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NPSI MPRD 2.2

NAVAIR PORTABLE SOURCE INITIATIVE (NPSI) STANDARD FOR MATERIAL PROPERTIES REFERENCE DATABASE (MPRD)

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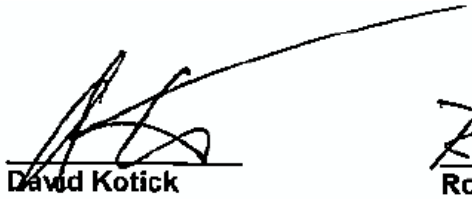

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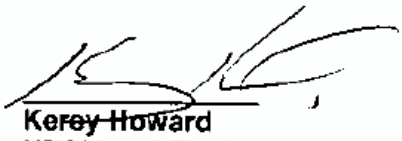

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The mission of NPSI is to provide maximum database reuse across Type/Model/Series platforms to lower the life cycle cost of out-the-window visual terrain, 3-D models, and sensor databases, along with dataset archive capability, and short-notice distribution services. To better facilitate sensor simulation interoperability, the NPSI Material Properties Reference Database (MPRD) was established as a component of the NPSI metadata architecture to provide a common set of material properties and a common mechanism for referencing and enumeration. This document is intended to serve as a reference for users of NPSI datasets containing MPRD attribution.

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1. Introduction

NPSI is a simple concept with a simple goal to minimize the waste and redundancy in database production without inhibiting innovation. The basic concept of NPSI is to capture value added work performed on raw source data. This concept has resulted in significant cost savings to many Department of Defense (DoD) programs by minimizing the amount of raw source data required to be purchased and processed. The NPSI archive stores refined source data in datasets and makes the datasets available for utilization by future programs. To better facilitate sensor simulation interoperability, the NPSI Material Properties Reference Database (MPRD) was established as a component of the NPSI metadata architecture to provide a common set of material properties and a common mechanism for referencing and enumeration. This document is intended to serve as a reference for users of NPSI datasets containing MPRD attribution.

1.1 XML and Material Markup Language (MatML)

The NPSI MPRD is intended to contain a catalog of material properties data and metadata that may be referenced in simulation datasets. Based on eXtensible Markup Language (XML) technology, the "container" is intended to be extensible, allowing new definitions of material properties and data types to be added progressively. However, the data structure must conform to a universal standardized format to allow interoperability and data interchange with minimum user intervention. The structural definition, logical relationships, and business rules of a database is summarized in a "schema." In XML technology, a schema is also a validating document that defines the "grammar" of an XML document. When an XML database document is validated against a schema, the structural conformity and business rules are enforced.

As an example, consider the following information table for metal:

Material ID	Description	Melting Point	Heat Capacity
MZ100	Metal, Titanium Alloy	1550 – 1600 Deg C	7 W/m-K

The data is presented in HTML as:

```
<tr>
<td> MZ100 </td>
<td> Metal, Titanium Alloy </td>
<td> 1550 – 1600 Deg C </td>
<td> 7 W/m-K </td>
<tr>
```

HTML represents the data in its display format; however, the collective identity and structure of the object are lost. In contrast, XML preserves the structure of the object by using custom tags that are descriptive to the nature of elements. Consider this generic example of XML formatted data:

```
<Metal>
        <Material ID> MZ100 </Material ID >
<Description> Metal, Titanium Alloy </Description>
        <Thermal Property>
                <Melting point>1550 – 1600 Deg C </Melting point >
                <Heat capacity> 7 W/m-K  </Heat capacity >
</Thermal Property>
</Metal>
```

The focus of XML is the data and the structure of the data. The meaningful nature of the components promotes the interchangeability of the data across heterogeneous platforms. The self-documentation and structure preservation inherent in XML facilitates interoperability between applications, as desired under the NPSI program.

The Material Markup Language (MatML) XML schema has been adopted and extended as the basis for MPRD schema. The National Institute of Standards and Technology (NIST) initiated MatML in 1999 as an attempt to consolidate the mostly proprietary formats of material resources. MatML was conceived out of the efforts from private industries, government labs, and universities to define a standard and descriptive document structure to enable universal interchange for materials property data. More information regarding MatML is available at (http://www.matml.org).

2. Organization of the Data

2.1 Classes and Subclasses

MPRD materials are organized by material *class* and *subclass*. The definitions of class and subclass are not rigid, but a common nomenclature and convention can help with the overall organization. Listed below are MPRD standard classes:

2.1.1 Classes

- ROCK
- SOIL
- MINERAL
- VEGETATION
- COATING
- LIQUID
- METAL
- CONSTRUCTION
- PLASTIC
- WOOD
- GLASS
- FABRIC

2.1.2 Subclasses

Subclasses are created using relevant taxonomy from the authority in a particular class. Some examples of subclasses nomenclature in MPRD are:

Subclasses for SOIL

- Oxisols
- Vertisols
- Aridisols
- Ultisols
- Mollisols
- Alfisols
- Inceptisols
- Entisols

Subclasses for ROCK

- Igneous
- Sedimentary
- Metamorphic

Subclasses for MINERAL

- Native_elements
- Sulfides
- Oxides
- Hydroxides
- Halides
- Carbonates
- Nitrates
- Borates
- Phosphates
- Sulfates
- Tungstates
- Silicates

Subclasses for VEGETATION

- Tree
- Shrub
- Forb
- Vine
- Graminoid
- Cactus
- Fern
- Lichen
- Bryophyte

MPRD Material Library is conceptually organized as a conventional library of books. A group of materials is placed in one "book," the abstraction of an XML file. Each "book" may contain the information for one or many materials with their properties. Usually materials of the same *subclass are* collected in a "book." Books (xml files) from the same class are shelved on the same shelf (folder). See Figure 1 below as an example.

