (date, number, etc).
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

amendmentNumber — Format version amendment number.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

specification — The subset name, profile, or product specification of the format.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
fileDecompressionTechnique – Description of recommended processes or algorithms to apply to the compressed resource.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

formatDistributor – Provides information about the distributor’s format.
   Type: MD_Distributor
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_GeometricObjects – Number of objects, listed by geometric object type, used in the dataset.
  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid

  geometricObjectType – Name of point or vector objects used to locate zero, one-, two-, or three-
dimensional spatial locations in the dataset.
  Type: MD_GeometricObjectTypeCode
  Domain:
  Multiplicity: mandatory
  Attributes: nilReason

  geometricObjectCount – Total number of the point or vector object type occurring in the dataset.
  Type: gco:Integer
  Domain: any whole number
  Multiplicity: optional
  Attributes: nilReason
MD_Georectified – Information on the grid used to georectify the data.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

numberOfDimensions – Number of independent spatial-temporal axes (x, y, or z).
Type: gco:Integer
Domain: any whole number
Multiplicity: mandatory
Attributes: nilReason

axisDimensionProperties – Information on the dimension name, size, and resolution used.
Type: MD_Dimension
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

cellGeometry – Identification of grid data as point or cell.
Type: MD_CellGeometryCode
Domain: point, area
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C.

transformationParameterAvailability – Indication of image coordinates and geographic or map coordinates availability.
Type: gco:Boolean
Domain: 0, 1 (1 = Yes, 0 = No)
Multiplicity: mandatory
Attributes: nilReason

checkPointAvailability – Indication of availability of geographic position points in order to test the accuracy of the georeferenced grid data.
Type: gco:Boolean
Domain: 0, 1 (1 = Yes, 0 = No)
Multiplicity: mandatory
Attributes: nilReason

checkPointDescription – Description of geographic position points in order to test the accuracy of the georeferenced grid data.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: checkPointDescription is mandatory if checkPointAvailability = ‘1’ (yes).

cornerPoints – Location in coordinate system defined by Spatial Reference System and grid coordinates of the cells at opposite ends of the grid coverage along two diagonals in the grid spatial dimension.
Type: gml:Point
Domain: single coordinate tuple
Multiplicity: mandatory, repeatable twice
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: At a minimum, two corner points shall be provided along a diagonal. When providing more than two corner points, they shall be in the clockwise order.

centerPoint – Earth location, represented as a point, in the coordinate system defined by the Spatial Reference System and the grid coordinate of the cell halfway between opposite ends of the grid.
  Type: gml:Point
  Domain: single coordinate tuple
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

pointInPixel – Point in a pixel corresponding to the Earth location of the pixel.
  Type: MD_PixelOrientationCode
  Domain: center, lowerLeft, lowerRight, upperLeft, upperRight
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: See Annex C.

transformationDimensionDescription – General description of the transformation.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

transformationDimensionMapping – Information about which grid axes are spatial axes.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable twice
  Attributes: nilReason
MD_Georeferenceable – Grid with cells irregularly spaced in any given geographic/map projection coordinate system, whose individual cells can be geolocated using geolocation information supplied with the data but cannot be geolocated from the grid properties alone.

Type: compound
Multiplicity: conditional
Attributes: id, uuid

numberOfDimensions – Number of independent spatial-temporal axes (x, y, or z).
Type: gco:Integer
Domain: any whole number
Multiplicity: mandatory
Attributes: nilReason

axisDimensionProperties – Information on the dimension name, size, and resolution used.
Type: MD_Dimension
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
cellGeometry – Identification of grid data as point or cell.
   Type: MD_CellGeometryCode
   Domain: point, area
   Multiplicity: mandatory
   Attributes: nilReason
   Best Practices: See Annex C.

transformationParameterAvailability – Indication of image coordinates and availability of geographic or map coordinates.
   Type: gco:Boolean
   Domain: 0, 1 (1 = Yes, 0 = No)
   Multiplicity: mandatory
   Attributes: nilReason

controlPointAvailability – Indication of control point existence.
   Type: gco:Boolean
   Domain: 0, 1 (1 = Yes, 0 = No)
   Multiplicity: mandatory
   Attributes: nilReason

orientationParameterAvailability – Indication of orientation parameters availability.
   Type: gco:Boolean
   Domain: 0, 1 (1 = Yes, 0 = No)
   Multiplicity: mandatory
   Attributes: nilReason

orientationParameterDescription – Description of parameters used to describe sensor orientation.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason

georeferencedParameters – Terms which support grid data georeferencing.
   Type: gco:Record
   Multiplicity: mandatory
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

parameterCitation – Citation for the parameter reference.
   Type: CI_Citation
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_GridSpatialRepresentation – Information about grid spatial objects in the dataset.
  Type: compound
  Multiplicity: conditional
  Attributes: id, uuid
  Best Practices: MD_GridSpatialRepresentation is mandatory if dataset objects are gridded and MD_Georectified or MD_Georeferenceable are not used.

numberOfDimensions – Number of independent spatial-temporal axes (x, y, or z).
  Type: gco:Integer
  Domain: any whole number
  Multiplicity: mandatory
  Attributes: nilReason

axisDimensionProperties – Information on the dimension name, size, and resolution used.
  Type: MD_Dimension
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

cellGeometry – Identification of grid data as point or cell.
  Type: MD_CellGeometryCode
  Domain: point, area
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: See Annex C.

transformationParameterAvailability – Indication of image coordinates and availability of geographic or map coordinates.
  Type: gco:Boolean
  Domain: 0, 1 (1 = Yes, 0 = No)
  Multiplicity: mandatory
  Attributes: nilReason
MD_Identifier – Information about the unique identification of an object.
  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid
  Best Practices: The namespace is stored in the attribute authority and the ID is stored in the attribute code.

  authority – Recognized responsible party or organisation for a reference.
  Type: CI_Citation
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

  code – The alphanumeric value that identifies a resource.
  Type: gco:characterString
  Domain: free text
  Multiplicity: mandatory
  Attributes: nilReason

FAQ: What would MD_Identifier look like for the 1:50,000 map sheet of Sherbrooke in Canada that is identified by the code ‘21E05’ under the authority of ‘National Topographic System’?

Ex:
<gmd:MD_Identifier>
  <gmd:authority>
    <gmd:CI_Citation>
      <gmd:title>
        <gco:CharacterString>1:50,000 Topographic Map of Sherbrooke, Canada</gco:CharacterString>
      </gmd:title>
      <gmd:date gco:nilReason="unknown"/>
      <gmd:citedResponsibleParty>
        <gmd:CI_ResponsibleParty>
          <gmd:organisationName>
            <gco:CharacterString>National Topographic System (NTS)</gco:CharacterString>
          </gmd:organisationName>
        </gmd:CI_ResponsibleParty>
      </gmd:citedResponsibleParty>
    </gmd:CI_Citation>
  </gmd:authority>
</gmd:MD_Identifier>
MD_ImageDescription – Information about image characteristics.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

attributeDescription – Description of the cell measurement.
Type: gco:RecordType
Multiplicity: mandatory
Attributes: nilReason

contentType – Information represented by the cell.
Type: MD_CoverageContentTypeCode
Domain: image, thematicClassification, physicalMeasurement
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C.
dimension – Information on the dimension of the cell measurement value.
   Type: MD_RangeDimension or MD_Band
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

illuminationElevationAngle – Illumination elevation measure in degrees clockwise for the target plane at intersection of the optical line of sight with the Earth’s surface.
   Type: gco:Real
   Domain: any number [-90, 90]
   Multiplicity: optional
   Attributes: nilReason

illuminationAzimuthAngle – Illumination azimuth measured in degrees clockwise from true north at the time the image is taken.
   Type: gco:Real
   Domain: any number [0, 360]
   Multiplicity: optional
   Attributes: nilReason

imagingCondition – Conditions affecting the image.
   Type: MD_ImagingConditionCode
   Domain: blurredImage, cloud, degradingObliquity, fog, heavySmokeOrDust, night, rain, semidarkness, shadow, snow, terrainMasking
   Multiplicity: optional
   Attributes: nilReason
   Best Practices: See Annex C.

imageQualityCode – Specifies the image quality.
   Type: MD_Identifier or RS_Identifier
   Multiplicity: optional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

cloudCoverPercentage – Percentage of dataset area obscured by clouds.
   Type: gco:Real
   Domain: any number [0.0, 100.0]
   Multiplicity: optional
   Attributes: nilReason

processingLevelCode – Identification of the image processing level.
   Type: MD_Identifier or RS_Identifier
   Multiplicity: optional
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

compressionGenerationQuantity – The number of compression cycles performed on the image.
   Type: gco:Integer
   Domain: any whole number
   Multiplicity: optional
   Attributes: nilReason
triangulationIndicator – Indication if triangulation was performed on the image.
   Type: gco:Boolean
   Domain: 0,1 (0 = no and 1 = yes)
   Multiplicity: optional
   Attributes: nilReason

radiometricCalibrationDataAvailability – Indication if radiometric calibration information to generate radiometrically calibrated standard data product is available.
   Type: gco:Boolean
   Domain: 0,1 (0 = no and 1 = yes)
   Multiplicity: optional
   Attributes: nilReason

cameraCalibrationInformationAvailability – Indication of camera calibration constants availability.
   Type: gco:Boolean
   Domain: 0,1 (0 = no and 1 = yes)
   Multiplicity: optional
   Attributes: nilReason

filmDistortionInformationAvailability – Indication of Calibration Reseau information availability.
   Type: gco:Boolean
   Domain: 0,1 (0 = no and 1 = yes)
   Multiplicity: optional
   Attributes: nilReason

crossDistortionInformationAvailability – Indication of lens aberration correction information availability.
   Type: gco:Boolean
   Domain: 0,1 (0 = no and 1 = yes)
   Multiplicity: optional
   Attributes: nilReason
MD_Keywords – Commonly used words or phrases that describe the resource. Optionally, the keyword type and a citation for the authoritative or registered resource of the keywords are also provided.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid
Best Practices: It is highly recommended that keywords from the authoritative source be used instead of using user defined keywords.

keyword – Commonly used words or phrases which describe the resource.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory, repeatable
Attributes: nilReason

type – Terms or type used to group keywords.
Type: MD_KeywordTypeCode
Domain: discipline, place, stratum, temporal, theme
Multiplicity: optional
Attributes: nilReason
Best Practices: See Annex C.

thesaurusName – The name of a registered authoritative keyword resource.
Type: CI_Citation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: It is strongly recommended to provide contact information.
MD_LegalConstraints – The legal restrictions or prerequisites to using the resource or accessing the metadata.
  Type: compound
  Multiplicity: conditional
  Attributes: id, uuid

  useLimitation – Statement on the fitness of use or limitations on the use of the resource or metadata.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

  accessConstraints – Limitations on access to the resource or metadata to protect privacy, intellectual property, or any special limitations.
  Type: MD_RestrictionCode
  Domain: copyright, patent, patentPending, trademark, license, intellectualPropertyRights, restricted, otherRestrictions
  Multiplicity: optional, repeatable
  Attributes: nilReason
  Best Practices: See Annex C.

  useConstraints – Restrictions or limitations or warnings to protect privacy, intellectual property, or other special restrictions on the resource or the metadata.
  Type: MD_RestrictionCode
  Domain: copyright, patent, patentPending, trademark, license, intellectualPropertyRights, restricted, otherRestrictions
  Multiplicity: optional, repeatable
  Attributes: nilReason
  Best Practices: See Annex C.
otherConstraints – Other restrictions or legal prerequisites for accessing the resource or metadata.

Type: gco:characterString
Domain: free text
Multiplicity: conditional, repeatable
Attributes: nilReason

Best Practices: otherConstraints becomes mandatory when accessConstraints or useConstraints are set to ‘otherRestrictions’.

FAQ: Why are some use and access constraints found in ‘otherConstraints’?

useConstraints and accessConstraints are restricted to only allow use of the codelist values. If none of the values can accurately describe the constraints, other constraints allows free text. Often, when translating from legacy metadata, it is difficult to translate to the codelist values with accuracy. To preserve the integrity of the content, the entire content, verbatim is mapped to ‘otherConstraints’.

Ex:

```xml
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:accessConstraints>
      <gmd:MD_RestrictionCode
        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_RestrictionCode"
        codeListValue="otherRestrictions"
        codeSpace="008">otherRestrictions</gmd:MD_RestrictionCode>
    </gmd:accessConstraints>
    <gmd:useConstraints>
      <gmd:MD_RestrictionCode
        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_RestrictionCode"
        codeListValue="otherRestrictions"
        codeSpace="008">otherRestrictions</gmd:MD_RestrictionCode>
    </gmd:useConstraints>
  </gmd:MD_LegalConstraints>
  <gmd:otherConstraints>
    <gco:characterString>
      Access Constraints: None    Use Constraints: The user is responsible for the results of any application of this data for other than its intended purpose.    Distribution Liability: NOAA makes no warranty regarding these data, expressed or implied, nor does the fact of distribution constitute such a warranty. NOAA, NESDIS, NODC and NCDDC cannot assume liability for any damages caused by any errors or omissions in these data, nor as a result of the failure of these data to function on a particular system.
    </gco:characterString>
  </gmd:otherConstraints>
</gmd:resourceConstraints>
```
MD_MaintenanceInformation – Provides information about how the resources or metadata records are updated.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

maintenanceAndUpdateFrequency – Frequency of changes and additions made to the resource after the initial completion.
Type: MD_MaintenanceFrequencyCode
Domain: continual, daily, weekly, fortnightly, monthly, quarterly, biannually, annually, asNeeded, irregular, notPlanned, unknown
Multiplicity: mandatory
Attributes: nilReason
Best Practices: See Annex C.

dateOfNextUpdate – The scheduled revision date for the resource.
Type: choice of gco:Date or gco:DateTime
Domain: date
Multiplicity: optional
Attributes: nilReason
userDefinedMaintenanceFrequency – The maintenance period other than those defined.
Type: gts:TM_PeriodDuration
Multiplicity: optional
Attributes: nilReason

updateScope – Scope of data to which maintenance is applied.
Type: MD_ScopeCode
Domain: attribute, attributeType, collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, feature, featureType, propertyType, fieldSession, software, service, model, tile
Multiplicity: optional, repeatable
Attributes: nilReason
Best Practices: See Annex C.

updateScopeDescription – Additional information about the range or extent of the resource.
Type: MD_ScopeDescription
Multiplicity: optional, repeatable
Attributes: nilReason

maintenanceNote – Information regarding specific requirements for maintaining the resource.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

contact – Identification of and means of communicating with the person or organisation with responsibility for maintaining the resource.
Type: CI_ResponsibleParty
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_Medium – Information on the name, density units, volumes, medium format, and medium note used to describe the transfer of data to a medium.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid
Best Practices: At least one of name, density, volumes, mediumFormat, or mediumNote shall be provided. densityUnits is mandatory if density is provided.

name – Medium name code.
Type: MD_MediumNameCode
Domain: cdRom, dvd, dvdRom, 3halfInchFloppy, 5quarterInchFloppy, 7trackTape, 9trackTape, 3480Cartridge, 3490Cartridge, 3580Cartridge, 4mmCartridgeTape, 8mmCartridgeTape, 1quarterInchCartridgeTape, digitalLinearTape, onLine, satellite, telephoneLink, hardcopy
Multiplicity: conditional
Attributes: nilReason
Best Practices: See Annex C.

density – The recording density on the specified media.
Type: gco:Real
Domain: any number
Multiplicity: conditional, repeatable
Attributes: nilReason
Best Practices: Value greater than ‘0.0’.
densityUnits – The recording density units.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: densityUnits is mandatory when density is documented.

volumes – Identification of the number of recorded items on the media.
Type: gco:Integer
Domain: any whole number
Multiplicity: conditional
Attributes: nilReason
Best Practices: Value greater than ‘0’.

mediumFormat – Method used to write to the medium.
Type: MD_MediumFormatCode
Domain: cpio, tar, highSierra, iso9660, iso9660RockRidge, iso9660AppleHFS
Multiplicity: conditional, repeatable
Attributes: nilReason
Best Practices: See Annex C.

mediumNote – Description of limitations or requirements for using the medium.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
MD_MetadataExtensionInformation – Information describing metadata extensions.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

extensionOnlineResource – Information about on-line sources containing the community profile name and the extended metadata elements. Information for all new metadata elements.
Type: CI_OnlineResource
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

extendedElementInformation – Provides information about a new metadata element.
Type: MD_ExtendedElementInformation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_PortrayalCatalogueReference

MD_PortrayalCatalogueReference – Information used to identify and locate the portrayal catalogue.
  Type: portrayalCatalogueCitation
  Multiplicity: mandatory
  Attributes: id, uuid

  portrayalCatalogueCitation – Bibliographic citation for the portrayal catalogue.
  Type: CI_Citation
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
MD_RangeDimension – Information on the dimensions of the cell measurement value.
Type: compound
Multiplicity: conditional
Attributes: id, uuid

sequenceIdentifier – Sensor band wavelengths.
Type: gco:MemberName
Multiplicity: conditional
Attributes: id, uuid
Best Practices: Either sequenceIdentifier or descriptor shall be provided, or both.

descriptor – Description of cell value range.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: Either descriptor or sequenceIdentifier shall be provided, or both.
MD_ReferenceSystem – Describes the attributes that provide information about reference system information.
  Type: compound
  Multiplicity: mandatory
  Attributes: id, uuid

referenceSystemIdentifier – Identifier of the Reference System.
  Type: RS_Identifier
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Best Practices: A coordinate reference system (CRS) should be taken from a publicly available register or document, such as the EPSG Geodetic Parameter Dataset (http://www.epsg-registry.org/) or Spatial Reference (http://spatialreference.org). An identifier or well known name with an authority is defined and referenced here. If a coordinate reference system (CRS) is not available from a publicly available register or document and as such has no identifier or well known name, then that CRS shall be described according to ISO 19111.

FAQ: How would you document a map with a Mercator projection?