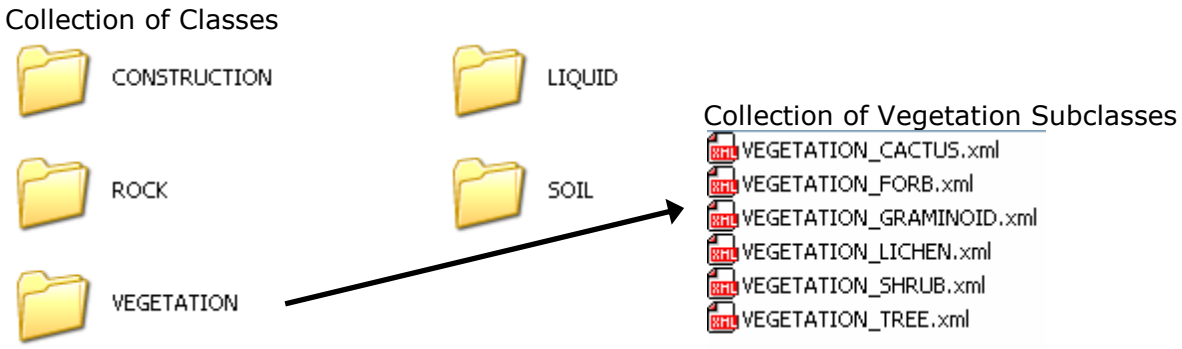


Figure 1 MPRD Classes and Subclasses Example

2.2 Dictionary

There are two types of dictionaries: local and global. Each XML file for a subclass of materials contains a local "dictionary." The local dictionary is an XML data structure that defines the terms and variables used in the specific XML file.

For definitions of global scope, the global dictionary file is created as a standalone XML file. This global dictionary must be referenced to interpret the terms and variables used in any of the material XML files.

2.3 Data Packaging

The MPRD library is transmitted as a set of folders. A summary of these folders and their content follows.

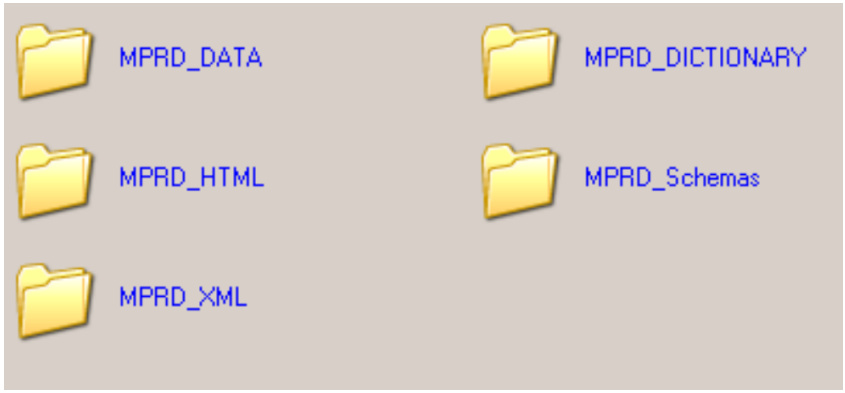


Figure 2 MPRD Package

2.3.1 MPRD_XML

This is the main folder that stores all the material properties databases in XML format. Included in the XML folder are style-sheets that may be used to display the XML data with Internet Explorer.

2.3.2 MPRD_Dictionary

2.3.3 This is the folder that stores the global dictionary database in XML format.MPRD_Data

This is the folder that stores all referenced data that are not embedded directly in the MPRD XML files. As an example, some large spectral distribution data associated with materials are externally referenced here rather than inline in the individual material property XML files.

2.3.4 MPRD_Schema

This is the folder that stores all schemas used to validate and load the MPRD XML files.

2.3.5 MPRD_HTML

This is the folder that stores the transformed XML files in HTML format. This folder as a whole can be used and viewed without the other previously mentioned folders and may be useful for viewing a summary of the MPRD library catalog without parsing actual data.

3. MPRD Illustrative Examples

The following illustrations are intended to give a visual representation of the overall typical MPRD data using the MPRD schema documented in this standard. The illustrations were captured from transformed XML files into HTML pages using the attached XML Style-sheet. Note that not all of the data in the MPRD are rendered by the style-sheet.

3.1 MPRD Catalog

MPRD_Catalog.xml is a catalog that lists the available materials in the MPRD_XML library.

MPRD LIBRARY MATERIAL LIST

CLASS	SUBCLASS	REV DATE	MPRD_ID
LIQUID\LIQUID_WATER			
Liquid	Water	2005-06-14	Liquid_Water_Distilled
Liquid	Water	2005-06-14	Liquid_Water_Sea
SOIL\SOIL_ARIDISOL			
Soil	Aridisol	2005-06-14	Soil_Aridisol_Argid_Forkwood GrayishBrownLoam
Soil	Aridisol	2005-06-14	Soil_Aridisol_Argid_Penistaja BrownFineSandyLoam
Soil	Aridisol	2005-06-14	Soil_Aridisol_Argids_CasaGrande FineSandyLoam
Soil	Aridisol	2005-06-14	Soil_Aridisol_Calcid_Mivida YellowishRedFineSandyLoam
Soil	Aridisol	2005-06-14	Soil_Aridisol_Cambid_Orovada FineSandyLoam
VEGETATION\VEGETATION_TREE			
Vegetation	Tree	2005-06-14	Vegetation_Tree_Quaking Aspen
Vegetation	Tree	2005-06-14	Vegetation_Tree_Sierra Lodgepole Pine
Vegetation	Tree	2005-06-14	Vegetation_Tree_Silver Maple
Vegetation	Tree	2005-06-14	Vegetation_Tree_Subalpine Fir
Vegetation	Tree	2005-06-14	Vegetation_Tree_White Oak

3.2 LIQUID_WATER Example

The following data is rendered from a subset of the LIQUID_WATER.xml file. This is a sample collection of LIQUID class and WATER subclass materials.