Ex:

```xml
<gmd:referenceSystemInfo>
  <gmd:MD_ReferenceSystem>
    <gmd:referenceSystemIdentifier>
      <gmd:RS_Identifier>
        <gmd:authority>
          <gmd:CI_Citation>
            <gmd:title>
              <gco:CharacterString>WGS 84 / World Mercator</gco:CharacterString>
            </gmd:title>
          </gmd:CI_Citation>
          <gmd:date>
            <gmd:CI_Date>
              <gmd:date>2006-06-02</gmd:date>
            </gmd:CI_Date>
            <gmd:dateType codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#CI_DateTypeCode" codeListValue="revision">revision</gmd:dateType>
          </gmd:CI_Date>
          <gmd:citedResponsibleParty>
            <gmd:CI_ResponsibleParty>
              <gmd:role>WGS 84 / World Mercator</gmd:role>
            </gmd:CI_ResponsibleParty>
          </gmd:citedResponsibleParty>
        </gmd:authority>
      </gmd:RS_Identifier>
    </gmd:referenceSystemIdentifier>
  </gmd:MD_ReferenceSystem>
</gmd:referenceSystemInfo>
```
MD_RepresentativeFraction – The scale of a map or other cartographic object expressed as a fraction or ratio which relates unit distance on the map or other cartographic object to distance, measured in the same units, on the ground.

Type: compound
Multiplicity: mandatory
Attributes: id, uuid

denominator – The number below the line in a proper fraction that the numerator is equal to 1.

Type: gco:Integer
Domain: any whole number
Multiplicity: mandatory
Attributes: nilReason
Best Practices: Value is greater than 0.
**MD Resolution**

MD Resolution – The level of detail in a dataset expressed as equivalent scale or ground distance.

  - **Type:** compound
  - **Multiplicity:** mandatory
  - **Best Practices:** One and only one of the following must be entered: equivalentScale or distance.

  **equivalentScale** – Detail expressed as the numerical scale of a comparable hardcopy map or chart.
  - **Type:** MD_RepresentativeFraction
  - **Multiplicity:** conditional
  - **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason

  **distance** – Ground sample distance.
  - **Type:** gco:Distance
  - **Multiplicity:** conditional
  - **Attributes:** nilReason
  - **Best Practice:** Distance is a measure of length between two points. A distance is made of a value and a unit of measure (uom), which is an attribute of distance and is mandatory.

**FAQ:** How would you populate the element ‘distance’ for a distance of 5 meters?

Ex:

```xml
<MD_Resolution>
  <distance>
    <gco:Distance uom="meters">5</gco:Distance>
  </distance>
</MD_Resolution>
```
MD_ScopeDescription – Description of the class of information covered by the information.

Type: compound
Multiplicity: mandatory
Best Practices: A choice must be made between attributes or features or featureInstances or attributeInstances or dataset or other.

attributes – Attributes to which the information applies.
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

features – Features to which the information applies.
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

featureInstances – Feature instances to which the information applies.
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

attributeInstances – Attribute instances to which the information applies.
Multiplicity: conditional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

dataset – Dataset to which the information applies.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
other – Class of information that does not fall into the other categories to which the information applies.
   Type: gco:characterString
   Domain: free text
   Multiplicity: conditional
   Attributes: nilReason

Ex:
<gmd:MD_ScopeDescription>
  <gmd:dataset>
    <gco:CharacterString>Name of the Parameter goes here</gco:CharacterString>
  </gmd:dataset>
</gmd:MD_ScopeDescription>
MD_SecurityConstraints – Restrictions applied to the resource or metadata to protect security concerns.

  Type: compound
  Multiplicity: conditional
  Attributes: id, uuid

useLimitation – Statement on the fitness of use or limitations on the use of the resource or metadata.

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

classification – Name of the handling restrictions on the resource or the metadata.

  Type: MD_ClassificationCode
  Domain: unclassified, restricted, confidential, secret, topSecret
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: See Annex C.

userNote – An explanation of the classification level applied to the resource or metadata.

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

classificationSystem – Name of the security classification system.

  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason
handlingDescription – Additional information regarding security restrictions on handling the resource or metadata.
   Type: gco:characterString
   Domain: free text
   Multiplicity: optional
   Attributes: nilReason
MD_StandardOrderProcess

MD_StandardOrderProcess – The process in which the resource is obtained or received and other related instructions or fee information.

- **Type**: compound
- **Multiplicity**: mandatory
- **Attributes**: id, uuid
- **Best Practices**: At least one of fees, plannedAvailableDateTime, orderingInstructions, or turnaround shall be provided.

**fees** – Fees and terms for obtaining the data/dataset.

- **Type**: gco:characterString
- **Domain**: free text
- **Multiplicity**: conditional
- **Attributes**: nilReason
- **Best Practices**: Include at the end the monetary unit alphabetic code as specified in ISO 4217. (see http://www.iso.org/iso/support/faqs/faqs_widely_used_standards/widely_used_standards_other/currency_codes/currency_codes_list-1.htm) Common codes: United States = USD, Canada = CAD, Mexico = MXN or MXV

**FAQ:** How would you show that a dataset costs $45.00?

```xml
<gmd:fees>45.00USD</gmd:fees>
```

**plannedAvailableDateTime** – Date and time the resource will be available.

- **Type**: gco:DateTime
- **Domain**: date
- **Multiplicity**: conditional
- **Attributes**: nilReason

**orderingInstructions** – General instructions, terms, and services provided by the data distributor.

- **Type**: gco:characterString
- **Domain**: free text
- **Multiplicity**: conditional
- **Attributes**: nilReason
turnaround – Typical time required for filing a data request.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
MD_Usage – Brief description of ways in which the resource(s) is/are currently or has been used
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

specificUsage – Brief description of the resource and/or resource series usage.
Type: gco:CharacterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

usageDateTime – Data and time of the first use or range of uses of the resource and/or resource series.
Type: gco:DateTime
Domain: date
Multiplicity: optional

userDeterminedLimitations – Applications determined by the user for which the resource and/or resource series is not suitable.
Type: gco:CharacterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

userContactInfo – Identification of and means of communicating with the person(s) and organisation(s) using the resource(s).
Type: CI_ResponsibleParty
Multiplicity: mandatory, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
**MD_VectorSpatialRepresentation**

- **MD_VectorSpatialRepresentation** – Information about the vector spatial objects in the dataset.
  - Type: compound
  - Multiplicity: conditional
  - Attributes: id, uuid
  - Best Practices: MD_VectorSpatialRepresentation is mandatory if the dataset objects are vectors.

- **topologyLevel** – Code which identifies the degree of complexity of the spatial relationships.
  - Type: MD_TopologyLevelCode
  - Domain: geometryOnly, topology1D, planarGraph, fullPlanarGraph, surfaceGraph, fullSurfaceGraph, topology3D, fullTopology3D, abstract
  - Multiplicity: optional
  - Attributes: nilReason
  - Best Practices: See Annex C.

- **geometricObjects** – Information about the geometric objects used in the dataset.
  - Type: MD_GeometricObjects
  - Multiplicity: optional, repeatable
  - Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
PT PACKAGE
PT_Locale – Declared language properties.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

languageCode – Language codelist
Type: gmd:LanguageCode
Multiplicity: mandatory
Attributes: nilReason

Type: LanguageCodeList
Multiplicity: mandatory
Best Practices: Use the three-letter code in lowercase. See Annex B.

country – Country codelist
Type: gmd:Country
Multiplicity: optional
Attributes: nilReason

Country – ISO 3166-1 two-letter code
Type: CountryCodeList
Multiplicity: mandatory
Best Practices: Use the two-letter code in uppercase. See Annex B.

characterEncoding – Character coding standard.
Type: MD_CharacterSetCode
Domain: ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2, 8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13, 8859part14, 8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii, eubcdic, eucKR, big5, GB2312
Multiplicity: mandatory
Attributes: nilReason
Best Practices: Encoding shall be set to the recommended default value ‘utf8’.

Ex:

```xml
<gmd:locale>
  <gmd:PT_Locale>
    <gmd:languageCode>
    </gmd:languageCode>
    <gmd:country>
    </gmd:country>
    <gmd:characterEncoding>
      <gmd:MD_CharacterSetCode codeList="../Codelist/ML_gmxCodelists.xml#MD_CharacterSetCode" codeListValue="utf8">utf8</gmd:MD_CharacterSetCode>
    </gmd:characterEncoding>
  </gmd:PT_Locale>
</gmd:locale>
```
RS PACKAGE
RS_Identifier – Information about the unique identification of an object.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

authority – Recognized responsible party or organisation for a reference.
Type: CI_Citation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

code – The alphanumeric value that identifies a resource.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

codeSpace – Identifier/namespace of the system in which the code is valid, e.g., ‘http://www.epsg.org/databases/Discv7_5.html’
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

version – The cited version, e.g., ’7.5.’
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
FAQ: What would the RS_Identifier look like for the 1:50,000 map sheet of Sherbrooke in Canada that is identified by the code ‘21E05’ under the authority of ‘National Topographic System’?

Ex:
```xml
<gmd:RS_Identifier>
  <gmd:authority>
    <gmd:CI_Citation>
      <gmd:title>
        <gco:CharacterString>1:50,000 Topographic Map of Sherbrooke, Canada</gco:CharacterString>
      </gmd:title>
      <gmd:date gco:nilReason="unknown"/>
      <gmd:citedResponsibleParty>
        <gmd:CI_ResponsibleParty>
          <gmd:organisationName>
            <gco:CharacterString>National Topographic System (NTS)</gco:CharacterString>
          </gmd:organisationName>
          <gmd:role>
            <gmd:CI_RoleCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
                            codeListValue="resourceProvider" codeSpace="001">resourceProvider</gmd:CI_RoleCode>
          </gmd:role>
        </gmd:CI_ResponsibleParty>
      </gmd:citedResponsibleParty>
    </gmd:CI_Citation>
    <gmd:code>
      <gco:CharacterString>21E05</gco:CharacterString>
    </gmd:code>
  </gmd:authority>
</gmd:RS_Identifier>
```
SV PACKAGE
SV_CoupledResource – Information describing the linkage between a service operation and a tightly coupled dataset.

Type: Compound
Multiplicity: mandatory
Attributes: id, uuid

operationName – Designation of the operation
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

identifier – The dataset name or identifier of the associated dataset.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason
SV_OperationMetadata – Description of one's service operation to provide the signature of the operation.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

operationName – An identifier that uniquely designates the operation.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

DCP – Distributed Computing Platforms that have been used to implement the operation.
Type: srv:DCPList
Domain: XML, CORBA, JAVA, COM, SQL, WebServices
Multiplicity: mandatory, repeatable
Attributes: nilReason
Best Practices: See Annex C.
operationDescription – Description of the purpose of the operation and results obtained from the operation.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

invocationName – The name used to invoke the operation on all Distributed Computing Platforms.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

parameters – Values required for the interface invocation.
  Type: SV_Parameter
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

connectPoint – Reference to access the service interface.
  Type: CI_OnlineResource
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

dependsOn – The list of operations required prior to invoking the service; Structured as a list for capturing alternate or parallel predecessor paths.
  Type: SV_OperationMetadata
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
SV_Parameter – Information describing parameters of an operation.
Type: compound
Multiplicity: mandatory
Attributes: id, uuid

name – The name that the service uses for the parameter.
Type: gco:MemberName
Multiplicity: mandatory
Attributes: id, uuid

direction – Indication if the parameter serves as input, output, or both.
Type: SV_ParameterDirection
Domain: in, out, in/out
Multiplicity: optional
Attributes: nilReason

description – Explanation of the purpose and function of the parameter.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
optionality – Indicates the necessity of the parameter.
  Type: gco:characterString
  Domain: free text
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: The default value is ‘Mandatory’.

repeatability – Indication if one or more values for the parameter may be provided.
  Type: gco:Boolean
  Domain: 0,1 (0 = not repeatable, 1 = repeatable)
  Multiplicity: mandatory
  Attributes: nilReason

valueType – The class used for the value type.
  Type: gco:TypeName
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
SV_ServiceIdentification – Service metadata describes the operation and address of an electronic geographic delivery system. This identifies capabilities which a service provider makes available to a service user through a set of interfaces.

Type: compound
Multiplicity: conditional
Attributes: id, uuid
Best Practices: identificationInfo must have at least one occurrence of Data Identification or Service Identification.

citation – Citation for the dataset.
Type: CI_Citation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

abstract – Brief narrative summary of the dataset’s contents.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

purpose – Summary of the intentions for which the dataset was developed.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

credit – Recognition of those who contributed to the dataset.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

status – The development phase of the dataset.
Type: MD_ProgressCode
Domain: completed, historicalArchive, obsolete, ongoing, planned, required, underdevelopment
Multiplicity: optional, repeatable *this is a NAP requirement*
Attributes: nilReason

pointOfContact – Identification and means to contact people/organisations associated with the dataset.
Type: CI_ResponsibleParty
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceMaintenance – Describes the frequency, scope, and responsible party for the updating of the dataset.
Type: MD_MaintenanceInformation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
graphicOverview – The name of, description of, and file type of an illustration of the dataset.
   Type: MD_BrowseGraphic
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceFormat – Provides a description of the format of the resource(s).
   Type: MD_Format
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

descriptiveKeywords – Commonly used words or phrases which describe the dataset. Optionally, the
   keyword type and a citation for the authoritative or registered resource of the keywords are also
   provided.
   Type: MD_Keywords
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceSpecificUsage – Provides basic information about specific application(s) for which the resource(s)
   has been or is being used by different users.
   Type: MD_Usage
   Multiplicity: optional, repeatable *this is not in NAP*
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

resourceConstraints – The limitations or constraints on the use of or access to the resource.
   Type: MD_Constraints or MD_LegalConstraints or MD_SecurityConstraints
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

aggregationInfo – The citation for the aggregate dataset or the name of the aggregate dataset, the type of
   aggregate dataset, and optionally the activity which produced the dataset.
   Type: MD_AggregateInformation
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

serviceType – The service type name from a service registry.
   Type: gco:LocalName
   Multiplicity: mandatory
   Attributes: nilReason
   Best Practices: serviceType should follow the format of <urn><:><domain-
   name><:><serviceType><:><unique name assigned by the vendor><:><version number>

FAQ: If I had an OGC map service, how would I document it?

   The registry namespace would be ‘ogc’ and the service type would be ‘WebMapService’.

   EX:
   <srv:serviceType>
     <gco:LocalName>urn:ogc:serviceType:WebMapService:1.1</gco:LocalName>
   </srv:serviceType>
serviceTypeVersion – The version of the service type.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional, repeatable
  Attributes: nilReason

accessProperties – Information on the availability of the service which includes attributes from Standard Order Process.
  Type: MD_StandardOrderProcess
  Multiplicity: optional
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

restrictions – The limitations or constraints on the use of or access to the service.
  Type: MD_Constraints or MD_LegalConstraints or MD_SecurityConstraints
  Multiplicity: optional, repeatable *this is not in NAP*
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

keywords – Commonly used words or phrases which describe the service.
  Type: MD_Keywords
  Multiplicity: optional, repeatable *this is not in NAP*
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

extent – Describes the spatial, horizontal and/or vertical, and the temporal coverage in the resource.
  Type: EX_Extent
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

couplingType – Qualitative information on the tightness with which the service and the associated data are coupled.
  Type: SV_CouplingType
  Domain: loose, mixed, tight
  Multiplicity: mandatory
  Attributes: nilReason

coupledResource – Further description of the coupling between the service and the data when they are tightly coupled.
  Type: SV_CoupledResource
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

containsOperations – Operations performed by the service.
  Type: SV_OperationMetadata
  Multiplicity: mandatory, repeatable
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason

operatesOn – Information describing datasets on which the service operates.
  Type: MD_DataIdentification
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrule, title, show, actuate, uuidref, nilReason
ISO 19115 METADATA EXAMPLES
  <gmd:fileIdentifier>
    <gco:CharacterString>EX1003</gco:CharacterString>
  </gmd:fileIdentifier>
  <gmd:fileIdentifier>
    <gco:CharacterString>EX1003</gco:CharacterString>
  </gmd:fileIdentifier>
  <gmd:language>
    <gco:CharacterString>eng; USA</gco:CharacterString>
  </gmd:language>
  <gmd:characterSet>
    <gmd:MD_CharacterSetCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode" codeListValue="utf8" codeSpace="004">utf8</gmd:MD_CharacterSetCode>
  </gmd:characterSet>
  <gmd:hierarchyLevel>
    <gmd:MD_ScopeCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ScopeCode" codeListValue="fieldSession" codeSpace="012">fieldSession</gmd:MD_ScopeCode>
  </gmd:hierarchyLevel>
  <gmd:hierarchyLevelName>
    <gco:CharacterString>cruise-level metadata</gco:CharacterString>
  </gmd:hierarchyLevelName>
  <gmd:contact xlink:title="NOAA/OAR/OER - Ocean Exploration and Research">
    <gmd:CI_ResponsibleParty uuid="08D95C427FB128479945893256DADE37">
      <gmd:organisationName>
        <gco:CharacterString>NOAA/OAR/OER - Ocean Exploration and Research</gco:CharacterString>
      </gmd:organisationName>
      <gmd:contactInfo>
        <gmd:CI_Contact>
          <gmd:phone>
            <gmd:CI_Telephone>
              <gmd:voice>
                <gco:CharacterString>301-713-9444</gco:CharacterString>
              </gmd:voice>
              <gmd:facsimile>
                <gco:CharacterString>301-713-4252</gco:CharacterString>
              </gmd:facsimile>
            </gmd:CI_Telephone>
          </gmd:phone>
          <gmd:address>
            <gmd:CI_Address>
              <gmd:deliveryPoint>
                <gco:CharacterString>SSMC3, 1315 East-West Highway, 10th Floor</gco:CharacterString>
              </gmd:deliveryPoint>
              <gmd:city>
                <gco:CharacterString>Silver Spring</gco:CharacterString>
              </gmd:city>
              <gmd:administrativeArea>
                <gco:CharacterString>MD</gco:CharacterString>
              </gmd:administrativeArea>
              <gmd:postalCode>
                <gco:CharacterString>20910</gco:CharacterString>
              </gmd:postalCode>
              <gmd:country>
                <gco:CharacterString>USA</gco:CharacterString>
              </gmd:country>
            </gmd:CI_Address>
          </gmd:address>
          <gmd:hoursOfService>
            <gco:CharacterString>8am-5pm, Monday through Friday</gco:CharacterString>
          </gmd:hoursOfService>
        </gmd:CI_Contact>
      </gmd:contactInfo>
    </gmd:CI_ResponsibleParty>
  </gmd:contact>
</gmd:MD_Metadata>
EX1003 Transit from Hawaii to Guam (EX1003) on NOAA Ship Okeanos Explorer in Hawaii to Guam between 20100519 and 20100603
Silver Spring, MD 20910, USA

EX1003 Transit from Hawaii to Guam produced the following data: Ship Navigation Data (CNAV, Gyro, POSMV), Ship Sensor Data (Depth, DGPS, Doppler, EventData, Met, Router, SAMOS, SciSwSys, TWind, Webship, Winches, Wind), Oceanographic Sensor Data (XBT, ASVP); Multibeam Bathymetric Data.
This page describes the NASA GCMD Keywords, how to reference those keywords and provides download instructions. This page is part of the NASA Global Change Master Directory (GCMD) Keywords page.