Header Information

LIQUID/LIQUID_WATER

INDUSTRY CONTACT :	mailto:
GOVERNMENT CONTACT :	NAVAIR Orlando
LICENSE TYPE :	PUBLIC_DOMAIN
LICENSE RESTRICTIONS :	
CLASSIFICATION TYPE :	UNCLASS
HANDLING CAVEAT :	
REVISION :	2.1
LAST REVISED DATE:	2006-09-01

Distilled Water Material Data

MPRD_ID : **Liquid_Water_Distilled**

CLASS : Liquid
SUBCLASS : Water
DATE : 2005-06-14

Property Name	Data Source	Specimen Name	Data (qualifier) [parameter]	Unit
specific heat capacity p-special_heat_capacity	US Coast Guard manual ds-US_CoastGuard	sp-distilled-water	4213,4201,4188,4184,4180,4176,4176,4176,4176,4176 pa-testTempF [test Temperature (F) : 32,40,50,60,70,80,90,100,110,120F]	J/kg-K joule per kilogram Kelvin
density p-density	US Coast Guard manual ds-US_CoastGuard	sp-distilled-water	1000,1000,1000,999,998,996,995,993,991,988 pa-testTempF [test Temperature (F) : 32,40,50,60,70,80,90,100,110,120F]	kg/m^3 kilogram per cubic meter

thermal conductivity p-thermal_conductivity	US Coast Guard manual ds-US_CoastGuard	H2O-Ice GDS136 sp-distilled-ice1	2.7,2.65,2.59,2.53,2.47,2.41,2.35,2.29,2.23 pa-testTempF [test Temperature (F) : -50,-40,-30,-20,-10,0,10,20,30F]	W/m-K	watt per meter Kelvin
specific heat capacity p-special_heat_capacity	US Coast Guard manual ds-US_CoastGuard	H2O-Ice GDS136 sp-distilled-ice1	1675,1729,1784,1834,1888,1943,1993,2047,2102 pa-testTempF [test Temperature (F) : -50,-40,-30,-20,-10,0,10,20,30F]	J/kg-K	joule per kilogram Kelvin
density p-density	US Coast Guard manual ds-US_CoastGuard	H2O-Ice GDS136 sp-distilled-ice1	924,923,923,922,922,915,921,920,920 pa-testTempF [test Temperature (F) : -50,-40,-30,-20,-10,0,10,20,30F]	kg/m^3	kilogram per cubic meter
thermal conductivity p-thermal_conductivity	US Coast Guard manual ds-US_CoastGuard	sp-distilled-water	0.567,0.574,0.582,0.591,0.599,0.607,0.616,0.624,0.633,0.641 pa-testTempF [test Temperature (F) : 32,40,50,60,70,80,90,100,110,120F]	W/m-K	watt per meter Kelvin
reflectance p-reflectance	USGS Digital Spectral Library ds-USGS	H2O-Ice GDS136 sp-distilled-ice1	Path : local-usgs-L- ..\MPRD_DATA\pubs.usgs.gov\of\2003\ofr-03-395\ASCII\L MinMax : (200nm, 2970nm) Data File : ascii-2- h2o_ice_gds136.9052.asc		

Sea Water Material Data

MPRD_ID : **Liquid_Water_Sea**

CLASS : Liquid
SUBCLASS : Water
DATE : 2005-06-14

Property Name	Data Source	Specimen Name	Data (qualifier) [parameter]	Unit	
thermal conductivity p-thermal_conductivity	US Coast Guard manual ds-US_CoastGuard		0.561,0.57,0.578,0.587,0.596,0.604,0.613,0.622 pa-testTempF [test Temperature (F) : 30,40,50,60,70,80,90,100F]	W/m-K	watt per meter Kelvin
specific heat capacity p-special_heat_capacity	US Coast Guard manual ds-US_CoastGuard		3919,3915,3911,3902,3898,3894,3885,3881 pa-testTempF [test Temperature (F) : 30,40,50,60,70,80,90,100F]	J/kg-K	joule per kilogram Kelvin

density p-density	US Coast Guard manual ds-US_CoastGuard		1029,1028,1028,1027,1026,1024,1022,1020 pa-testTempF [test Temperature (F) : 30,40,50,60,70,80,90,100F]	kg/m^3	kilogram per cubic meter
reflectance p-reflectance	USGS Digital Spectral Library ds-USGS	Seawater_Open_Ocean SW2 lwch sp-sea1	Path : local-usgs-L- ..\MPRD_DATA\pubs.usgs.gov\of\2003\ofr-03-395\ASCII\L MinMax : (200nm, 2970nm) Data File : ascii-2- seawater_open_ocean_sw2.9455.asc		

Local Dictionary

MPRD Dictionary

Global MPRD Dictionary : ../MPRD_Dictionary/MPRD_Dictionary.xml

Local MPRD Dictionary :

Specimen	Authority	Description	Location
H2O-Ice GDS136 sp-distilled-ice1	USGS Digital Spectral LIBRARY auth-USGS	solid The sample was created by growing ice on a 77K cold finger from water vapor from triply distilled H2O from Gary Olhoeft's lab, USGS, Denver. The sample should have very little contaminants; being essentially pure H2O.	
Seawater_Open_Ocean SW2 lwch sp-sea1	USGS Digital Spectral LIBRARY auth-USGS	liquid Seawater, Atlantic ocean; Marine Light Mixed Layer, sta. G3 , 8-16-91 (August 16, 1991), 1400 local time (1500Z) Lat: 59 27 N Long: 21 12 W.	Oceans Atlantic Ocean Lat: 59 deg 27 min + Long: 21 deg 12 min +

DataPath id	Type	Data Path
local-usgs-L	local	..\MPRD_DATA\pubs.usgs.gov\of\2003\ofr-03-395\ASCII\L

3.3 MPRD Global Dictionary

MPRD Global Dictionary is a XML file that is referenced by all MPRD XML material files. The Global Dictionary defines parameters and ids that are global in scope.