- **Title**: NASA Global Change Master Directory, Goddard Space Flight Center
- **Contact**: gcmduso@gcmd.gsfc.nasa.gov
- **URL**: http://gcmd.nasa.gov/Resources/valids/
- **Protocol**: http
- **Application Profile**: web browser

**Keywords**

- Ocean Exploration
<gmd:DS_InitiativeTypeCode
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#DS_InitiativeTypeCode"
codeListValue="program"/>
</gmd:initiativeType>
</gmd:MD_AggregateInformation>
</gmd:aggregationInfo>
<gmd:language>
<gco:CharacterString>eng; USA</gco:CharacterString>
</gmd:language>
<gmd:topicCategory>
<gmd:MD_TopicCategoryCode>oceans</gmd:MD_TopicCategoryCode>
</gmd:topicCategory>
<gmd:extent>
<gmd:EX_Extent id="boundingExtent">
</gmd:EX_Extent>
</gmd:geographicElement>
<gmd:EX_GeographicBoundingBox id="boundingGeographicBoundingBox">
</gmd:EX_GeographicBoundingBox>
</gmd:EX_GeographicDescription id="startPort">
</gmd:geographicIdentifier>
</gmd:MD_Identifier>
</gmd:authority>
</gmd:CI_Citation>
</gmd:title>
</gmd:EX_GeographicDescription>
</gmd:geographicElement>
<gmd:EX_GeographicDescription id="endPort">
</gmd:EX_GeographicDescription>
</gmd:geographicElement>
</gmd:EX_GeographicBoundingBox>
</gmd:EX_GeographicDescription>
**Text View**

**MD_Metadata:** (schema: http://www.isotc211.org/2005/gmd
..\..\..\ISO\gmd\gmd.xsd)

**File identifier:**
- Character string: EX1003

**Language:**
- Character string: eng; USA

**Character set:**
- **MD_CharacterSetCode:** (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode)
  - utf8

**Hierarchy level:**
- **MD_ScopeCode:** (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ScopeCode)
  - fieldSession

**Hierarchy level name:**
- Character string: cruise-level metadata

**Metadata author:** (title: NOAA/OAR/OER - Ocean Exploration and Research)

**CI_ResponsibleParty:** (uuid: 08D95C427FB128479945893256DADE37)
- **Organisation name:**
  - Character string: NOAA/OAR/OER - Ocean Exploration and Research

**Contact information:**

**CI_Contact:**
- **Phone:**
  - **CI_Telephone:**
    - **Voice:**
      - Character string: 301-713-9444
    - **Facsimile:**
      - Character string: 301-713-4252

**Address:**
- **CI_Address:**
  - **Delivery point:**
    - Character string: SSMC3, 1315 East-West Highway, 10th Floor
  - **City:**
    - Character string: Silver Spring
  - **Administrative area:**
    - Character string: MD
  - **Postal code:**
    - Character string: 20910
  - **Country:**
    - Character string:
USA

Electronic mail address:
Character string:
ncddcmetadata@noaa.gov

Hours of service:
Character string:
8am-5pm, Monday through Friday

Role:
CI_RoleCode: (codeList:
http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode)

Date stamp:
Date:
2010-10-07

Metadata standard name:
Character string:
ISO 19115 Geographic information - Metadata

Metadata standard version:
Character string:
ISO 19115:2003(E)

Identification information:
MD_DataIdentification:
Citation:
CI_Citation:
Title:
Character string:
EX1003 Transit from Hawaii to Guam (EX1003) on NOAA Ship Okeanos Explorer in Hawaii to Guam between 20100519 and 20100603

Date:
CI_Date:
Date:
Date:
2010

Date type:
CI_DateTypeCode: (codeList:
http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode)
publication

Identifier:
MD_Identifier:
Code:
Character string:
EX1003

Cited responsible party: (title: NOAA/OAR/OER - Ocean Exploration and Research)
CI_ResponsponsibleParty: (uuid: 0ca7cab0-elfe-11df-85ca-0800200c9a66)

Organisation name:
Character string:
NOAA/OAR/OER - Ocean Exploration and Research

Contact information:
CI_Contact:
Phone:
CI_Telephone:
Voice:
Abstract:
Character string:
EX1003 Transit from Hawaii to Guam produced the following data:
Ship Navigation Data (CNAV, Gyro, POSMV), Ship Sensor Data (Depth, DGPS, Doppler, EventData, Met, Router, SAMOS, SciSwSys, TWind, Webship, Winches, Wind), Oceanographic Sensor Data (XBT, ASVP); Multibeam Bathymetric Data.

Purpose:
Character string:
Ocean Exploration and Research

Credit:
Character string:
OER/UNH

Status:
MD_ProgressCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ProgressCode)
completed

Point of contact:
CI_ResponsibleParty:
  Organisation name:
    Character string:
      OER/UNH
Contact information:
  CI_Contact:
    Phone:
      CI_Telephone:
        Voice:
          Character string:
            401-662-9297
  Address:
    CI_Address:
      Delivery point:
        Character string:
          24 Colovos Road
      City:
        Character string:
          Durham
      Administrative area:
        Character string:
          NH
      Postal code:
        Character string:
          03824
      Country:
        Character string:
          US
  Electronic mail address:
    Character string:
      elizabeth.lobecker@noaa.gov
Role:
  CI_RoleCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode)
pointOfContact

Resource maintenance:
MD_MaintenanceInformation:
  Maintenance and update frequency:
    MD_MaintenanceFrequencyCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_MaintenanceFrequencyCode)
      unknown

Descriptive keywords:
MD_Keywords:
  Keyword:
    Character string:
      EARTH SCIENCE > Oceans
MD_KeywordTypeCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode)

theme

Thesaurus name: (title: GCMD)
CI_Citation: (uuid: 9f0de6e6-428b-11df-9879-0800200c9a66)

Title:
Character string:
NASA/GCMD Data Center Keywords

Date: (nilReason: unknown)

Cited responsible party: (title: GCMD User Support Office)
CI_ResponsibleParty: (uuid: 8294BEE08B11359FE040AC8C5AB460D1)

Organisation name:
Character string:
NASA Global Change Master Directory (GCMD) User Support Office

Contact information:
CI_Contact:
Phone: (nilReason: missing)
Address:
CI_Address:
Delivery point:
Character string:
NASA Global Change Master Directory, Goddard Space Flight Center
City:
Character string:
Greenbelt
Administrative area:
Character string:
MD
Postal code:
Character string:
20771
Country:
Character string:
USA

Electronic mail address:
Character string:
gcmduso@gcmd.gsfc.nasa.gov

Online resource:
CI_OnlineResource: (uuid: 5e4e9d00-4288-11df-9879-0800200c9a66)

Linkage:
URL:
http://gcmd.nasa.gov/index.html
Protocol:
Character string:
http

Application profile:
Character string:
web browser
Name:
Character string:
NASA Global Change Master Directory

Description:
Character string:
Home Page

Function:
CI_OnLineFunctionCode: (codeList:

Contact instructions:
Character string:

http://gcmd.nasa.gov/MailComments/MailComments.jsf?rcpt=gcmduso

Role:
CI_RoleCode: (codeList:
http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmx
Codelists.xml#CI_RoleCode)
custodian

Cited responsible party: (title: GCMD Valids)
CI_ResponsibleParty: (uuid: 1edb41d0-428a-11df-9879-0800200c9a66)

Organisation name:
Character string:
NASA Global Change Master Directory (GCMD)

Contact information:
CI_Contact:
Phone: (nilReason: missing)
Address:
CI_Address:
Delivery point:
Character string:
NASA Global Change Master Directory, Goddard Space Flight Center
City:
Character string:
Greenbelt
Administrative area:
Character string:
MD
Postal code:
Character string:
20771
Country:
Character string:
USA

Electronic mail address:
Character string:
gcmduso@gcmd.gsfc.nasa.gov

Online resource:
CI_OnlineResource: (uuid: 18ec3410-4289-11df-9879-0800200c9a66)

Linkage:
URL:
Protocol:  
Character string:  
http

Application profile:  
Character string:  
web browser

Name:  
Character string:  
NASA Global Change Master Directory

(GCMD)Keyword Page

Description:  
Character string:  
This page describes the NASA GCMD Keywords, how to reference those keywords and provides download instructions.

Function:  
CI_OnLineFunctionCode:  (codeList:  

download

Contact instructions:  
Character string:  

http://gcmd.nasa.gov/MailComments/MailComments.jsf?rcpt=gcmduso

Role:  
CI_RoleCode:  (codeList:  
http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_RoleCode)

custodian

Descriptive keywords:  

MD_Keywords:  
Keyword:  
Character string:  
Ocean Exploration

Type:  
MD_KeywordTypeCode:  (codeList:  
http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode)

theme

Thesaurus name:  
CI_Citation:  
Title:  
Character string:  
None

Date:  (nilReason: Unknown)

Descriptive keywords:  

MD_Keywords:  
Keyword:  
Character string:  
South Pacific Ocean

Keyword:  
Character string:  
Hawaii to Guam

Type:
MD_KeywordTypeCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode)

place

Thesaurus name:
CI_Citation:
Title:
Character string: None
Date: (nilReason: Unknown)

Resource constraints:
MD_LegalConstraints:
Access constraints:

MD_RestrictionCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_RestrictionCode)
otherRestrictions

Use constraints:
MD_RestrictionCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_RestrictionCode)
otherRestrictions

Other constraints:
Character string:

Aggregation information:
MD_AggregateInformation:
Aggregate dataset identifier:
MD_Identifier:
Character string:
NOAA Office of Ocean Exploration and Research (OER)

Association type:
Association type code: (codeList: http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#DS_AssociationTypeCode)
largerWorkCitation

Initiative type:
DS_InitiativeTypeCode: (codeList: http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#DS_InitiativeTypeCode)
program

Language:
Character string: eng; USA

Topic category:
MD_TopicCategoryCode: oceans

Extent:
EX_Extent: (id: boundingExtent)
Geographic element:
EX_GeographicBoundingBox: (id: boundingGeographicBoundingBox)
West bound longitude:
Decimal:
East bound longitude:
Decimal:
140
South bound latitude:
Decimal:
10
North bound latitude:
Decimal:
25

Geographic element:
EX_GeographicDescription: (id: startPort)
Geographic identifier:
MD_Identifier:
Authority:
CI_Citation:
Title:
Character string:
University-National Oceanographic Laboratory System

(UNOLS) Port Table
Date: (nilReason: missing)
Code:
Character string:
Pearl Harbor, HI

Geographic element:
EX_GeographicDescription: (id: endPort)
Geographic identifier:
MD_Identifier:
Authority:
CI_Citation:
Title:
Character string:
University-National Oceanographic Laboratory System

(UNOLS) Port Table
Date: (nilReason: missing)
Code:
Character string:
Apra, GU

Temporal element:
EX_TemporalExtent:
Extent:
Time period:
gml:description:
ground condition
Begin date:
2010-05-19
End date:
2010-06-03

Supplemental information:
Character string:
Data Inventory Report:
Content information:
MD_FeatureCatalogueDescription:
Included with dataset:
Boolean:
false

Feature catalogue citation: (nilReason: unknown)

Metadata maintenance:
  MD_MaintenanceInformation:
    Maintenance and update frequency: (nilReason: Unknown)
    Maintenance note: 
      Character string: 
        This metadata was automatically generated from the FGDC Content Standard for Digital Geospatial Metadata standard version FGDC-STD-001-1998.

Metadata author: (title: NOAA/OAR/OER - Ocean Exploration and Research)
  CI_ResponsibilityParty: (uuid: 99fd1600-e1fd-11df-85ca-0800200c9a66)
    Organisation name: 
      Character string: NOAA/OAR/OER - Ocean Exploration and Research

Contact information:
  CI_Cons spending bLUCK:
    Phone:
      CI Phone:
        Voice: 
          Character string: 301-713-9444
        Facsimile: 
          Character string: 301-713-4252

Address:
  CI_Address:
    Delivery point: 
      Character string: SSMC3, 1315 East-West Highway, 10th Floor
    City: 
      Character string: Silver Spring
    Administrative area: 
      Character string: MD
    Postal code: 
      Character string: 20910
    Country: 
      Character string: USA

Electronic mail address: 
  Character string: ncddcmetadata@noaa.gov

Hours of service: 
  Character string: 8am-5pm, Monday through Friday

Contact instructions:
Role: 
  CI_RoleCode: (codeList: http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode)
custodian
FC PACKAGE
FC_FeatureCatalogue – A catalogue containing definitions and descriptions of the feature types, feature attributes, and feature associations occurring in one or more sets of geographic data, together with any feature operations that may be applied.

Type: compound
Multiplicity:
Attributes: id, uuid

name – Name of the feature catalogue.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

scope – Subject domain(s) of feature types defined in the feature catalogue.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory, repeatable
Attributes: nilReason

fieldOfApplication – Description of kind(s) of use to which the feature catalogue may be put.
Type: gco:characterString
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

versionNumber – Version number of the feature catalogue.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason
Best Practices: versionNumber may include a major version number or letter and a sequence of minor release numbers or letters, such as ‘3.2.4a’. Format may differ between cataloguing authorities.

versionDate – Effective date of the feature catalogue.
Type: gco:Date or gco:DateTime
Domain: date
Multiplicity: mandatory
Attributes: nilReason

Type: gco:characterString
Domain: free text
Multiplicity: optional *this is a NAP requirement*
Attributes: nilReason
Best Practices: The language code and country code are documented in the following manner:
<ISO639-2/T three-letter language code>;<>blank space><ISO3166-1 three-letter country code> Country code is given in uppercase. See Annex B.
characterSet – Character coding standard in the metadata.
   Type: MD_CharacterSetCode
   Domain: ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2, 8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13, 8859part14, 8859part15, 8859part16, jis, shiftjis, eucJP, usAscii, ebcdic, eucKR, big5, GB2312
   Multiplicity: optional *this is a NAP requirement*
   Attributes: nilReason
   Best Practices: The character set for the metadata is set to ‘utf8’ by default. See Annex C.

locale – Other languages used in metadata free text descriptions.
   Type: PT_Locale
   Multiplicity: conditional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
   Best Practices: locale is mandatory when more than one language is used in free text descriptions

subCatalogue – A catalogue where the entries taken from a list of subject headings or an authority file are filed by subjects either in alphabetical or in classified order.
   Type: CT_CodelistCatalogue or CT_CrsSatalogue or CT_UomCatalogue or FC_FeatureCatalog
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

producer – Contact information of the person or organisation having primary responsibility for the intellectual content of the feature catalogue.
   Type: CI_ResponsibleParty
   Multiplicity: mandatory
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

functionalLanguage – Language in which feature operations are formally specified.
   Type: gco:characterString
   Domain: free text
   Multiplicity: conditional
   Attributes: nilReason
   Best Practices: functionalLanguage is mandatory if featureOperation formal definition occurs in the feature catalogue.

featureType – Role that links this feature catalogue to the feature types that it contains.
   Type: FC_FeatureType or FC_FeatureAssociation
   Multiplicity: mandatory, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

definitionSource – Role that links this feature catalogue to the sources of definitions of feature types, property types, and listed values that it contains.
   Type: FC_DefinitionSource
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

globalProperty – Feature properties.
   Type: FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation
   Multiplicity: optional, repeatable
   Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
inheritanceRelation – Relationships that link a more generalized feature type (supertype) with a more specialized feature type (subtype).

Type: FC_InheritanceRelation

Multiplicity: optional, repeatable

Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_AssociationRole – Real world phenomena with common properties.
Type: compound
Multiplicity: optional
Attributes: id, uuid
Best Practices: Association roles included in a feature catalogue shall be identified by a name that is unique within that feature catalog.

featureType – Role that links the operations with feature types that contain them.
Type: FC_FeatureType
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

constrainedBy – Role that links this property type to the constraints placed upon it.
Type: FC_Constraint
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

memberName – Member name that located this member within a feature type.
Type: gco:LocalName
Multiplicity: mandatory
Attributes: nilReason

definition – Definition of the feature type in a natural language.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

cardinality – Cardinality of the member in a feature class.
Type: gco:Multiplicity
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: Default value is ‘0...*’.

definitionReference – Role that links this instance to the source of its definition.
Type: FC_DefinitionReference
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

featureCatalogue – Role that links this instance to the feature catalogue that it is found within.
Type: FC_FeatureCatalogue
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: This is mandatory but a bit recursive, use the nilReason attribute and fill in ‘inapplicable’ if this is not needed. If this is not the case, reference the feature catalogue identifier.

type – Type of association role, indicating whether this role acts as ‘is part of’ or ‘is a member of’ semantics.
Type: FC_RoleType
Multiplicity: mandatory
Attributes: nilReason
isOrdered – Indicates if the instances of this association role within the containing feature instance are ordered or not with FALSE = not ordered and TRUE = ordered.
  Type: gco:Boolean
  Domain: 0, 1 (0 = ‘false’, 1 = ‘true’)
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: Default value = FALSE.

isNavigable – Indicates whether this role is navigable from the source feature to the target feature of the association.
  Type: gco:Boolean
  Domain: 0, 1 (0 = ‘false’, 1 = ‘true’)
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: Default value = TRUE.

relation – Relation of which this association role is a part.
  Type: FC_FeatureAssociation
 Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

rolePlayer – Type of the target value of this association role.
  Type: FC_FeatureType
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_Binding – Class that is used to describe the specifics of how a property type is bound to a particular feature type.