MPRD Dictionary

MPRD Dictionary contains definitions of global ids used for MPRD library.

GOVERNMENT CONTACT : NAVAIR Orlando
LICENSE TYPE :
LICENSE RESTRICTIONS :
CLASSIFICATION TYPE : UNCLASS
HANDLING CAVEAT :
LAST REVISED : 2006-09-01

Authority Details

Authority	Notes
auth-ArmyTEC U.S. Army Topographic Engineering Center, Hypermedia Terrain Database (HTD)	The Hypermedia Terrain Database is a hypermedia database of desert landforms. The database contains: airphoto, ground-based, LANDSAT and panoramic imagery; anaglyphs; fly-overs; video; spectral data; and text. This data is organized in a desert landform hierarchy.
auth-FEIS FEIS	Fire Effects Information System (USDA forest service).
auth-MPRD MPRD	NAVAIR Portable Source Initiative and NAWC-AD Manned Flight Simulator under the NPSI Program and the NAVAIR AWTD Joint IPT efforts.
auth-NRCS NRCS	National Resources Conservation Service.
auth-USGS USGS Digital Spectral LIBRARY	Splib05a contains 800+ spectra of minerals, mixtures, artificial, liquids and volatiles and vegetation, each with documentation.

Data Source Details

DataSource	Type	Public Domain	Notes
ds-ArmyTEC US Army TEC (Topographic Engineering Center)	government source	true	http://www.tec.army.mil/research/products/desert_guide/lspectra/lspec1.htm
ds-NRCS NRCS Soil mart	government source	true	http://soildatamart.nrcs.usda.gov/Default.aspx
ds-simetric simetric	internet engineering references	true	http://www.simetric.co.uk/si_materials.htm
ds-US_CoastGuard US Coast Guard manual	government source	true	http://www.chrismanual.com/Intro/prop.htm
ds-USGS USGS Digital Spectral Library	government source	true	http://pubs.usgs.gov/of/2003/ofr-03-395/datatable.html

Source Details

Source	Type	Notes
s-AFRL AFRL-MESA	Government Source	AFRL Mesa provides this data under NAVAIR AWTD Joint IPT Program.

Parameter Details

Parameter	Units	Notes
pa-color color code		
pa-soil_depth Soil depth	in inch	
pa-soil_moisture Moisture Content	% percent	
pa-testFreq test Frequency	Hz Hertz	
pa-testTempC test Temperature (C)	C degree Celsius	
pa-testTempF test Temperature (F)	F degree Fahrenheit	

Property Details

Property	Type	Units	Notes
p-CaCO3 Calcium Carbonate in soil	chemical	% percent	The quantity of Carbonate (CO3) in the soil expressed as CaCO3 and as a weight percentage of the less than 2 mm size fraction.
p-pH pH	chemical		A measure of soil exchangeable hydrogen ions that may become active by cation exchange.
p-salinity soil salinity	chemical	mmhos/cm millimhos per centimeter	The electrical conductivity of an extract from saturated soil paste.
p-dielectric_constant dielectric constant	electrical		The ratio of the capacity of a condenser with that substance as dielectric to the capacity of the same condenser with a vacuum for dielectric.
p-dielectric_strength dielectric strength	electrical	v/mil volts per mil	The voltage which an insulating material can withstand before breakdown occurs.

p-electrical_conductivity electrical conductivity	electrical	mho/m	The ability of a material to conduct electricity.
p-electrical_resisitivity electrical resistivity	electrical	ohm-m	The property of a material that resists the flow of electrical current.
p-magnetic_susceptibility magnetic susceptibility	electrical		The degree to which a material can be magnetized in an external magnetic field.
p-elastic_modulus elastic modulus	mechanical	GPa giga pascal MPa mega pascal Pa pascal	The ratio of the applied stress to the change in shape of an elastic body.
p-flexible_strength flexible strength	mechanical	GPa giga pascal MPa mega pascal Pa pascal	The strength of a material in bending, expressed as the stress on the outermost fibers of a bent test specimen, at the instant of failure.
p-hardness hardness	mechanical		The property of being rigid and resistant to pressure; not easily scratched.
p-modulus_rupture modulus of rupture	mechanical	GPa giga pascal MPa mega pascal Pa pascal	The force necessary to break a specimen of specified width and thickness.
p-poisson_ratio poisson's ratio	mechanical		The ratio of the transverse contracting strain to the longitudinal elongational strain when a tensile stress is applied to a material.
p-ultimate_stress ultimate stress	mechanical	GPa giga pascal MPa mega pascal Pa pascal	Ultimate stress often or ultimate strength is the maximum stress that a material can withstand while being stretched or pulled before necking, which is when the specimen's cross-section starts to significantly contract. Tensile strength is the opposite of compressive strength and the values can be quite different.
p-viscocity viscocity	mechanical	centipoises poise	A measure of internal friction or the resistance of a fluid flow.
p-young_modulus young modulus	mechanical	GPa giga pascal MPa mega pascal Pa pascal	The ratio of normal stress within the proportional limit to the corresponding normal strain.

p_compressive_strength compressive strength	mechanical	GPa giga pascal MPa mega pascal Pa pascal	(1) The maximum compressive load (sustained by a specimen during a compression test) divided by the original cross-sectional area. (2) The ability of a material to resist a uniaxial compressive load that tends to crush it.
p-clay clay content in soil	physical	% percent	Clay as a soil separate consists of mineral soil particles that are less than 0.02 millimeter in diameter. The estimated clay content is given as a percentage by weight.
p-density density	physical	kg/m^3 kilogram per cubic meter	The density is defined as a mediums mass per unit volume.
p-LAI leaf area index	physical		The area of foliage per unit area of ground. Conventionally this refers to the ratio of the area of the upper side of the leaves in a canopy projected onto a flat surface to the area of the surface under the canopy. Occasionally this has been used in reference to both sides of the leaves.
p-moisture moisture bulk density in soil	physical	% percent	Plant and animal residue in the soil at various stages of decomposition.
p-organic organic matter in soil	physical	% percent	Plant and animal residue in the soil at various stages of decomposition.
p-permeability permeability	physical	cm/sec centimeter per second	The ease with which fluids flow through a rock or sediment.
p-porosity porosity	physical	% percent	The amount of pore space in a rock (the spaces between the grains).
p-sand sand content in soil	physical	% percent	Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeter in diameter. The estimated sand content is given as a percentage by weight.
p-silt silt content in soil	physical	% percent	Sand as a soil separate consists of mineral soil particles that are 0.002 millimeter to 0.05 millimeter in diameter. The estimated silt content is given as a percentage by weight.
p-special_gravity specific gravity	physical		The ratio of the weight of a particular volume of a given substance to the weight of an equal volume of pure water.
p-VI vegetation index	physical		The reduction of multispectral scanning measurements to a single value for predicting and assessing vegetative characteristics such as plant leaf area, total biomass and general plant stress and vigor.

p-color_x CIE chromaticity x coordinate	surface			In the CIE Yxy color space, x represents the red component of the perceived color.
p-color_y CIE chromaticity y coordinate	surface			In the CIE Yxy color space, y represents the green component of the perceived color.
p-color_Y_D65 CIE chromaticity brightness parameter Y	surface			In the CIE Yxy color space, Y provides the brightness function of the perceived color.
p-reflectance reflectance	surface	%	percent	The fraction or percent of a particular frequency or wavelength of electromagnetic radiation that is reflected from the surface of a substance without being absorbed or transmitted.
p-reflectance-VIS reflectance in Visible band 410-722 nm	surface	%	percent	The fraction or percent of a particular frequency or wavelength of electromagnetic radiation that is reflected from the surface of a substance without being absorbed or transmitted.
p-reflectance_BDR bi-directional directional reflectance	surface	%	percent	Reflectance as a function of reflectance angle in the plane of illuminating source for each incidence angle for which SDR data are measured. These data are provided in three spectral bands (visible, 3-5µm, and 8-12µm) from which the lobe width of the specular lobe can be determined.
p-reflectance_DDR diffuse directional reflectance	surface	%	percent	Hemispherical reflectance for specific angles of incidence of the illuminating source with the specular component blocked (+1/2 degree from the specular angle).
p-reflectance_HDR hemispherical directional reflectance	surface	%	percent	Hemispherical reflectance for specific angles of incidence of the illuminating source.
p-reflectance_NIR reflectance in NIR band 724-2500 nm	surface	%	percent	The fraction or percent of a particular frequency or wavelength of electromagnetic radiation that is reflected from the surface of a substance without being absorbed or transmitted.
p-reflectance_SDR specular directional reflectance	surface	%	percent	Specular reflectance component for specific angles of incidence of the illuminating source, computed by subtracting HDR and DDR.

p-reflectance_solar reflectance in solar band 300-2500 nm	surface	%	percent	The fraction or percent of a particular frequency or wavelength of electromagnetic radiation that is reflected from the surface of a substance without being absorbed or transmitted.
p-reflectance_SRI Solar Reflectance Index	surface			The Solar Reflectance Index (SRI.) is a measure of a material's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. For example, the standard black has a temperature rise of 90 deg. F (50 deg. C) in full sun, and the standard white has a temperature rise of 14.6 deg. F (8.1 deg. C). Once the maximum temperature rise of a given material has been computed, the SRI can be computed by interpolating between the values for white and black.
p-reflectance_THR total hemispherical reflectance	surface	%	percent	Total reflectance for a near-normal angle of incidence (7 or 10 degrees) of illuminating source.
p-reflectance_UV reflectance in UV band 300-400 nm	surface	%	percent	The fraction or percent of a particular frequency or wavelength of electromagnetic radiation that is reflected from the surface of a substance without being absorbed or transmitted.
p-infrared_emittance infrared emittance	thermal			Infrared Emittance is a parameter between 0 and 1 that measures the ability of a warm or hot material to shed some of its heat in the form of infrared radiation. The wavelength range for this radiant energy is roughly 5 to 40 micrometers.
p-special_heat_capacity specific heat capacity	thermal	J/kg-K	joule per kilogram Kelvin	This is the amount of heat (in calories or Joules) that must be added or removed from a unit mass of that substance to change its temperature by one degree
p-thermal_conductivity thermal conductivity	thermal	W/m-K	watt per meter Kelvin	The property of a material that describes the rate at which heat will be conducted through a unit area of the material for a given period of time.
p-thermal_radiation thermal radiation emissivity coefficient	thermal			The ratio of the radiation emitted by a surface to that emitted by a black body at the same temperature.