Type: compound
Multiplicity: optional
Attributes: id, uuid

featureType – Describes particular information regarding the use of this property type within this feature type.
Type: FC_FeatureType or FC_FeatureAssociation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

constrainedBy – Role that links this property type to the constraints placed upon it.
Type: FC_Constraint
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

description – Description of how a property is bound to a particular feature type.
Type: gco:CharacterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

globalProperty – Role that links this to feature properties.
Type: FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_BoundAssociationRole

- **Type**: compound
- **Multiplicity**: optional
- **Attributes**: id, uuid

**featureType** — Feature type involved in the binding
- **Type**: FC_FeatureType or FC_FeatureAssociation
- **Multiplicity**: optional
- **Attributes**: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**constrainedBy** — Role that links this property type to the constraints placed upon it.
- **Type**: FC_Constraint
- **Multiplicity**: optional, repeatable
- **Attributes**: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**description** — Description of how a property is bound to a particular feature type.
- **Type**: gco:CharacterString
- **Domain**: free text
- **Multiplicity**: optional
- **Attributes**: nilReason

**globalProperty** — Role that links this to feature properties.
- **Type**: FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation
- **Multiplicity**: mandatory
- **Attributes**: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

**rolePlayer** —
- **Type**: FC_FeatureType or FC_FeatureAssociation
- **Multiplicity**: optional
- **Attributes**: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_BoundFeatureAttribute – Class that represents an association between a particular feature type and a particular property type, in order that operational effect information may be supplied for feature operations
Type: compound
Multiplicity: optional
Attributes: id, uuid

featureType – Feature type involved in the binding
Type: FC_FeatureType or FC_FeatureAssociation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

constrainedBy – Role that links this property type to the constraints placed upon it.
Type: FC_Constraint
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

description – Description of how a property is bound to a particular feature type.
Type: gco:CharacterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

globalProperty – Role that links this to feature properties.
Type: FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

valueType – Type of value of this feature attribute.
Type: gco:TypeName
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_Constraint – Class for defining constraints for types.
Type: compound
Multiplicity: optional
Attributes: id, uuid

description – Description of the constraint that is being applied.
Type: gco:CharacterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

FAQ: What is an example of a constraint?
The example below shows that the measurement value of the ‘depth’ feature attribute is constrained as to direction of measurement.

<table>
<thead>
<tr>
<th>Class FC_FeatureAttribute (identity = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute FC_PropertyType.memberName</td>
</tr>
<tr>
<td>Attribute FC_PropertyType.definition</td>
</tr>
<tr>
<td>Attribute FC_PropertyType.cardinality</td>
</tr>
<tr>
<td>Role FC_PropertyType.featureType</td>
</tr>
<tr>
<td>Role FC_PropertyType.constrainedBy</td>
</tr>
<tr>
<td>Attribute FC_FeatureAttribute.code</td>
</tr>
<tr>
<td>Attribute FC_FeatureAttribute.valueMeasurementUnit</td>
</tr>
<tr>
<td>Attribute FC_FeatureAttribute.valueType</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class FC_Constraint (identity = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute FC_Constraint.description</td>
</tr>
</tbody>
</table>

```xml
<gfc:FC_Constraint id="5">
  <gfc:description>
    <gco:CharacterString>Positive values represent distance below the reference point from which the measurement is made.</gco:CharacterString>
  </gfc:description>
</gfc:FC_Constraint>
```
FC_DEFINITIONREFERENCE

FC_DEFINITIONREFERENCE – Class that links a data instance to the source of its definition.

Type: compound
Multiplicity: optional
Attributes: id, uuid

sourceIdentifier – Additional information to help locate the definition in the source document.
Type: gco:CharacterString
Domain: free text
Multiplicity: optional
Attributes: nilReason
Best Practices: The format of this information is specific to the structure of the source document.

definitionSource – Role that links this definition reference to the citation for the source document.
Type: FC_DEFINITIONSOURCE
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
**FC_DefinitionSource**

Class that specifies the source of a definition.
Type: compound
Multiplicity: optional
Attributes: id, uuid

source – Actual citation of the source, sufficient to identify the document and how to obtain it.
Type: CI_Citation
Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_FeatureAssociation – Relationship that links instances of this feature type with instances of the same or of a different feature type.

- Type: compound
- Multiplicity: optional
- Attributes: id, uuid
- Best Practices: All feature attributes included in a feature catalogue shall be identified by a name that is unique within that feature catalogue.

typeName – Name that uniquely identifies the feature type within the catalogue.

- Type: gco:LocalName
- Domain: free text
- Multiplicity: mandatory
- Attributes: nilReason

definition – Definition of the feature type in a natural language.

- Type: gco:characterString
- Domain: free text
- Multiplicity: optional
- Attributes: nilReason

code – Code that uniquely identifies the feature type within a catalogue.

- Type: gco:characterString
- Domain: free text
- Multiplicity: optional
- Attributes: nilReason

isAbstract – Boolean expression indicating if this is an abstract class.

- Type: gco:Boolean
- Domain: 0, 1 (0 = ‘false’, 1 = ‘true’)
- Multiplicity: mandatory
- Attributes: nilReason
- Best Practices: Default value is set to false.

aliases – Other names by which the association is known.

- Type: gco:LocalName
- Domain: free text
- Multiplicity: optional, repeatable
- Attributes: nilReason

inheritsFrom – Identifies one or more feature types from which the subject feature type inherits all properties, including feature operations, feature attributes, and feature associations.

- Type: FC_InheritanceRelation
- Multiplicity: optional, repeatable
- Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

inheritsTo – Identifies one or more feature types which inherit all properties from subject feature type, including feature operations, feature attributes, and feature associations.

- Type: FC_InheritanceRelation
- Multiplicity: optional, repeatable
- Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
featureCatalogue – A feature catalogue contains its identification and contact information, and definition of some number of feature types with other information necessary for those definitions.

  Type: FC_FeatureCatalogue
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Best Practices: This is mandatory but a bit recursive, use the nilReason attribute and fill in ‘inapplicable’ if this is not needed. If this is not the case, reference the feature catalogue identifier.

constrainedBy – Role that links this feature type to the constraints placed upon it.

  Type: FC_Constraint
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

definitionReference – Role that links this feature type to the source of its definition.

  Type: FC_DefinitionReference
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

carrierOfCharacteristics – Property types that the feature type contains.

  Type: FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation or FC_Binding or FC_BoundAssociationRole or FC_BoundFeatureAttribute
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

roleName – Roles that are a part of this association.

  Type: FC_AssociationRole
  Multiplicity: mandatory, repeatable, minimum of two
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
**FC_FeatureAttribute** – Characteristic of a feature type.
Type: compound
Multiplicity: optional
Attributes: id, uuid
Best Practices: Feature attributes included in a feature catalogue shall be identified by a name that is unique within that feature catalog.

**featureType** – Role that links the operations with feature types that contain them.
Type: FC_FeatureType or FC_FeatureAssociation
Multiplicity: optional
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
constrainedBy – Role that links this property type to the constraints placed upon it.
  Type: FC_Constraint
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

memberName – Member name that located this member within a feature type.
  Type: gco:LocalName
  Multiplicity: mandatory
  Attributes: nilReason

definition – Definition of the feature type in a natural language.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

cardinality – Cardinality of the member in a feature class.
  Type: gco:Multiplicity
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: Default value is ‘1’.

definitionReference – Role that links this instance to the source of its definition.
  Type: FC_DefinitionReference
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

featureCatalogue – Role that links this instance to the feature catalogue that it is found within.
  Type: FC_FeatureCatalogue
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: This is mandatory but a bit recursive, use the nilReason attribute and fill in ‘inapplicable’ if this is not needed. If this is not the case, reference the feature catalogue identifier.

code – Numeric of alphanumeric code that uniquely identifies the feature attribute within the feature catalogue.
  Type: gco:CharacterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

valueMeasurementUnit – Unit of measure used for values of this feature attribute.
  Type: BaseUnit or ConventionalUnit or DerivedUnit
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: See Annex D.

valueType – Type of the value of this feature attribute; a name from some namespace.
  Type: gco:TypeName
  Multiplicity: conditional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: valueType is mandatory if feature attribute listedValue is empty.
listedValue – Permissible values of this feature attribute. If present, then this feature attribute is enumerated.

Type: FC_ListedValue
Multiplicty: conditional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
Best Practices: listedValue is mandatory if valueType is not given.

FAQ: What is an example of a feature attribute?

A feature attribute can have a name, a data type, and a value domain associated to it. A feature attribute for a feature instance also has an attribute value taken from the value domain.

Ex:
A feature named ‘color’ may have an attribute value ‘green’.

A feature named ‘length’ may have an attribute value ‘54.6’.

A feature type of ‘Roads’ may have several attributes, such as ‘Number of Lanes’ and ‘Road Surface’, etc.
FC_FeatureOperation — Operation that every feature of a feature type may perform.

Type: compound

Multiplicity: conditional

Attributes: id, uuid

Beat Practices: Mandatory if feature operation name occurs in feature operations names list. All feature operations included in a feature catalogue shall be identified by a name that is unique within that feature catalogue.
featureType – Role that links the operations with feature types that contain them.
  Type: FC_FeatureType
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

constrainedBy – Role that links this property type to the constraints placed upon it.
  Type: FC_Constraint
  Multiplicity: optional, repeatable
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

memberName – Member name that located this member within a feature type.
  Type: gco:LocalName
  Multiplicity: mandatory
  Attributes: nilReason

definition – Definition of the feature type in a natural language.
  Type: gco:characterString
  Domain: free text
  Multiplicity: optional
  Attributes: nilReason

cardinality – Cardinality of the member in a feature class.
  Type: gco:Multiplicity
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: Default value is ‘1’.

definitionReference – Role that links this instance to the source of its definition.
  Type: FC_DefinitionReference
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

featureCatalogue – Role that links this instance to the feature catalogue that it is found within.
  Type: FC_FeatureCatalogue
  Multiplicity: optional
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
  Best Practices: This is mandatory but a bit recursive, use the nilReason attribute and fill in ‘inapplicable’ if this is not needed. If this is not the case, reference the feature catalogue identifier.

signature – Name and parameters for this operation.
  Type: gco:characterString
  Domain: free text
  Multiplicity: mandatory
  Attributes: nilReason
  Best Practices: The signature of an operation must be unique. The signature is usually derived from the formal definition.

formalDefinition – Formal description of the behavior of the member.
  Type: gco:characterString
  Domain: free text
Multiplicity: optional
Attributes: nilReason
triggeredByValuesOf – Specifies attributes which may trigger an operation.
Type: FC_BoundFeatureAttribute
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

affectsValuesOf – Specifies attributes that will be affected by an operation.
Type: FC_BoundFeatureAttribute
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

observesValuesOf – Specifies attributes that may be used as input to perform an operation.
Type: FC_BoundFeatureAttribute
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_FeatureType – Real world phenomena with common properties.
Type: compound
Multiplicity: optional
Attributes: id, uuid
Best Practices: All feature types included in a feature catalogue shall be identified by a name that is unique within that feature catalogue.

typeName – Name that uniquely identifies the feature type within the catalogue.
Type: gco:LocalName
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

definition – Definition of the feature type in a natural language.
Type: gco:characterString
Domain: free text
Multiplicity: conditional
Attributes: nilReason
Best Practices: definition is mandatory if definition is not provided by definition source.

code – Code that uniquely identifies the feature type within a catalogue.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

isAbstract – Boolean expression indicating if this is an abstract class.
Type: gco:Boolean
Domain: 0, 1 (0 = ‘false’, 1 = ‘true’)
Multiplicity: mandatory
Attributes: nilReason
Best Practices: Default value is set to false.

aliases – Other names by which the type is known.
Type: gco:LocalName
Domain: free text
Multiplicity: optional, repeatable
Attributes: nilReason

inheritsFrom – Identifies one or more feature types from which the subject feature type inherits all properties, including feature operations, feature attributes, and feature associations.
Type: FC_InheritanceRelation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

inheritsTo – Identifies one or more feature types which inherit all properties from subject feature type, including feature operations, feature attributes, and feature associations.
Type: FC_InheritanceRelation
Multiplicity: optional, repeatable
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
featureCatalogue – A feature catalogue contains its identification and contact information, and definition of some number of feature types with other information necessary for those definitions.

- **Type:** FC_FeatureCatalogue
- **Multiplicity:** mandatory
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason
- **Best Practices:** This is mandatory but a bit recursive, use the nilReason attribute and fill in ‘inapplicable’ if this is not needed. If this is not the case, reference the feature catalogue identifier.

constrainedBy – Role that links this feature type to the constraints placed upon it.

- **Type:** FC_Constraint
- **Multiplicity:** optional, repeatable
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason

definitionReference – Role that links this feature type to the source of its definition.

- **Type:** FC_DefinitionReference
- **Multiplicity:** optional
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason

carrierOfCharacteristics – Property types that the feature type contains.

- **Type:** FC_AssociationRole or FC_FeatureAttribute or FC_FeatureOperation or FC_Binding or FC_BoundAssociationRole or FC_BoundFeatureAttribute
- **Multiplicity:** optional, repeatable
- **Attributes:** type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FC_InheritanceRelation – Links a more generalized supertype with a more specialized subtype.
Type: compound
Multiplicity: optional
Attributes: id, uuid

name – Name that uniquely identifies this inheritance relationship within the feature catalogue that contains this inherited relation.
Type: gco:characterString
Domain: free text
Multiplicity: optional
Attributes: nilReason

description – Natural language description of the inheritance relationship.
Type: gco:characterString
Domain: free text
Multiplicity: mandatory
Attributes: nilReason

uniqueInstance – Indicates if an instance of the supertype can be an instance of at most one of its subtypes.
Type: gco:Boolean
Domain: 0,1 (0 = false, 1 = true)
Multiplicity: mandatory
Attributes: nilReason
subtype – Identifies one feature type to which the associated Superclass feature type supplies inherence properties, associations, and operations.
  Type: FC_FeatureType
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

supertype – Identifies one feature type from which the associated subtype class inherits properties, associations, and operations.
  Type: FC_FeatureType
  Multiplicity: mandatory
  Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

FAQ: What is an example of an inheritance relation?

Below is an example of a feature catalogue that contains the ‘is a’ inheritance relation relating the two feature types ‘building’ and ‘lighthouse’. An instance of a ‘lighthouse’ feature type is also an instance of a ‘building’ feature type; feature properties, feature associations, and feature operations to the ‘building’ feature type in the example feature catalogue also apply to the ‘lighthouse’ feature type. Pay special attention to the identities.

Class FC_FeatureType (identity = 25)

| Attribute FC_FeatureType.typeName | Building |
| Attribute FC_FeatureType.definition | A relatively permanent structure, roofed and usually walled and designed for some particular use. |
| Attribute FC_FeatureType.code | AL015 |
| Attribute FC_FeatureType.isAbstract | FALSE |
| Role FC_FeatureType.inheritsTo | FC_FeatureInheritanceRelation (identity = 27) |
| Role FC_FeatureType.featureCatalogue | FC_FeatureCatalogue (identity = 1) |

Class FC_FeatureType (identity = 26)

| Attribute FC_FeatureType.typeName | Lighthouse |
| Attribute FC_FeatureType.definition | A distinctive structure exhibiting light(s) designed to serve as an aid to navigation. |
| Attribute FC_FeatureType.code | BC050 |
| Attribute FC_FeatureType.isAbstract | FALSE |
| Role FC_FeatureType.inheritsFrom | FC_FeatureInheritanceRelation (identity = 27) |
| Role FC_FeatureType.featureCatalogue | FC_FeatureCatalogue (identity = 1) |

Class FC_InheritanceRelation (identity = 27)

| Attribute FC_InheritanceRelation.name | is a (see above) |
| Attribute FC_InheritanceRelation.description | An object is classified as a specialization of another object. |
| Attribute FC_InheritanceRelation.uniqueInstance | TRUE |
| Role FC_InheritanceRelation.subtype | FC_FeatureType (identity = 26) |
| Role FC_InheritanceRelation.supertype | FC_FeatureType (identity = 25) |
**FC_ListedValue** – Value for an enumerated feature attribute domain, including its codes and interpretation.

Type: compound  
Multiplicity: optional  
Attributes: id, uuid

**label** – Descriptive label that uniquely identifies one value of the feature attribute.

Type: gco:CharacterString  
Domain: free text  
Multiplicity: mandatory  
Attributes: nilReason

**code** – Numeric or alphanumeric code that uniquely identifies this value of the feature attribute.

Type: gco:CharacterString  
Domain: free text  
Multiplicity: optional  
Attributes: nilReason

---

**FAQ:** What is an example of a listed value attribute code?

A country code would be an example of an alphanumeric code that uniquely identifies a value.

---

**definition** – Definition of the attribute value in a natural language.

Type: gco:CharacterString  
Domain: free text  
Multiplicity: optional  
Attributes: nilReason  
Best Practices: If definition is not provided, the definitionReference may specify a citation where the definition may be found as well as any additional information.

**definitionReference** – Role that links this instance to the source of its definition.

Type: FC_DefinitionReference  
Multiplicity: optional  
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason
FAQ: What is an example of FC_ListedValue and how is it used?

If I have a feature type named ‘Roads’ and a feature attribute of that type named ‘Road Surface’, I will want to document the domain that identifies the road surface materials.