Data File Format Details

Data File Format	Headings	Columns	Notes
ascii-1	delimiter: , header to skip: 5	Labels: Wavelength, Reflectance Units: nm,% Formats: float, float	
ascii-2	delimiter: SPACE header to skip: 14	Labels: Wavelength,Reflectance,Standard Deviation Units: um,%,% Formats: float,float,float	
ascii-3	delimiter: SPACE header to skip: 26	Labels: Wavelength, Reflectance Units: um,% Formats: float, float	
ascii-4	delimiter: SPACE header to skip: 0	Labels: Wavelength, Reflectance Units: um,% Formats: float, float	

Data Table Details

Table Format	# of columns	Columns
tbl1	2	Labels: wavelength, reflectance Units: um,% Formats: float, float

4. Organization of the Standard

The metadata standard is defined in a schema file based on World Wide Web Consortium (W3C) XML format (http://www.w3.org/2001/XMLSchema) and is available separately from this document in XSD file format. The filename of the schema is:

MPRD.2.2.xx.xsd, where xx = minor file revision

The schema hard copy is reported in the following sections and organized into:

MPRD_Doc

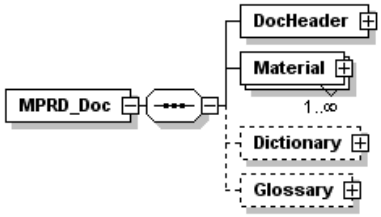
MPRD_Doc Complex Types (alphabetical)

MPRD_Doc Simple Types (alphabetical)

MPRD_Dictionary_Doc

MPRD_Dictionary_Doc Complex Types (alphabetical)

MPRD_Doc is the root element of the MPRD XML document. Its child elements are grouped as follows:



DocHeader is the document header containing document title, revision history, and other administrative information (contact info, licensing, security, etc.)

Material element contains the material definitions, such as MPRD_ID, material property data (*BulkDetails*), and component details. One *MPRD_Doc* may contain one or many *Material* elements. *ComponentDetails* is an optional element and can be used for complex/composite materials.

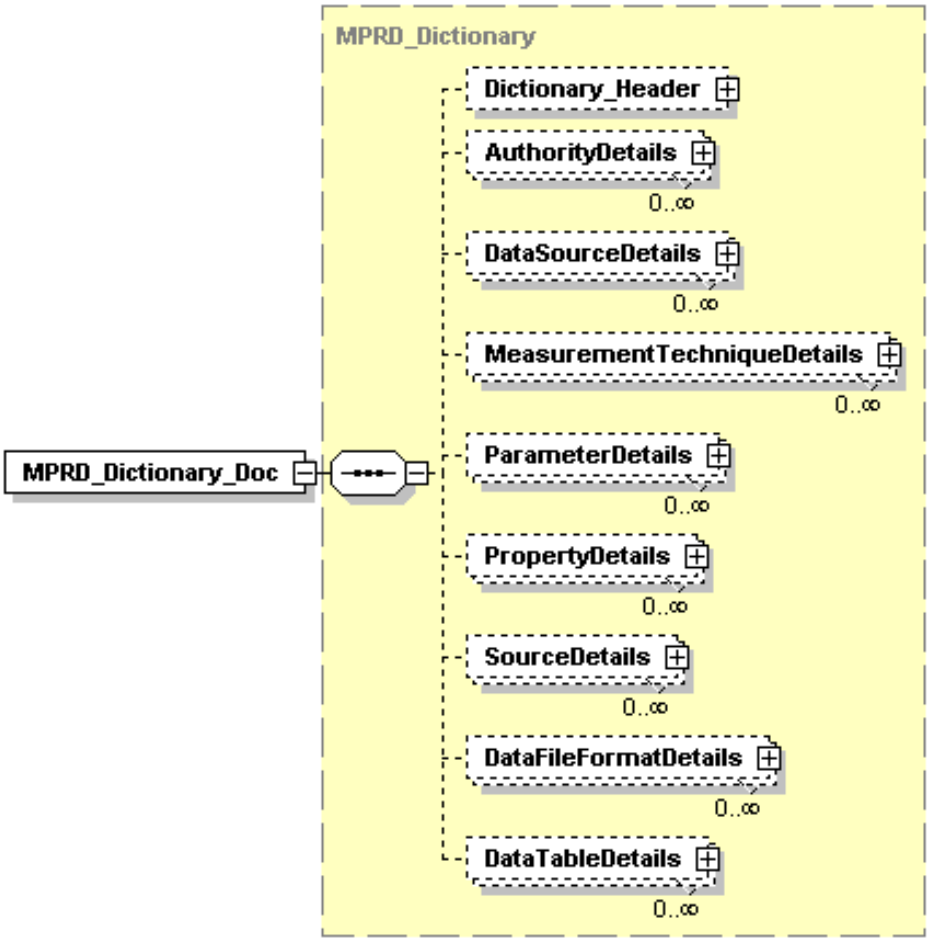
Dictionary element is a local definition of "id"s attribute that are valid for this document only. For "ids" attribute that are valid for *all* MPRD documents, the definition would be stored in a global dictionary *MPRD_Dictionary* document.

Glossary is a collection of definition of terms that are used in this XML document.

MPRD_Doc Complex Types list all of the complex-types used in *MPRD_Doc*. A complex type is a typical complex element that may be used in multiple instances of elements. A complex element is an element having child element(s). The list is alphabetical and not grouped into logical application.

MPRD_Doc Simple Types list all of the simple-types used by in *MPRD_Doc*. A simple type is a typical simple element that may be used in multiple instances of elements. A simple element is an element without a child. A simple element may contain an enumeration of valid data entry. The list is alphabetical and not grouped into logical application.

MPRD_Dictionary_Doc is the root element of the global MPRD Dictionary XML document. Its child elements are grouped as follows:



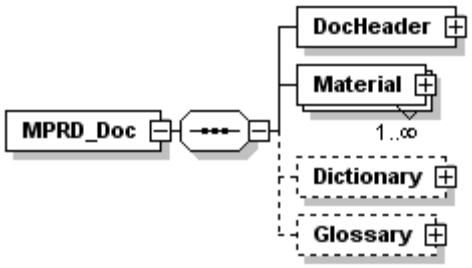
MPRD_Dictionary_Doc Complex Types list all of the complex-types used in *MPRD_Dictionary_Doc* in alphabetical order.