Ex:

<table>
<thead>
<tr>
<th>Label</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>001</td>
</tr>
<tr>
<td>Concrete</td>
<td>002</td>
</tr>
<tr>
<td>Dirt</td>
<td>003</td>
</tr>
<tr>
<td>Asphalt</td>
<td>004</td>
</tr>
</tbody>
</table>

```xml
<gfc:listedValue>
  <gfc:FC_ListedValue>
    <gfc:label>
      <gco:CharacterString>gravel</gco:CharacterString>
    </gfc:label>
    <gfc:code>
      <gco:CharacterString>001</gco:CharacterString>
    </gfc:code>
    <gfc:definition>
      <gco:CharacterString>unpaved road surfaced with gravel</gco:CharacterString>
    </gfc:definition>
  </gfc:FC_ListedValue>
</gfc:listedValue>

<gfc:listedValue>
  <gfc:FC_ListedValue>
    <gfc:label>
      <gco:CharacterString>concrete</gco:CharacterString>
    </gfc:label>
    <gfc:code>
      <gco:CharacterString>002</gco:CharacterString>
    </gfc:code>
    <gfc:definition>
      <gco:CharacterString>road paved with concrete, includes jointed plain (JPCP), jointed reinforced (JRCP) and continuously reinforced (CRCP)</gco:CharacterString>
    </gfc:definition>
  </gfc:FC_ListedValue>
</gfc:listedValue>

<gfc:listedValue>
  <gfc:FC_ListedValue>
    <gfc:label>
      <gco:CharacterString>dirt</gco:CharacterString>
    </gfc:label>
    <gfc:code>
      <gco:CharacterString>003</gco:CharacterString>
    </gfc:code>
    <gfc:definition>
      <gco:CharacterString>unpaved road made from subgrade material</gco:CharacterString>
    </gfc:definition>
  </gfc:FC_ListedValue>
</gfc:listedValue>

<gfc:listedValue>
  <gfc:FC_ListedValue>
    <gfc:label>
      <gco:CharacterString>asphalt</gco:CharacterString>
    </gfc:label>
    <gfc:code>
      <gco:CharacterString>004</gco:CharacterString>
    </gfc:code>
    <gfc:definition>
      <gco:CharacterString>road paved with the petroleum based asphalt concrete</gco:CharacterString>
    </gfc:definition>
  </gfc:FC_ListedValue>
</gfc:listedValue>
```
**FEATURE CATALOG EXAMPLE**

**Feature Catalog Example – Transportation96**

<table>
<thead>
<tr>
<th><strong>Feature Catalogue id=1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong></td>
</tr>
<tr>
<td><strong>Scope:</strong></td>
</tr>
<tr>
<td><strong>Field of Application:</strong></td>
</tr>
<tr>
<td><strong>Version Number:</strong></td>
</tr>
<tr>
<td><strong>Version Date:</strong></td>
</tr>
<tr>
<td><strong>Definition Source:</strong></td>
</tr>
<tr>
<td><strong>Feature Catalogue Producer:</strong></td>
</tr>
</tbody>
</table>

---

**Feature Catalog Example – Transportation96**

**Feature Type id=2**

| **Name:** | Roads |
| **Definition:** | Open way for the movement of motor vehicles on land |
| **Code:** | TR96-02 |

**Feature Attribute Names:** Number of lanes (id=3), Road Surface (id=4)

**Feature Attribute id=3**

| **Name:** | Number of Lanes |
| **Definition:** | Number of lanes of the road, including both directions |
| **Code:** | 15942 |
| **Value Data Type:** | Long |
| **Value Measurement Unit:** | lanes |
| **Value Domain Type:** | 0 = ‘not enumerated’ |
| **Value Domain:** | N/A |

**Feature Attribute id=4**

| **Name:** | Road Surface |
| **Definition:** | Road surface material |
| **Code:** | 19586 |
| **Value Data Type:** | text |
| **Value Domain Type:** | 1 = ‘enumerated’ |
| **Value Domain:** |

<table>
<thead>
<tr>
<th><strong>Label</strong></th>
<th><strong>Code</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>gravel</td>
<td>001</td>
</tr>
<tr>
<td>concrete</td>
<td>002</td>
</tr>
<tr>
<td>dirt</td>
<td>003</td>
</tr>
<tr>
<td>asphalt</td>
<td>004</td>
</tr>
</tbody>
</table>
<gmx:name>
  <gco:CharacterString>Transportation96</gco:CharacterString>
</gmx:name>

<gmx:scope>
  <gco:CharacterString>Road network in Urbana-Champaign surveyed in 1996 for all transportation facilities within the twin cities.</gco:CharacterString>
</gmx:scope>

<gmx:fieldOfApplication>
  <gco:CharacterString>Transportation planning, Land use planning</gco:CharacterString>
</gmx:fieldOfApplication>

<gmx:versionNumber>
  <gco:CharacterString>1.1</gco:CharacterString>
</gmx:versionNumber>

<gmx:versionDate>
  <gco:Date>1996-10-01</gco:Date>
</gmx:versionDate>

<gmx:language>
  <gco:CharacterString>eng; US</gco:CharacterString>
</gmx:language>

<gmx:characterSet>
  <gmd:MD_CharacterSetCode
    codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCodeType" codeListValue="utf8"/>
</gmx:characterSet>

<gfc:producer>
  <gmd:CI_ResponsibleParty>
    <gmd:organisationName>
      <gco:CharacterString>CCRPC</gco:CharacterString>
    </gmd:organisationName>
    <gmd:contactInfo>
      <gmd:CI_Contact>
        <gmd:phone>
          <gmd:CI_Telephone>
            <gmd:voice>
              <gco:CharacterString>+1 217 488-3331</gco:CharacterString>
            </gmd:voice>
            <gmd:facsimile>
              <gco:CharacterString>+1 217 482-9331</gco:CharacterString>
            </gmd:facsimile>
          </gmd:CI_Telephone>
        </gmd:phone>
        <gmd:address>
          <gmd:CI_Address>
            <gmd:deliveryPoint>
              <gco:CharacterString>10 Main St.</gco:CharacterString>
            </gmd:deliveryPoint>
            <gmd:city>
              <gco:CharacterString>Urbana</gco:CharacterString>
            </gmd:city>
            <gmd:administrativeArea>
              <gco:CharacterString>IL</gco:CharacterString>
            </gmd:administrativeArea>
            <gmd:postalCode>
              <gco:CharacterString>61801</gco:CharacterString>
            </gmd:postalCode>
            <gmd:country>
              <gco:CharacterString>US</gco:CharacterString>
            </gmd:country>
          </gmd:CI_Address>
        </gmd:address>
        <gmd:electronicMailAddress>
          <gco:CharacterString>landuse96@urbana.net</gco:CharacterString>
        </gmd:electronicMailAddress>
      </gmd:CI_Contact>
    </gmd:contactInfo>
  </gmd:CI_ResponsibleParty>
</gfc:producer>
<gmd:address>
</gmd:address>
</gmd:CI_Contact>
</gmd:contactInfo>
</gmd:role>
</gmd:CI_ResponsibleParty>
</gfc:producer>
</gfc:featureType>
</gfc:FC_FeatureType id="_2">
</gfc:typeName>
</gco:LocalName>Roads</gco:LocalName>
</gfc:typeName>
</gfc:definition>
</gco:CharacterString>Open way for the movement of motor vehicles on land</gco:CharacterString>
</gfc:definition>
</gco:code>
</gco:CharacterString>TR96-02</gco:CharacterString>
</gfc:code>
</gco:Boolean>false</gco:Boolean>
</gfc:isAbstract>
</gfc:carrierOfCharacteristics>
</gfc:FC_FeatureAttribute id="_3">
</gfc:memberName>
</gco:LocalName>Number of Lanes</gco:LocalName>
</gfc:memberName>
</gfc:definition>
</gco:CharacterString>Number of lanes of the road, including both directions</gco:CharacterString>
</gfc:definition>
</gfc:cardinality>
</gco:Multiplicity>
</gco:range>
</gco:MultiplicityRange>
</gco:lower>
</gco:range>
</gco:Multiplicity>
</gfc:cardinality>
</gco:CharacterString>15942</gco:CharacterString>
</gfc:code>
</gml:UnitDefinition gml:id="lanes">
<gml:identifier codeSpace="lanes"/>
</gml:UnitDefinition>
</gfc:valueMeasurementUnit>
</gfc:valueType>
</gco:TypeName>
</gco:aName>
</gco:CharacterString>Long</gco:CharacterString>
</gco:aName>
</gco:Multiplicity>
</gfc:cardinality>
</gco:CharacterString>15942</gco:CharacterString>
</gfc:code>
</gml:UnitDefinition gml:id="lanes">
<gml:identifier codeSpace="lanes"/>
</gml:UnitDefinition>
</gfc:valueMeasurementUnit>
</gfc:valueType>
</gco:TypeName>
</gco:aName>
</gco:CharacterString>Long</gco:CharacterString>
</gco:aName>
</gfc:FC_FeatureAttribute>
</gfc:carrierOfCharacteristics>
</gfc:carrierOfCharacteristics>
</gfc:FC_FeatureAttribute id="_4">
</gfc:memberName>
</gco:LocalName>Road Surface</gco:LocalName>
<gfc:memberName>
  <gfc:definition>
  <gco:CharacterString>Road surface material</gco:CharacterString>
  </gfc:definition>
  <gfc:cardinality>
  </gfc:cardinality>
  <gfc:Multiplicity>
  <gco:Multiplicity>
  <gco:range>
  <gco:MultiplicityRange>
  <gco:lower>
  1
  </gco:lower>
  <gco:upper>
  <gco:UnlimitedInteger xsi:nil="true" isFinite="true"/>
  </gco:upper>
  </gco:MultiplicityRange>
  </gco:range>
  </gco:Multiplicity>
  </gfc:cardinality>
  </gfc:code>
  <gco:CharacterString>19586</gco:CharacterString>
  </gfc:code>
  <gfc:valueType>
  <gco:TypeName>
  <gco:aName>
  text
  </gco:aName>
  </gco:TypeName>
  </gfc:valueType>
  <gfc:listedValue>
  <gfc:FC_ListedValue>
  <gfc:label>
  gravel
  </gfc:label>
  <gfc:code>
  001
  </gfc:code>
  <gfc:definition>
  unpaved road surfaced with gravel
  </gfc:definition>
  </gfc:FC_ListedValue>
  </gfc:listedValue>
  <gfc:listedValue>
  <gfc:FC_ListedValue>
  <gfc:label>
  concrete
  </gfc:label>
  <gfc:code>
  002
  </gfc:code>
  <gfc:definition>
  road paved with concrete, includes jointed plain (JPCP), jointed reinforced (JRCP) and continuously reinforced (CRCP)
  </gfc:definition>
  </gfc:FC_ListedValue>
  </gfc:listedValue>
  <gfc:listedValue>
  <gfc:FC_ListedValue>
  <gfc:label>
  dirt
  </gfc:label>
  <gfc:code>
  003
  </gfc:code>
  <gfc:definition>
  unpaved road made from subgrade material
  </gfc:definition>
  </gfc:FC_ListedValue>
  </gfc:listedValue>
</gfc:memberName>
<gfc:listedValue>
  <gfc:listedValue>
    <gfc:FC_ListedValue>
      <gfc:label>
        <gco:CharacterString>asphalt</gco:CharacterString>
      </gfc:label>
      <gfc:code>
        <gco:CharacterString>004</gco:CharacterString>
      </gfc:code>
      <gfc:definition>
        <gco:CharacterString>road paved with the petroleum based asphalt concrete</gco:CharacterString>
      </gfc:definition>
    </gfc:FC_ListedValue>
  </gfc:listedValue>
</gfc:carrierOfCharacteristics>
</gfc:FC_FeatureType>
</gfc:featureType>
</gfc:definitionSource>
</gfc:FC_DefinitionSource>
</gfc:FC_FeatureCatalogue>
ANNEX A. DATA TYPES

A.1 Binary
Any binary data (e.g., image, sound) encoded as a sequence of bits (see ISO/TS19133:2005, Geographic information – Location based services – Tracking and navigation, clause 10.2.3).

A.2 Boolean
Truth value representing true or false. True can be represented by {true, 1} and false by {false,0} (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.2.11).

A.3 CharacterString
An arbitrary-length sequence of characters, including accents and special characters from the identified character set. CharacterStrings provide an area for free text. If an element has a characterString allowing free text, and you want to restrict this to using a controlled vocabulary, substitute gco:CharacterString with gmx:Anchor.

A.4 Date
Date gives values for the representation of:
1. year, e.g., 2006
2. year and month, e.g., 2006-10;
3. year, month, and day, e.g., 2006-10-01-05:00;
4. year, month, day, and time, e.g., 2006-10-01T12:00:00-05:00 (see A.5 DateTime).

Case 3 and 4 include optionally a time zone representation showing the time shift related to Coordinated Universal Time (UTC) origin. (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.2.8, and ISO/TS19139:2007, Geographic information – Metadata – XML schema implementation, clause 8.5.8.4.7)

A.5 DateTime
Date gives values for the representation of year, month, day, and time of the day in terms of hours, minutes, and second, with an optional time zone. Example 2006-10-01T12:00:00-05:00 corresponds to noon on October 1st, 2002, Eastern Standard Time in the U.S. NAP – Metadata, version 1.0.1 (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.2.8, and ISO/TS19139:2007, Geographic information – Metadata – XML schema implementation, clause 8.5.8.4.7)

A.6 Decimal
A number that represents an exact value, e.g., 2.5, 5.25, 12.125 (see ISO/TS19103:2005, Geographic information – Conceptual schema language, clause 6.5.2.4).

A.7 Distance
Measure of length between two points. (see ISO/TS19103:2005, Geographic information – Conceptual schema language, clause 6.5.7.7).

A.8 GenericName
Abstract class for the representation of a name in a namespace. A GenericName can be either a LocalName of a ScopedName. A LocalName is either a MemberName (see A.15) or a TypeName. A TypeName is a name that references either a RecordType or an object in a schema. (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.6.3).

A.9 Gf_AttributeType
ISO19109:2005, Geographic information – Rules for application schema metaclass used for the representation of an attribute of a class of features, e.g., ‘numberOfLane’, and ‘buildingUsage’ (see ISO19109:2005, Geographic information – Rules for application schema, clause 7.3.6).
A.10 GF_FeatureType

A.11 GM_Object
ISO19107:2003, Geographic information – Spatial schema abstract classes standing for any geometric objects (e.g., GM_Point, GM_Curve, GM_Surface) for the representation of the geometry of objects (see ISO19107:2003, Geographic information – Spatial schema, clause 6.2.2). NAP – Metadata, version 1.0.1

A.12 GM_Point

A.13 Integer
A signed number with no fractional part, e.g., -12, 125, 12000963 (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.2.3).

A.14 Measure
A value resulting from the process to evaluate an amount or a quantity expressed in a unit of measure. (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.7.2).

A.15 MemberName
Name that references an attribute in a record, a RecordType, an attribute, an operation, or an association role (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.6.7).

A.16 Real
A signed floating point number composed of a mantissa and an optional exponent, e.g., -2E5, 364.236E8, 15.32e-3, 24, -0, 0.(see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.2.5).

A.17 Record
A structure of logically related elements (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.5).

A.18 RecordType
Specification of the content and structure of a Record.(see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.5). NAP – Metadata, version 1.0.1

*The usage of the RecordType and Record are described in ISO 19139. A RecordType element refers to a definition a type. The RecordType is implemented in XML as an xlink to the definition of that type. A Record is an instance of that type. The content of the tags RecordType and Record are free text. In the example below, the RecordType is an xlink to the definition of a netCDF variable type from the NcML schema. The Record is an xlink to an instance of the variable provided by a web service (ncmlService).

Ex.
<gmd:dimension>
  <gmd:SampleDimension>
    <gmd:otherAttributeType>
      <gco:RecordType xlink:href="http://www.unidata.ucar.edu/schemas/netcdf/ncml-2.2.xsd"
        #xpointer(//element[@name='variable'])">netCDF Variable Type</gco:RecordType>
    </gmd:otherAttributeType>
    <gmd:otherAttributeValue>
      <gco:Record xlink:href="http://www.ngdc.noaa.gov/ncmlService/granuleIdentifier"
        #xpointer(/netcdf/variable[@name=MemberName])">Attributes for variable = memberName in granule =
A.19 SC_CRS
Coordinate reference system documented according to ISO/TS19111:2003, Geographic information – Spatial referencing by coordinates.

A.20 TM_PeriodDuration
Time span of an object or an event. A TM_PeriodDuration of 5 year, 1 months, 6 days, 12 hours, and 35 minutes is represented by P5Y1M6DT10H35M. Any subset of this representation is allowed as long as one unit is represented, e.g., a period duration of minus 80 days is represented as −P80D. (see ISO19108:2003, Geographic information – Temporal schema, clause 5.2.3.7).

A.21 TM_Primitive
TM_Primitive is an abstract data type for temporal geometric primitives (TM_Instant and TM_Period) and temporal topological primitives (TM_Node and TM_Edge) (see ISO19108:2003, Geographic information – Temporal schema, clause 5.2.2).

A.22 Type
Any acceptable data type.

A.23 UnitOfMeasure
A quantity adopted as a standard unit of measure, e.g., metre, degree, kilogram (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.7.3).

A.24 UomLength
Reference quantities to express the value of a length, e.g., metre (see ISO/TS19103:2005, Geographic information - Conceptual schema language, clause 6.5.7.8).

A.25 URL
A uniform resource locator, e.g., http://napmetadata.org.

A.26 Anchor
Anchor can be used as a substitute for a characterString when you want to restrict the free text to a controlled vocabulary.