Appendix A MPRD Schema in a pictorial detailed description

A.1 MPRD_Doc Elements

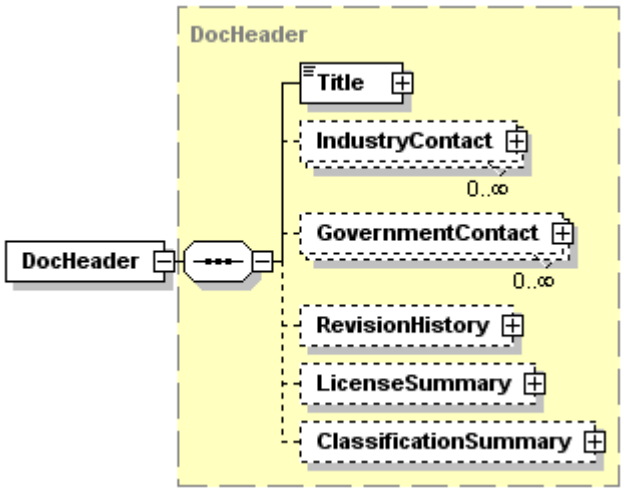
A.1.1 Document Root: MPRD_Doc

element **MPRD_Doc**

diagram	
annotation	MPRD document root.

A.1.2 DocHeader

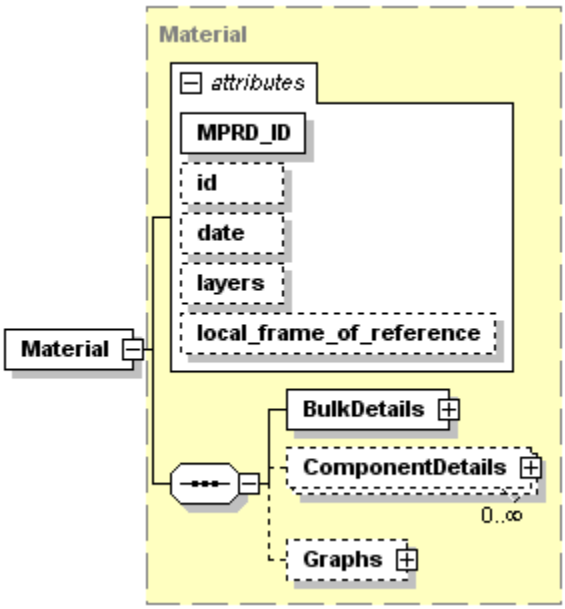
element **MPRD_Doc/DocHeader**

diagram	
type	**DocHeader**
annotation	DocHeader contains MPRD_Doc administrative information.

A.1.3 Material

element **MPRD_Doc/Material**

diagram



type **Material**

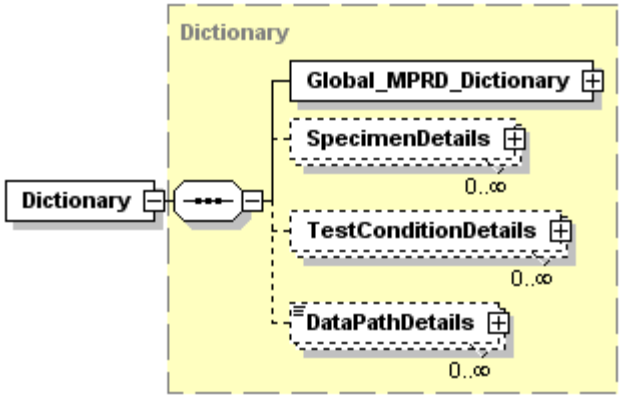
attributes

Name	Type	Use	Annotation
MPRD_ID		required	attribute: human readable unique ID that identify the material using the following rule: [Class]_[Subclass]_[Name]] [Name] is the same as the Bulk_Name element under BulkDetails. [Class] is the same as the Class element under BulkDetails. [Subclass] is the same as the Subclass element under BulkDetails. Examples: - Vegetation_Tree_Sierra Lodgepole Pine - Liquid_Water_Distilled - Construction_Roof_Red Concrete Tile
id	**xsd:ID**	optional	attribute: a unique sequential index or a computer generated globally unique identification (GUID). This id will be used in managing the material database.
date	**xsd:string**	optional	attribute: the date the material is last updated.
layers	**xsd:integer**	optional	attribute: may be used to indicate the number of layers in complex systems such as composite laminates.
local_frame_of_reference	**xsd:string**	optional	attribute: may be used as an identification specifier for the local material orientation relative to the global frame of reference, which is especially useful for complex systems such as anisotropic materials.

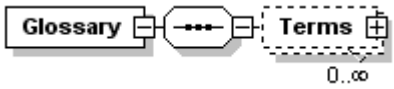
annotation Material element contains MPRD _Doc material definitions.

A.1.4 Dictionary

element **MPRD_Doc/Dictionary**

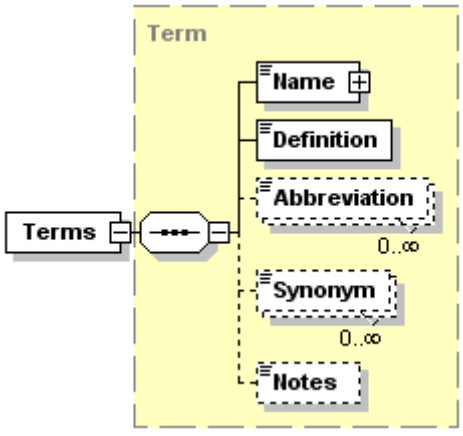
diagram	
type	**Dictionary**
annotation	Dictionary element contains local data dictionary and location of external global data dictionary. The dictionaries contain details describing ids used in MPRD_Doc.

element **MPRD_Doc/Glossary**

diagram	
annotation	Glossary contains descriptions of material and property terms used in MPRD_Doc.