Ex:
<gmX:Anchor xlink:href="http://www.rvdata.us/voc/port#101065">Pearl Harbor, HI</gmX:Anchor>

This restricts the field to the controlled vocabulary located at http://www.rvdata.us/voc/port and selects the term as defined.
ANNEX B. COMMONLY USED ISO CODES

B.1 ISO 639-2/T Three-letter Language Codes
English = eng
Spanish = spa
French = fre

B.2 ISO 3166-1 Country Codes
Canada
Short name: Canada
Alpha-2: CA
Alpha-3: CAN
Numeric: 124

United Mexican States
Short name: Mexico
Alpha-2: MX
Alpha-3: MEX
Numeric: 484

United States of America
Short name: United States
Alpha-2: US
Alpha-3: USA
Numeric: 840
ISO codeLists are located at http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml and are listed below. (For NAP codeLists, go to http://www.geoconnections.org/developersCorner/nap/metadata/register/registerItemClasses.html#IC_97).

C.1 CI_DateTypeCode - identification of when a given event occurred

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>creation</td>
<td>001</td>
<td>date identifies when the resource was brought into existence</td>
</tr>
<tr>
<td>publication</td>
<td>002</td>
<td>date identifies when the resource was issued</td>
</tr>
<tr>
<td>revision</td>
<td>003</td>
<td>date identifies when the resource was examined or re-examined and improved or amended</td>
</tr>
</tbody>
</table>

C.2 CI_OnlineFunctionCode - function performed by the resource

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>download</td>
<td>001</td>
<td>online instructions for transferring data from one storage device or system to another</td>
</tr>
<tr>
<td>information</td>
<td>002</td>
<td>online information about the resource</td>
</tr>
<tr>
<td>offlineAccess</td>
<td>003</td>
<td>online instructions for requesting the resource from the provider</td>
</tr>
<tr>
<td>order</td>
<td>004</td>
<td>online order process for obtaining the resource</td>
</tr>
<tr>
<td>search</td>
<td>005</td>
<td>online search interface for seeking out information about the resource</td>
</tr>
</tbody>
</table>

C.3 CI_PresentationFormCode - mode in which the data is represented

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>documentDigital</td>
<td>001</td>
<td>digital representation of a primarily textual item (can contain illustrations also)</td>
</tr>
<tr>
<td>documentHardcopy</td>
<td>002</td>
<td>representation of a primarily textual item (can contain illustrations also) on paper, photographic material, or other media</td>
</tr>
<tr>
<td>imageDigital</td>
<td>003</td>
<td>likeness of natural or man-made features, objects, and activities acquired through the sensing of visual or any other segment of the electromagnetic spectrum by sensors, such as thermal infrared, and high resolution radar and stored in digital format</td>
</tr>
<tr>
<td>imageHardcopy</td>
<td>004</td>
<td>likeness of natural or man-made features, objects, and activities acquired through the sensing of visual or any other segment of the electromagnetic spectrum by sensors, such as thermal infrared, and high resolution radar and reproduced on paper, photographic material, or other media for use directly by the human user</td>
</tr>
<tr>
<td>Name</td>
<td>Domain code</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>mapDigital</td>
<td>005</td>
<td>map represented in raster or vector form</td>
</tr>
<tr>
<td>mapHardcopy</td>
<td>006</td>
<td>map printed on paper, photographic material, or other media for use directly by the human user</td>
</tr>
<tr>
<td>modelDigital</td>
<td>007</td>
<td>multi-dimensional digital representation of a feature, process, etc.</td>
</tr>
<tr>
<td>modelHardcopy</td>
<td>008</td>
<td>3-dimensional, physical model</td>
</tr>
<tr>
<td>profileDigital</td>
<td>009</td>
<td>vertical cross-section in digital form</td>
</tr>
<tr>
<td>profileHardcopy</td>
<td>010</td>
<td>vertical cross-section printed on paper, etc.</td>
</tr>
<tr>
<td>tableDigital</td>
<td>011</td>
<td>digital representation of facts or figures systematically displayed, especially in columns</td>
</tr>
<tr>
<td>tableHardcopy</td>
<td>012</td>
<td>representation of facts or figures systematically displayed, especially in columns, printed on paper, photographic material, or other media</td>
</tr>
<tr>
<td>videoDigital</td>
<td>013</td>
<td>digital video recording</td>
</tr>
<tr>
<td>videoHardcopy</td>
<td>014</td>
<td>video recording on film</td>
</tr>
</tbody>
</table>

**C.4 CI_RoleCode** - function performed by the responsible party

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>resourceProvider</td>
<td>001</td>
<td>party that supplies the resource</td>
</tr>
<tr>
<td>custodian</td>
<td>002</td>
<td>party that accepts accountability and responsibility for the data and ensures appropriate care and maintenance of the resource</td>
</tr>
<tr>
<td>owner</td>
<td>003</td>
<td>party that owns the resource</td>
</tr>
<tr>
<td>user</td>
<td>004</td>
<td>party who uses the resource</td>
</tr>
<tr>
<td>distributor</td>
<td>005</td>
<td>party who distributes the resource</td>
</tr>
<tr>
<td>originator</td>
<td>006</td>
<td>party who created the resource</td>
</tr>
<tr>
<td>pointOfContact</td>
<td>007</td>
<td>party who can be contacted for acquiring knowledge about or acquisition of the resource</td>
</tr>
<tr>
<td>principalInvestigator</td>
<td>008</td>
<td>key party responsible for gathering information and conducting research</td>
</tr>
<tr>
<td>processor</td>
<td>009</td>
<td>party who has processed the data in a manner such that the resource has been modified</td>
</tr>
<tr>
<td>publisher</td>
<td>010</td>
<td>party who published the resource</td>
</tr>
<tr>
<td>author</td>
<td>011</td>
<td>party who authored the resource</td>
</tr>
</tbody>
</table>

**C.5 DQ_EvaluationMethodTypeCode** - type of method for evaluating an identified data quality measure

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>directInternal</td>
<td>001</td>
<td>method of evaluating the quality of a dataset based on inspection of items within the dataset, where all data required is internal to the dataset being evaluated</td>
</tr>
<tr>
<td>directExternal</td>
<td>002</td>
<td>method of evaluating the quality of a dataset based on inspection of items within the</td>
</tr>
</tbody>
</table>
dataset, where reference data external to the dataset being evaluated is required

indirect  003  method of evaluating the quality of a dataset based on external knowledge

C.6 DS_AssociationTypeCode - justification for the correlation of two datasets

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>crossReference</td>
<td>001</td>
<td>reference from one dataset to another</td>
</tr>
<tr>
<td>largerWorkCitation</td>
<td>002</td>
<td>reference to a master dataset of which this one is a part</td>
</tr>
<tr>
<td>partOfSeamlessDatabase</td>
<td>003</td>
<td>part of same structured set of data held in a computer</td>
</tr>
<tr>
<td>source</td>
<td>004</td>
<td>mapping and charting information from which the dataset content originates</td>
</tr>
<tr>
<td>stereoMate</td>
<td>005</td>
<td>part of a set of imagery that when used together, provides three-dimensional images</td>
</tr>
</tbody>
</table>

C.7 DS_InitiativeTypeCode - type of aggregation activity in which datasets are related

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>campaign</td>
<td>001</td>
<td>series of organized planned actions</td>
</tr>
<tr>
<td>collection</td>
<td>002</td>
<td>accumulation of datasets assembled for a specific purpose</td>
</tr>
<tr>
<td>exercise</td>
<td>003</td>
<td>specific performance of a function or group of functions</td>
</tr>
<tr>
<td>experiment</td>
<td>004</td>
<td>process designed to find if something is effective or valid</td>
</tr>
<tr>
<td>investigation</td>
<td>005</td>
<td>search or systematic inquiry</td>
</tr>
<tr>
<td>mission</td>
<td>006</td>
<td>specific operation of a data collection system</td>
</tr>
<tr>
<td>sensor</td>
<td>007</td>
<td>device or piece of equipment which detects or records</td>
</tr>
<tr>
<td>operation</td>
<td>008</td>
<td>action that is part of a series of actions</td>
</tr>
<tr>
<td>platform</td>
<td>009</td>
<td>vehicle or other support base that holds a sensor</td>
</tr>
<tr>
<td>process</td>
<td>010</td>
<td>method of doing something involving a number of steps</td>
</tr>
<tr>
<td>program</td>
<td>011</td>
<td>specific planned activity</td>
</tr>
<tr>
<td>project</td>
<td>012</td>
<td>organized undertaking, research, or development</td>
</tr>
<tr>
<td>study</td>
<td>013</td>
<td>examination or investigation</td>
</tr>
<tr>
<td>task</td>
<td>014</td>
<td>piece of work</td>
</tr>
<tr>
<td>trial</td>
<td>015</td>
<td>process of testing to discover or demonstrate something</td>
</tr>
</tbody>
</table>
### C.8 MD_CellGeometryCode - code indicating whether grid data is point or area

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>point</td>
<td>001</td>
<td>each cell represents a point</td>
</tr>
<tr>
<td>area</td>
<td>002</td>
<td>each cell represents an area</td>
</tr>
</tbody>
</table>

### C.9 MD_CharacterSetCode – name of the character coding standard used for the resource

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ucs2</td>
<td>001</td>
<td>16-bit fixed size Universal Character Set, based on ISO/IEC 10646</td>
</tr>
<tr>
<td>ucs4</td>
<td>002</td>
<td>32-bit fixed size Universal Character Set, based on ISO/IEC 10646</td>
</tr>
<tr>
<td>utf7</td>
<td>003</td>
<td>7-bit variable size UCS Transfer Format, based on ISO/IEC 10646</td>
</tr>
<tr>
<td>utf8</td>
<td>004</td>
<td>8-bit variable size UCS Transfer Format, based on ISO/IEC 10646</td>
</tr>
<tr>
<td>utf16</td>
<td>005</td>
<td>16-bit variable size UCS Transfer Format, based on ISO/IEC 10646</td>
</tr>
<tr>
<td>8859part1</td>
<td>006</td>
<td>ISO/IEC 8859-1, Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1</td>
</tr>
<tr>
<td>8859part2</td>
<td>007</td>
<td>ISO/IEC 8859-2, Information technology – 8-bit single-byte coded graphic character sets – Part 2: Latin alphabet No. 2</td>
</tr>
<tr>
<td>8859part5</td>
<td>010</td>
<td>ISO/IEC 8859-51, Information technology – 8-bit single-byte coded graphic character sets – Part 5: Latin/Cyrillic alphabet</td>
</tr>
<tr>
<td>8859part6</td>
<td>011</td>
<td>ISO/IEC 8859-6, Information technology – 8-bit single-byte coded graphic character sets – Part 6: Latin/Arabic alphabet</td>
</tr>
<tr>
<td>8859part7</td>
<td>012</td>
<td>ISO/IEC 8859-7, Information technology – 8-bit single-byte coded graphic character sets – Part 7: Latin/Greek alphabet</td>
</tr>
<tr>
<td>8859part8</td>
<td>013</td>
<td>ISO/IEC 8859-8, Information technology – 8-bit single-byte coded graphic character sets – Part 8: Latin/Hebrew alphabet</td>
</tr>
<tr>
<td>8859part9</td>
<td>014</td>
<td>ISO/IEC 8859-9, Information technology – 8-bit single-byte coded graphic character sets – Part 9: Latin alphabet No. 5</td>
</tr>
<tr>
<td>8859part10</td>
<td>015</td>
<td>ISO/IEC 8859-10, Information technology – 8-bit single-byte coded graphic character sets – Part 10: Latin alphabet No. 6</td>
</tr>
<tr>
<td>(reserved for future use)</td>
<td>017</td>
<td>a future ISO/IEC 8-bit single-byte coded graphic character set (e.g., possibly 8859 part 12)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8859part14</td>
<td>019</td>
<td>ISO/IEC 8859-14, Information technology – 8-bit single-byte coded graphic character sets – Part 14: Latin alphabet No. 8 (Celtic)</td>
</tr>
<tr>
<td>8859part16</td>
<td>021</td>
<td>ISO/IEC 8859-16, Information technology – 8-bit single-byte coded graphic character sets – Part 16: Latin alphabet No. 10</td>
</tr>
<tr>
<td>Jis</td>
<td>022</td>
<td>Japanese code set used for electronic transmission</td>
</tr>
<tr>
<td>shiftJIS</td>
<td>023</td>
<td>Japanese code set used on MS-DOS based machines</td>
</tr>
<tr>
<td>eucJP</td>
<td>024</td>
<td>Japanese code set used on UNIX based machines</td>
</tr>
<tr>
<td>usAscii</td>
<td>025</td>
<td>United States ASCII code set (ISO 646 US)</td>
</tr>
<tr>
<td>ebcDIC</td>
<td>026</td>
<td>IBM mainframe code set</td>
</tr>
<tr>
<td>eucKR</td>
<td>027</td>
<td>Korean code set</td>
</tr>
<tr>
<td>big5</td>
<td>028</td>
<td>Traditional Chinese code set used in Taiwan, Hong Kong of China and other areas</td>
</tr>
<tr>
<td>GB2312</td>
<td>029</td>
<td>Simplified Chinese code set</td>
</tr>
</tbody>
</table>

**C.10 MD_ClassificationCode** - name of the handling restrictions on the dataset

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>unclassified</td>
<td>001</td>
<td>Available for general disclosure</td>
</tr>
<tr>
<td>restricted</td>
<td>002</td>
<td>Not for general disclosure</td>
</tr>
<tr>
<td>confidential</td>
<td>003</td>
<td>Available for someone who can be entrusted with information</td>
</tr>
<tr>
<td>secret</td>
<td>004</td>
<td>Kept or meant to be kept private, unknown, or hidden from all but a select group of people</td>
</tr>
<tr>
<td>topSecret</td>
<td>005</td>
<td>Of the highest secrecy</td>
</tr>
</tbody>
</table>

**C.11 MD_CoverageContentTypeCode** - specific type of information represented in the cell

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>image</td>
<td>001</td>
<td>Meaningful numerical representation of a physical parameter that is not the actual value of the physical parameter</td>
</tr>
<tr>
<td>thematicClassification</td>
<td>002</td>
<td>Code value with no quantitative meaning, used to represent a physical quantity</td>
</tr>
<tr>
<td>physicalMeasurement</td>
<td>003</td>
<td>Value in physical units of the quantity being measured</td>
</tr>
</tbody>
</table>
### C.12 MD_DatatypeCode - datatype of element or entity

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>class</td>
<td>001</td>
<td>descriptor of a set of objects that share the same attributes, operations, methods, relationships, and behavior</td>
</tr>
<tr>
<td>codelist</td>
<td>002</td>
<td>flexible enumeration useful for expressing a long list of values, can be extended</td>
</tr>
<tr>
<td>enumeration</td>
<td>003</td>
<td>data type whose instances form a list of named literal values, not extendable</td>
</tr>
<tr>
<td>codelistElement</td>
<td>004</td>
<td>permissible value for a codelist or enumeration</td>
</tr>
<tr>
<td>abstractClass</td>
<td>005</td>
<td>class that cannot be directly instantiated</td>
</tr>
<tr>
<td>aggregateClass</td>
<td>006</td>
<td>class that is composed of classes it is connected to by an aggregate relationship</td>
</tr>
<tr>
<td>specifiedClass</td>
<td>007</td>
<td>subclass that may be substituted for its superclass</td>
</tr>
<tr>
<td>datatypeClass</td>
<td>008</td>
<td>class with few or no operations whose primary purpose is to hold the abstract state of another class for transmittal, storage, encoding or persistent storage</td>
</tr>
<tr>
<td>interfaceClass</td>
<td>009</td>
<td>named set of operations that characterize the behavior of an element</td>
</tr>
<tr>
<td>unionClass</td>
<td>010</td>
<td>class describing a selection of one of the specified types</td>
</tr>
<tr>
<td>metaClass</td>
<td>011</td>
<td>class whose instances are classes</td>
</tr>
<tr>
<td>typeClass</td>
<td>012</td>
<td>class used for specification of a domain of instances (objects), together with the operations applicable to the objects. A type may have attributes and associations</td>
</tr>
<tr>
<td>characterString</td>
<td>013</td>
<td>free text field</td>
</tr>
<tr>
<td>integer</td>
<td>014</td>
<td>numerical field</td>
</tr>
<tr>
<td>association</td>
<td>015</td>
<td>semantic relationship between two classes that involves connections among their instances</td>
</tr>
</tbody>
</table>

### C.13 MD_DimensionNameTypeCode - name of the dimension

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>row</td>
<td>001</td>
<td>ordinate (y) axis</td>
</tr>
<tr>
<td>column</td>
<td>002</td>
<td>abscissa (x) axis</td>
</tr>
<tr>
<td>vertical</td>
<td>003</td>
<td>vertical (z) axis</td>
</tr>
<tr>
<td>track</td>
<td>004</td>
<td>along the direction of motion of the scan point</td>
</tr>
<tr>
<td>crossTrack</td>
<td>005</td>
<td>perpendicular to the direction of motion of the scan point</td>
</tr>
<tr>
<td>line</td>
<td>006</td>
<td>scan line of a sensor</td>
</tr>
<tr>
<td>sample</td>
<td>007</td>
<td>element along a scan line</td>
</tr>
<tr>
<td>time</td>
<td>008</td>
<td>duration</td>
</tr>
</tbody>
</table>
### C.14 MD_GeometricObjectTypeCode - name of point or vector objects used to locate zero-, one-, two-, or three-dimensional spatial locations in the dataset

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>complex</td>
<td>001</td>
<td>set of geometric primitives such that their boundaries can be represented as a union of other primitives</td>
</tr>
<tr>
<td>composite</td>
<td>002</td>
<td>connected set of curves, solids or surfaces</td>
</tr>
<tr>
<td>curve</td>
<td>003</td>
<td>bounded, 1-dimensional geometric primitive, representing the continuous image of a line</td>
</tr>
<tr>
<td>point</td>
<td>004</td>
<td>zero-dimensional geometric primitive, representing a position but not having an extent</td>
</tr>
<tr>
<td>solid</td>
<td>005</td>
<td>bounded, connected 3-dimensional geometric primitive, representing the continuous image of a region of space</td>
</tr>
<tr>
<td>surface</td>
<td>006</td>
<td>bounded, connected 2-dimensional geometric primitive, representing the continuous image of a region of a plane</td>
</tr>
</tbody>
</table>

### C.15 MD_ImagingConditionCode - code which indicates conditions which may affect the image

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>blurredImage</td>
<td>001</td>
<td>portion of the image is blurred</td>
</tr>
<tr>
<td>cloud</td>
<td>002</td>
<td>portion of the image is partially obscured by cloud cover</td>
</tr>
<tr>
<td>degradingObliquity</td>
<td>003</td>
<td>acute angle between the plane of the ecliptic (the plane of the Earth’s orbit) and the plane of the celestial equator</td>
</tr>
<tr>
<td>fog</td>
<td>004</td>
<td>portion of the image is partially obscured by fog</td>
</tr>
<tr>
<td>heavySmokeOrDust</td>
<td>005</td>
<td>portion of the image is partially obscured by heavy smoke or dust</td>
</tr>
<tr>
<td>night</td>
<td>006</td>
<td>image was taken at night</td>
</tr>
<tr>
<td>rain</td>
<td>007</td>
<td>image was taken during rainfall</td>
</tr>
<tr>
<td>semiDarkness</td>
<td>008</td>
<td>image was taken during semi-dark conditions—twilight conditions</td>
</tr>
<tr>
<td>shadow</td>
<td>009</td>
<td>portion of the image is obscured by shadow</td>
</tr>
<tr>
<td>snow</td>
<td>010</td>
<td>portion of the image is obscured by snow</td>
</tr>
<tr>
<td>terrainMasking</td>
<td>011</td>
<td>the absence of collection data of a given point or area caused by the relative location of topographic features which obstruct the collection path between the collector(s) and the subject(s) of interest</td>
</tr>
</tbody>
</table>

### C.16 MD_KeywordTypeCode - methods used to group similar keywords

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>discipline</td>
<td>001</td>
<td>keyword identifies a branch of instruction or specialized learning</td>
</tr>
<tr>
<td>place</td>
<td>002</td>
<td>keyword identifies a location</td>
</tr>
</tbody>
</table>
### stratum
- **Domain code**: 003
- **Definition**: keyword identifies the layer(s) of any deposited substance

### temporal
- **Domain code**: 004
- **Definition**: keyword identifies a time period related to the dataset

### theme
- **Domain code**: 005
- **Definition**: keyword identifies a particular subject or topic

### C.17 MD_MaintenanceFrequencyCode - frequency with which modifications and deletions are made to the data after it is first produced

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>continual</td>
<td>001</td>
<td>data is repeatedly and frequently updated</td>
</tr>
<tr>
<td>daily</td>
<td>002</td>
<td>data is updated each day</td>
</tr>
<tr>
<td>weekly</td>
<td>003</td>
<td>data is updated on a weekly basis</td>
</tr>
<tr>
<td>fortnightly</td>
<td>004</td>
<td>data is updated every two weeks</td>
</tr>
<tr>
<td>monthly</td>
<td>005</td>
<td>data is updated each month</td>
</tr>
<tr>
<td>quarterly</td>
<td>006</td>
<td>data is updated every three months</td>
</tr>
<tr>
<td>biannually</td>
<td>007</td>
<td>data is updated twice each year</td>
</tr>
<tr>
<td>annually</td>
<td>008</td>
<td>data is updated every year</td>
</tr>
<tr>
<td>asNeeded</td>
<td>009</td>
<td>data is updated as deemed necessary</td>
</tr>
<tr>
<td>irregular</td>
<td>010</td>
<td>data is updated in intervals that are uneven in duration</td>
</tr>
<tr>
<td>notPlanned</td>
<td>011</td>
<td>there are no plans to update the data</td>
</tr>
<tr>
<td>unknown</td>
<td>012</td>
<td>frequency of maintenance for the data is not known</td>
</tr>
</tbody>
</table>

### C.18 MD_MediumFormatCode - method used to write to the medium

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>cpio</td>
<td>001</td>
<td>Copy In / Out (UNIX file format and command)</td>
</tr>
<tr>
<td>tar</td>
<td>002</td>
<td>Tape Archive</td>
</tr>
<tr>
<td>highSierra</td>
<td>003</td>
<td>high sierra file system</td>
</tr>
<tr>
<td>iso9660</td>
<td>004</td>
<td>information processing – volume and file structure of CD-ROM</td>
</tr>
<tr>
<td>iso9660RockRidge</td>
<td>005</td>
<td>rock ridge interchange protocol (UNIX)</td>
</tr>
<tr>
<td>iso9660AppleHFS</td>
<td>006</td>
<td>hierarchical file system (Macintosh)</td>
</tr>
</tbody>
</table>

### C.19 MD_MediumNameCode - name of the medium

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>cdRom</td>
<td>001</td>
<td>read-only optical disk</td>
</tr>
<tr>
<td>dvd</td>
<td>002</td>
<td>digital versatile disk</td>
</tr>
<tr>
<td>dvdRom</td>
<td>003</td>
<td>digital versatile disk, read only</td>
</tr>
<tr>
<td>3halfinchFloppy</td>
<td>004</td>
<td>3.5 inch magnetic disk</td>
</tr>
<tr>
<td>5quarterInchFloppy</td>
<td>005</td>
<td>5.25 inch magnetic disk</td>
</tr>
<tr>
<td>7trackTape</td>
<td>006</td>
<td>7 track magnetic tape</td>
</tr>
<tr>
<td>9trackTape</td>
<td>007</td>
<td>9 track magnetic tape</td>
</tr>
<tr>
<td>3480Cartridge</td>
<td>008</td>
<td>3480 cartridge tape drive</td>
</tr>
<tr>
<td>3490Cartridge</td>
<td>009</td>
<td>3490 cartridge tape drive</td>
</tr>
</tbody>
</table>
### Cartridge

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3580Cartridge</td>
<td>010</td>
<td>3580 cartridge tape drive</td>
</tr>
<tr>
<td>4mmCartridgeTape</td>
<td>011</td>
<td>4 millimeter magnetic tape</td>
</tr>
<tr>
<td>8mmCartridgeTape</td>
<td>012</td>
<td>8 millimeter magnetic tape</td>
</tr>
<tr>
<td>1quarterInchCartridgeTape</td>
<td>013</td>
<td>0.25 inch magnetic tape</td>
</tr>
<tr>
<td>digitalLinearTape</td>
<td>014</td>
<td>half inch cartridge streaming tape drive</td>
</tr>
<tr>
<td>onLine</td>
<td>015</td>
<td>direct computer linkage</td>
</tr>
<tr>
<td>satellite</td>
<td>016</td>
<td>linkage through a satellite communication system</td>
</tr>
<tr>
<td>telephoneLink</td>
<td>017</td>
<td>communication through a telephone network</td>
</tr>
<tr>
<td>hardcopy</td>
<td>018</td>
<td>pamphlet or leaflet giving descriptive information</td>
</tr>
</tbody>
</table>

### C.20 MD_ObligationCode - obligation of the element or entity

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>mandatory</td>
<td>001</td>
<td>element is always required</td>
</tr>
<tr>
<td>optional</td>
<td>002</td>
<td>element is not required</td>
</tr>
<tr>
<td>conditional</td>
<td>003</td>
<td>element is required when a specific condition is met</td>
</tr>
</tbody>
</table>

### C.21 MD_PixelOrientationCode - point in a pixel corresponding to the Earth location of the pixel

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>center</td>
<td>001</td>
<td>point halfway between the lower left and the upper right of the pixel</td>
</tr>
<tr>
<td>lowerLeft</td>
<td>002</td>
<td>the corner in the pixel closest to the origin of the SRS; if two are at the same distance from the origin, the one with the smallest x-value</td>
</tr>
<tr>
<td>lowerRight</td>
<td>003</td>
<td>next corner counterclockwise from the lower left</td>
</tr>
<tr>
<td>upperRight</td>
<td>004</td>
<td>next corner counterclockwise from the lower right</td>
</tr>
<tr>
<td>upperLeft</td>
<td>005</td>
<td>next corner counterclockwise from the upper right</td>
</tr>
</tbody>
</table>

### C.22 MD_ProgressCode - status of the dataset or progress of a review

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>completed</td>
<td>001</td>
<td>production of the data has been completed</td>
</tr>
<tr>
<td>historicalArchive</td>
<td>002</td>
<td>data has been stored in an offline storage facility</td>
</tr>
<tr>
<td>obsolete</td>
<td>003</td>
<td>data is no longer relevant</td>
</tr>
<tr>
<td>onGoing</td>
<td>004</td>
<td>data is continually being updated</td>
</tr>
<tr>
<td>planned</td>
<td>005</td>
<td>fixed date has been established upon or by which the data will be created or updated</td>
</tr>
<tr>
<td>required</td>
<td>006</td>
<td>data needs to be generated or updated</td>
</tr>
<tr>
<td>underDevelopment</td>
<td>007</td>
<td>data is currently in the process of being created</td>
</tr>
</tbody>
</table>
### C.23 MD_RestrictionCode - limitation(s) placed upon the access or use of the data

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>copyright</td>
<td>001</td>
<td>exclusive right to the publication, production, or sale of the rights to a literary, dramatic, musical, or artistic work, or to the use of a commercial print or label, granted by law for a specified period of time to an author, composer, artist, distributor</td>
</tr>
<tr>
<td>patent</td>
<td>002</td>
<td>government has granted exclusive right to make, sell, use or license an invention or discovery</td>
</tr>
<tr>
<td>patentPending</td>
<td>003</td>
<td>produced or sold information awaiting a patent</td>
</tr>
<tr>
<td>trademark</td>
<td>004</td>
<td>a name, symbol, or other device identifying a product, officially registered and legally restricted to the use of the owner or manufacturer</td>
</tr>
<tr>
<td>license</td>
<td>005</td>
<td>formal permission to do something</td>
</tr>
<tr>
<td>intellectualPropertyRights</td>
<td>006</td>
<td>rights to financial benefit from and control of distribution of non-tangible property that is a result of creativity</td>
</tr>
<tr>
<td>restricted</td>
<td>007</td>
<td>withheld from general circulation or disclosure</td>
</tr>
<tr>
<td>otherRestrictions</td>
<td>008</td>
<td>limitation not listed</td>
</tr>
</tbody>
</table>

### C.24 MD_ScopeCode - class of information to which the referencing entity applies

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute</td>
<td>001</td>
<td>information applies to the attribute class</td>
</tr>
<tr>
<td>attributeType</td>
<td>002</td>
<td>information applies to the characteristic of a feature</td>
</tr>
<tr>
<td>collectionHardware</td>
<td>003</td>
<td>information applies to the collection hardware class</td>
</tr>
<tr>
<td>collectionSession</td>
<td>004</td>
<td>information applies to the collection session</td>
</tr>
<tr>
<td>dataset</td>
<td>005</td>
<td>information applies to the dataset</td>
</tr>
<tr>
<td>series</td>
<td>006</td>
<td>information applies to the series</td>
</tr>
<tr>
<td>nonGeographicDataset</td>
<td>007</td>
<td>information applies to non-geographic data</td>
</tr>
<tr>
<td>dimensionGroup</td>
<td>008</td>
<td>information applies to a dimension group</td>
</tr>
<tr>
<td>feature</td>
<td>009</td>
<td>information applies to a feature</td>
</tr>
<tr>
<td>featureType</td>
<td>010</td>
<td>information applies to a feature type</td>
</tr>
<tr>
<td>propertyType</td>
<td>011</td>
<td>information applies to a property type</td>
</tr>
<tr>
<td>fieldSession</td>
<td>012</td>
<td>information applies to a field session</td>
</tr>
<tr>
<td>software</td>
<td>013</td>
<td>information applies to a computer program or routine</td>
</tr>
<tr>
<td>service</td>
<td>014</td>
<td>information applies to a capability which a service provider entity makes available to a service user entity through a set of interfaces that define a behaviour, such as a use case</td>
</tr>
</tbody>
</table>
model | 015 | information applies to a copy or imitation of an existing or hypothetical object

| tile | 016 | information applies to a tile, a spatial subset of geographic data

C.25 MD_SpatialRepresentationTypeCode - method used to represent geographic information in the dataset

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>vector</td>
<td>001</td>
<td>vector data is used to represent geographic data</td>
</tr>
<tr>
<td>grid</td>
<td>002</td>
<td>grid data is used to represent geographic data</td>
</tr>
<tr>
<td>textTable</td>
<td>003</td>
<td>textual or tabular data is used to represent geographic data</td>
</tr>
<tr>
<td>tin</td>
<td>004</td>
<td>triangulated irregular network</td>
</tr>
<tr>
<td>stereoModel</td>
<td>005</td>
<td>three-dimensional view formed by the intersecting homologous rays of an overlapping pair of images</td>
</tr>
<tr>
<td>video</td>
<td>006</td>
<td>scene from a video recording</td>
</tr>
</tbody>
</table>

C.25 MD_TopicCategoryCode - high-level geographic data thematic classification to assist in the grouping and search of available geographic data sets. Can be used to group keywords as well. Listed examples are not exhaustive.

NOTE: It is understood there are overlaps between general categories and the user is encouraged to select the one most appropriate.

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>farming</td>
<td>001</td>
<td>rearing of animals and/or cultivation of plants</td>
</tr>
<tr>
<td>biota</td>
<td>002</td>
<td>flora and/or fauna in natural environment</td>
</tr>
<tr>
<td>boundaries</td>
<td>003</td>
<td>legal land descriptions</td>
</tr>
<tr>
<td>climatology-Meteorology-Atmosphere</td>
<td>004</td>
<td>processes and phenomena of the atmosphere</td>
</tr>
<tr>
<td>economy</td>
<td>005</td>
<td>economic activities, conditions and employment</td>
</tr>
<tr>
<td>elevation</td>
<td>006</td>
<td>height above or below sea level</td>
</tr>
<tr>
<td>environment</td>
<td>007</td>
<td>environmental resources, protection and conservation</td>
</tr>
<tr>
<td>Category</td>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>geoscientificInformation</td>
<td>008</td>
<td>information pertaining to earth sciences Examples: geophysical features and processes, geology, minerals, sciences dealing with the composition, structure and origin of the earth’s rocks, risks of earth-quakes, volcanic activity, landslides, gravity information, soils, permafrost, hydrogeology, erosion</td>
</tr>
<tr>
<td>health</td>
<td>009</td>
<td>health, health services, human ecology, and safety Examples: disease and illness, factors affecting health, hygiene, substance abuse, mental and physical health, health services</td>
</tr>
<tr>
<td>imageryBaseMapsEarthCover</td>
<td>010</td>
<td>base maps Examples: land cover, topographic maps, imagery, unclassified images, annotations</td>
</tr>
<tr>
<td>intelligenceMilitary</td>
<td>011</td>
<td>military bases, structures, activities Examples: barracks, training grounds, military transportation, information collection</td>
</tr>
<tr>
<td>inlandWaters</td>
<td>012</td>
<td>inland water features, drainage systems and their characteristics Examples: rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, hydrographic charts</td>
</tr>
<tr>
<td>location</td>
<td>013</td>
<td>positional information and services Examples: addresses, geodetic networks, control points, postal zones and services, place names</td>
</tr>
<tr>
<td>oceans</td>
<td>014</td>
<td>features and characteristics of salt water bodies (excluding inland waters) Examples: tides, tidal waves, coastal information, reefs</td>
</tr>
<tr>
<td>planningCadastre</td>
<td>015</td>
<td>information used for appropriate actions for future use of the land Examples: land use maps, zoning maps, cadastral surveys, land ownership</td>
</tr>
<tr>
<td>society</td>
<td>016</td>
<td>characteristics of society and cultures Examples: settlements, anthropology, archaeology, education, traditional beliefs, manners and customs, demographic data, recreational areas and activities, social impact assessments, crime and justice, census information</td>
</tr>
<tr>
<td>structure</td>
<td>017</td>
<td>man-made construction Examples: buildings, museums, churches, factories, housing, monuments, shops, towers</td>
</tr>
<tr>
<td>transportation</td>
<td>018</td>
<td>means and aids for conveying persons and/or goods Examples: roads, airports/airstrips, shipping routes, tunnels, nautical charts, vehicle or vessel location, aeronautical charts, railways</td>
</tr>
<tr>
<td>utilitiesCommunication</td>
<td>019</td>
<td>energy, water and waste systems and communications infrastructure and services Examples: hydroelectricity, geothermal, solar and nuclear sources of energy, water purification and distribution, sewage collection and disposal,</td>
</tr>
</tbody>
</table>
C.26 MD_TrafficNetworkServiceCategory
- industry: electricity and gas distribution, data communication, telecommunication, radio, communication networks

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>geometryOnly</td>
<td>001</td>
<td>geometry objects without any additional structure which describes topology</td>
</tr>
<tr>
<td>topology1D</td>
<td>002</td>
<td>1-dimensional topological complex – commonly called ‘chain-node’ topology</td>
</tr>
<tr>
<td>planarGraph</td>
<td>003</td>
<td>1-dimensional topological complex that is planar. (A planar graph is a graph that can be drawn in a plane in such a way that no two edges intersect except at a vertex.)</td>
</tr>
<tr>
<td>fullPlanarGraph</td>
<td>004</td>
<td>2-dimensional topological complex that is planar. (A 2-dimensional topological complex is commonly called ‘full topology” in a cartographic 2D environment.)</td>
</tr>
<tr>
<td>surfaceGraph</td>
<td>005</td>
<td>1-dimensional topological complex that is isomorphic to a subset of a surface. (A geometric complex is isomorphic to a topological complex if their elements are in a one-to-one, dimensional- and boundary-preserving correspondence to one another.)</td>
</tr>
<tr>
<td>fullSurfaceGraph</td>
<td>006</td>
<td>2-dimensional topological complex that is isomorphic to a subset of a surface</td>
</tr>
<tr>
<td>topology3D</td>
<td>007</td>
<td>3-dimensional topological complex. (A topological complex is a collection of topological primitives that are closed under the boundary operations.)</td>
</tr>
<tr>
<td>fullTopology3D</td>
<td>008</td>
<td>complete coverage of a 3D Euclidean coordinate space</td>
</tr>
<tr>
<td>abstract</td>
<td>009</td>
<td>topological complex without any specified geometric realisation</td>
</tr>
</tbody>
</table>
**ANNEX D. Units**

**D.1 BaseUnit**

<table>
<thead>
<tr>
<th>Name</th>
<th>Unit Symbol</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>metre</td>
<td>m</td>
<td>length</td>
</tr>
<tr>
<td>kilogram</td>
<td>kg</td>
<td>mass</td>
</tr>
<tr>
<td>second</td>
<td>s</td>
<td>time</td>
</tr>
<tr>
<td>ampere</td>
<td>A</td>
<td>electric current</td>
</tr>
<tr>
<td>kelvin</td>
<td>K</td>
<td>thermodynamic temperature</td>
</tr>
<tr>
<td>candela</td>
<td>cd</td>
<td>luminous intensity</td>
</tr>
<tr>
<td>mole</td>
<td>mol</td>
<td>amount of substance</td>
</tr>
</tbody>
</table>

BaseUnit – A base unit is a unit of measure that cannot be derived by combination of other base units within a particular system of units. For example, in the SI system of units, the base units are metre, kilogram, second, ampere, kelvin, mole, and candela, for the physical quantity types of length, mass, time interval, electric current, thermodynamic temperature, amount of substance and luminous intensity, respectively.

Type: compound
Multiplicity: optional
Attributes: id
Best Practices: The id attribute is mandatory. It is recommend to reference the International System of Units (SI) at http://www.bipm.org/en/si/.

**identifier** – Special identifier assigned to the unit by the maintaining authority.

Multiplicity: mandatory
Attributes: codeSpace
Best Practices: The codeSpace attribute is mandatory.

**unitsSystem** – Reference to the maintaining authority or system of the unit.

Multiplicity: mandatory
Attributes: type, href, role, arcrole, title, show, actuate, uuidref, nilReason

Ex:
```
<gml:BaseUnit gml:id="lengthUnit">
  <gml:identifier codeSpace="meters"/>
</gml:BaseUnit>
```

**D.2 DerivedUnit**

DerivedUnit - Units formed from the multiplication and division of the seven base units.

Type: compound
Multiplicity: optional
Attributes: id
Best Practices: The id attribute is mandatory.
FAQ: What is an example of a derived unit?

<table>
<thead>
<tr>
<th>Name</th>
<th>Unit Symbol</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>metre per second</td>
<td>m/s</td>
<td>unit of speed</td>
</tr>
<tr>
<td>ohm</td>
<td>Ω (m²<em>kg</em>s⁻²*A⁻¹)</td>
<td>electrical resistance</td>
</tr>
</tbody>
</table>

identifier - Special identifier assigned to the unit by the maintaining authority.
- Multiplicity: mandatory
- Attributes: codeSpace
- Best Practices: The codeSpace attribute is mandatory.

derivationUnitTerm - Describes a derived unit of measure. This unit term references another unit of measure (uom) and provides an integer exponent applied to that unit in defining the compound unit.
- Multiplicity: mandatory, repeatable
- Attributes: uom, exponent
- Best Practices: The uom attribute is mandatory. The exponent attribute may be positive or negative, but not zero.

FAQ: How would you document mass density measured in kg/m³?

```xml
<gml:DerivedUnit gml:id="massDensity">
  <gml:identifier codeSpace="mass density"/>
  <gml:derivationUnitTerm uom="kg" exponent="1"/>
  <gml:derivationUnitTerm uom="m" exponent="-3"/>
</gml:DerivedUnit>
```

D.3 ConventionalUnit
ConventionalUnit – A unit of measure for which there is a conversion to a Base Unit.
- Type: compound
- Multiplicity: optional
- Attributes: id
- Best Practices: The id attribute is mandatory.

identifier – Special identifier assigned to the unit by the maintaining authority.
- Multiplicity: mandatory
- Attributes: codeSpace
- Best Practices: The codeSpace attribute is mandatory.

collectionToPreferredUnit – Parameters used to convert conventional units to preferred units.
- Type: factor or formula
- Multiplicity: conditional
- Attributes: uom
- Best Practices: There must be one occurrence of either conversionToPreferredUnit or roughConversionUnit. The uom attribute is mandatory.

factor – Scale factor for the conversion.
- Domain: any number
- Multiplicity: conditional
Best Practices: There must be one occurrence of either factor or formula.

**formula** – Formula for the conversion.
  Type: compound
  Multiplicity: conditional
  Best Practices: There must be once occurrence of either factor or formula. Formula consists of the elements a, b, c, and d; b and c are mandatory.

roughConversionToPreferredUnit – Parameters used to convert conventional units to preferred units.
  Type: factor or formula
  Multiplicity: conditional
  Attributes: uom
  Best Practices: There must be one occurrence of either conversionToPreferredUnit or roughConversionUnit. The uom attribute is mandatory.

**factor** – Scale factor for the conversion.
  Domain: any number
  Multiplicity: conditional
  Best Practices: There must be one occurrence of either factor or formula.

**FAQ:** How would you show the conversion for the unit ‘foot’ to ‘meters’ using the factor element?

```xml
<gml:ConventionalUnit gml:id="ft">
  <gml:identifier codeSpace="foot"/>
  <gml:conversionToPreferredUnit uom="m">
    <gml:factor>0.305</gml:factor>
  </gml:conversionToPreferredUnit>
</gml:ConventionalUnit>
```

In this case, the factor element contains a scale factor of 0.305. The scale factor is multiplied by the value of the conventional unit of measure (foot) to obtain the corresponding value for the preferred unit of measure (metre).

**formula** – Formula for the conversion.
  Type: compound
  Multiplicity: conditional
  Best Practices: There must be once occurrence of either factor or formula. Formula consists of the elements a, b, c, and d; b and c are mandatory.

**FAQ:** How would you show the conversion for the unit ‘Celsius’ to ‘Kelvin’ using the formula element?

```xml
<gml:ConventionalUnit gml:id="degC">
  <gml:identifier codeSpace="degree Celsius"/>
  <gml:conversionToPreferredUnit uom="K">
    <gml:formula>
      <gml:a>273.15</gml:a>
      <gml:b>1</gml:b>
      <gml:c>1</gml:c>
    </gml:formula>
  </gml:conversionToPreferredUnit>
</gml:ConventionalUnit>
```
The formula element can contain the four elements, a, b, c and d, whose values provide the parameters for converting the value of the conventional unit of measure (degrees Celsius) to the corresponding value for the preferred unit of measure (Kelvin). The values of the elements a, b, c and d are used in the formula \( y = \frac{a + bx}{c + dx} \), where x is a value using the current unit, and y is the corresponding value using the preferred unit. Elements a and d are optional. If those values are not provided, then those parameters are considered to be zero. The example above shows the conversion of Celsius to Kelvin so the formula becomes—

\[ K = 273.15 + C. \]
Unified Modeling Language (UML) is used to represent the relationships among classes and objects in object oriented programming.

**E.1 UML Notation**

Relationships can be represented in the ISO UML models as associations, aggregations, compositions, generalizations, and dependencies.

**Association**

Associations are general relationships between classes, if direction is not specified it is assumed to be a two-way association. Arrows marking an end of a line mark the direction of an association. The model will also show the ‘role’ of the target object in relation to the source object.

**Aggregation**

Aggregations are when one class is the ‘container’ and the other class is within/inside

Ex: MD_Metadata ‘contains’ MD_Distribution

**Composition**

Compositions are also known as strong aggregations. Compositions are used when the parts inside the container cannot exist without the container. If the container is deleted, then all of the objects ‘inside’ the container are deleted as well.
Generalization
Generalizations show depict a superclass and subclasses that may be substituted for the superclass

Ex: General overall constraints are documents through MD_Constraints but the subclass
MD_SecurityConstraints can substitute it’s Superclass MD_Constraints (Security constraints has the same
objects as MD_Constraints but also adds a few more objects to specifically deal with documenting
constraints dealing with security.)

Dependency
Dependencies are also known as instantiation. Dependencies are kind of like an ‘IF’ statement.

Ex: If accessConstraints or useConstraints = “otherRestrictions” then “otherConstraints” must be used.

E.2 UML Cardinality
Multiplicity and cardinality are denoted on the UML associations to depict if classes are mandatory, optional, and
how many times they may repeat as noted in the table below.

<table>
<thead>
<tr>
<th>Association cardinality</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1..*</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td>Class</td>
</tr>
<tr>
<td></td>
<td>0..*</td>
<td>n</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td>Class</td>
</tr>
<tr>
<td></td>
<td>0..1</td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
E.3 Metadata Entity UML
E.4 Spatial Representation UML
E.5 Reference System UML
E.6 Metadata Extension UML

- **MD_Metadata**
  - (from Metadata entity set Information)
  - 0..*
    - +metadataExtensionInfo

- **MD_MetadataExtensionInformation**
  - + extensionOnlineResource [0..1] : CI_OnlineResource

- **MD_ExtendedElementInformation**
  - + name : CharacterString
  - + shortName [0..1] : CharacterString
  - + domainCode [0..1] : integer
  - + definition : CharacterString
  - + obligation [0..1] : MD_ObligationCode
  - + condition [0..1] : CharacterString
  - + dataType : MD_DatatypeCode
  - + maximumOccurrence [0..1] : CharacterString
  - + domainValue [0..1] : CharacterString
  - + parentEntity [1..*] : CharacterString
  - + rule : CharacterString
  - + rationale [0..*] : CharacterString
  - + source [1..*] : CI_RespParty

- **MD_ObligationCode**
  - + mandatory
  - + optional
  - + conditional

- **MD_DatatypeCode**
  - + class
  - + codelist
  - + enumeration
  - + codelistElement
  - + abstractClass
  - + aggregateClass
  - + specifiedClass
  - + datatypeClass
  - + interfaceClass
  - + unionClass
  - + metaClass
  - + typeClass
  - + characterString
  - + integer
  - + association

If "dataType" = 'codelistElement' then "domainCode" is mandatory
If "dataType" notEqual 'codelistElement' then "shortName" is mandatory
If "dataType" notEqual 'codelist', 'enumeration' or 'codelistElement' then "obligation", "maximumOccurrence" and "domainValue" are mandatory
If "obligation" = 'conditional' then "condition" is mandatory
E.7 Identification (Data and Services) UML

- **MD_Usage**
  - specificUsage: CharacterString
  - usageDate: Date
  - userDeterminedLimitations: CharacterString
  - userContactInfo: Contact

- **MD_Metadata**
  - from: Metadata</br>
  - constraints: ConstraintInformation</br>

- **MD_BrowseGraphic**
  - fileDescription: CharacterString</br>
  - fileType: CharacterString

- **MD_Format**
  - from: FormatInformation</br>

- **MD_Identifier**
  - resourceIdentifier: Identifier

- **MD_AggregateInformation**
  - aggregationInfo: Information

- **MD_KeywordTypeCode**
  - keyword: CharacterString</br>

- **MD_DataIdentification**
  - spatialRepresentationType: CharacterString</br>
  - temporal: CharacterString

- **MD_CharacterSetCode**
  - from: CharacterSetCode</br>

- **MD_Resolution**
  - spatialResolution: CharacterString

- **MD_RepresentativeFraction**
  - from: RepresentativeFraction</br>

- **MD_InitiativeTypeCode**
  - from: InitiativeTypeCode</br>

- **MD_SpatialRepresentationTypeCode**
  - from: SpatialRepresentationTypeCode

- **MD_Enumeration**
  - topicCategory: CharacterString</br>

- **MD_ReivativeType**
  - derivativeType: CharacterString

- **MD_Extension**
  - extension: CharacterString

- **MD_SpatialReferenceSystem**
  - from: SpatialReferenceSystem

- **MD_ServiceIdentification**
  - service: ServiceIdentification

- **MD_ConstrainedTime**
  - from: ConstrainedTime

- **MD_Software**
  - from: SoftwareInformation

- **MD_Trademark**
  - from: TrademarkInformation

- **MD_License**
  - from: LicenseInformation

- **MD_Contact**
  - from: ContactInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

- **MD_MultilingualResource**
  - from: MultilingualResource

- **MD_Metadata**
  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

- **MD_Metadata**
  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

- **MD_Metadata**
  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

- **MD_Metadata**
  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
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- **MD_Contact**
  - from: ContactInformation

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  - from: DataTypes

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  - from: SoftwareEnvironment

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  - from: MaintenanceInformation

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  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

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  - from: MaintenanceInformation

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  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

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  - from: SoftwareEnvironment

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  - from: DataTypes

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  - from: SoftwareEnvironment

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  - from: MaintenanceInformation

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  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

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  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

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  - from: DataTypes

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  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

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  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation

- **MD_Metadata**
  - from: Metadata</br>

- **MD_Constraint**
  - from: ConstraintInformation

- **MD_ContactRole**
  - from: ContactRole

- **MD_Contact**
  - from: ContactInformation

- **MD_DataType**
  - from: DataTypes

- **MD_SoftwareEnvironment**
  - from: SoftwareEnvironment

- **MD_MainteinanceOfInformation**
  - from: MaintenanceInformation
E.8 Content UML

```
+contentinfo
0..*
<<Abstract>>
MD_ContentInformation

MD_CoverageDescription
+ attributeDescription : RecordType
+ contentType : MD_CoverageContentTypeCode

<<CodeList>>
MD_CoverageContentTypeCode
+ image
  + thematicClassification
    + physicalMeasurement

<<CodeList>>
MD_ImpovingConditionCode
+ blurrimage
  + cloud
    + degradingObliquity
    + fog
    + heavySmokeOrDust
    + night
    + rain
    + semi Darkness
    + shadow
    + snow
    + terrainMasking

MD_ImpovingConditionCode
+ cloud

<<CodeList>>
MD_ImpovingConditionCode
+ cloud

MD_ImpovingConditionCode
+ cloud
```

*units* is mandatory if *maxValue* or *minValue* are provided.

MD_RangeDimension
+ sequenceIdentifier [0..1] : MemberName
+ descriptor [0..1] : CharacterString

MD_Band
+ maxvalue [0..1] : Real
+ minvalue [0..1] : Real
+ units [0..1] : UomLength
+ peakResponse [0..1] : Real
+ bitsPerValue [0..1] : Integer
+ toneGradation [0..1] : Integer
+ scaleFactor [0..1] : Real
+ offset [0..1] : Real

MD_FeatureCatalogueDescription
+ complianceCode [0..1] : Boolean
+ language [0..1] : CharacterString
+ includeInTheDataset : Boolean
+ featureTypes [0..1] : GenericName
+ featureCatalogueCitation [0..1] : CI_Citation

MD_ImageDescription
+ illuminationElevationAngle [0..1] : Real
+ illuminationAzimuthAngle [0..1] : Real
+ imagingCondition [0..1] : MD_ImpovingConditionCode
+ imageQualityCode [0..1] : MD_ImpovingConditionCode
+ cloudCoverPercentage [0..1] : Real
+ processingLevelCode [0..1] : MD_ImpovingConditionCode
+ compressionGenerationQuantity [0..1] : Integer
+ triangulationIndicator [0..1] : Boolean
+ radiometricCalibrationDataAvailability [0..1] : Boolean
+ cameraCalibrationInformationAvailability [0..1] : Boolean
+ filmDistortionInformationAvailability [0..1] : Boolean
+ lensDistortionInformationAvailability [0..1] : Boolean

<<Abstract>>
MD_ContentInformation

+ +contentinfo
0..*
```

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E.11 Portrayal Catalogue UML

MD_Metadata
(from Metadata entity set information)

+portrayalCatalogueInfo 0..∗

MD_PorrayalCatalogueReference
+ portrayalCatalogueCitation [1..*: CI_Citation
E.12 Constraint UML

E.13 Application Schema UML
E.14 Maintenance UML

```
+ metadataMaintenance 0..1
+ maintenanceAndUpdateFrequency . MD_MaintenanceFrequencyCode
+ dateOfNextUpdate [0..1] : Date
+ userDefinedMaintenanceFrequency [0..1] : TM_PeriodDuration
+ updateScope [0..1] : MD_ScopeCode
+ updateScopeDescription [0..1] : MD_ScopeDescription
+ maintenanceNote [0..*] : CharacterString
+ contact [0..*] : CI_ResponsibilityParty
```

```
<<CodeList>>
MD_MaintenanceFrequencyCode
++ continual
++ daily
++ weekly
++ monthly
++ quarterly
++ biannually
++ annually
++ asNeeded
++ irregular
++ notPlanned
++ unknown
```

```
<<Union>>
MD_ScopeDescription
++ attributes : Set<GF_AttributeType>
++ features : Set<GF_FeatureType>
++ featureInstances : Set<GF_FeatureType>
++ attributeInstances : Set<GF_AttributeType>
++ dataset : CharacterString
++ other : CharacterString
```

E.15 Extent UML

```
<<Abstract>>
EX_GeographicExtent
+ extentTypeCode [1..1] : boolean = "Y"

<<Abstract>>
EX_SpatialTemporalExtent
+ spatialExtent 1..*:

<<Abstract>>
EX_TemporalExtent
+ extent : TM_Primitive

<<Abstract>>
EX_VerticalExtent
+ minimumValue : Real
+ maximumValue : Real
+ unitsOfMeasure : UomLength
```

```
<<CodeList>>
EX_GeographicDescription
+ geographicIdentifier : MD_Bearer
```

```
<<Abstract>>
EX_GeographyBoundingBox
+ westBoundLongitude : Angle
+ eastBoundLongitude : Angle
+ southBoundLatitude : Angle
+ northBoundLatitude : Angle
```

```
<<Abstract>>
EX_SoundingPolygon
+ polygon [1..*] : GI_Object
```

```
<<Abstract>>
EX_SpatialTemporalExtent
+ temporalElement 0..*:
```

```
<<Abstract>>
EX_VerticalDescription
+ verticalElement 0..*:
```

```
SC_VerticalDatum
+ verticalDatum 1
```

(from Spatial Referencing by Coordinates)
E.16 Citation UML
E.17 Feature Catalogue UML