A.1.5 Glossary

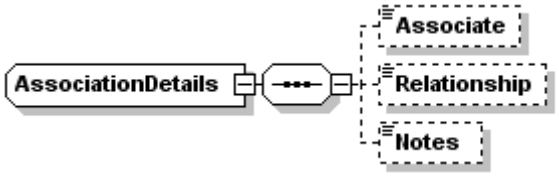
element **MPRD_Doc/Glossary/Terms**

diagram	
type	**Term.**

A.2 MPRD_Doc Complex Types (Alphabetical)

A.2.1 AssociationDetails

complexType **AssociationDetails**

diagram	
used by	element **ComponentDetails/AssociationDetails**
annotation	Complex-type: containing a description of a relationship of the component to another component in a complex material system such as a composite, weld, or multilayer material.

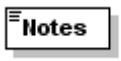
element **AssociationDetails/Associate**

diagram	
type	**xsd:IDREF**
annotation	Associate contains the id of the associated component.

element **AssociationDetails/Relationship**

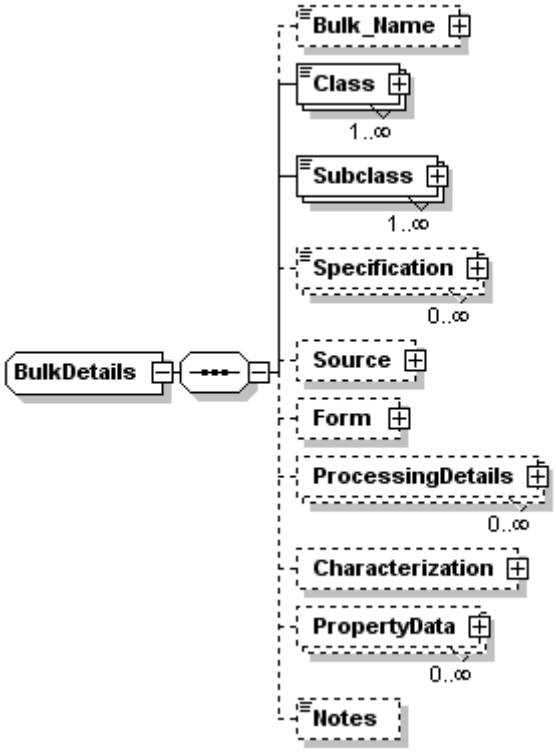
diagram	
type	**xsd:string**
annotation	Relationship contains a description of the relationship between a component and the associate. For example, in a metal roof, the paint material will be associated with the "base" as the "coating" of the "base material".

element **AssociationDetails/Notes**

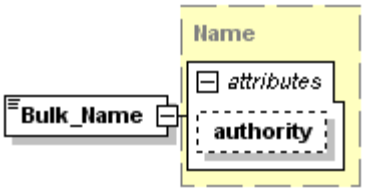
diagram	
type	**Notes**
annotation	Notes element contains any additional information concerning the association.

A.2.2 BulkDetails

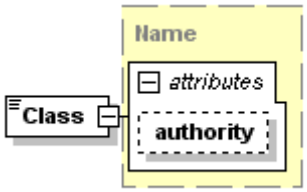
complexType **BulkDetails**

diagram	
used by	element **Material/BulkDetails**
annotation	Complex-type: containing bulk material information.

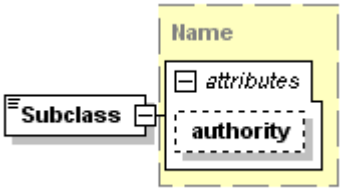
element **BulkDetails/Bulk_Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material name as assigned by the authoriative source defined in the authority attribute. Example: <Bulk_Name authority="Auth1">Sierra Lodgepole Pine</Bulk_Name>

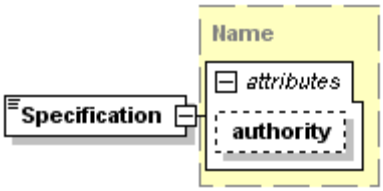
element **BulkDetails/Class**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material class to which the bulk material belongs. The Class name is defined by the authorative source. Examples for Class names: - Rock - Soil - Vegetation The xml format: <Class authority="Auth1">Rock</Class>

element **BulkDetails/Subclass**

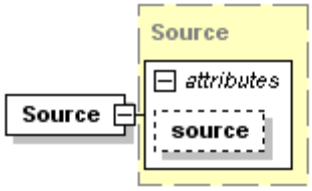
diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material subclass to which the bulk material belongs. The subclass is name is defined by the authorative source. Example subclass names for Vegetation material class: - Shrub - Tree - Cactus The xml format: <Subclass authority="Auth1">Tree</Subclass>

element **BulkDetails/Specification**

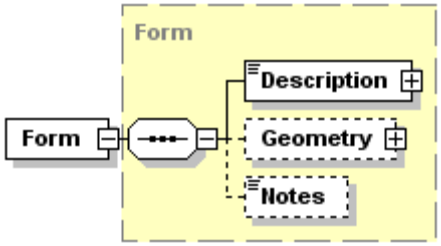
diagram	
type	**Name**

attributes	Name	Type	Use	Annotation
	authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	documentation	The material specification code assigned under the authoritative source. Example Specification for Sierra Lodgepole Pine: Pinus contorta var. murrayana (latin name, defined under authority FEIS (Fire Effects Information System (USDA forest service)) The xml format: <Specification authority="Auth6">Pinus contorta var. murrayana</Specification>		

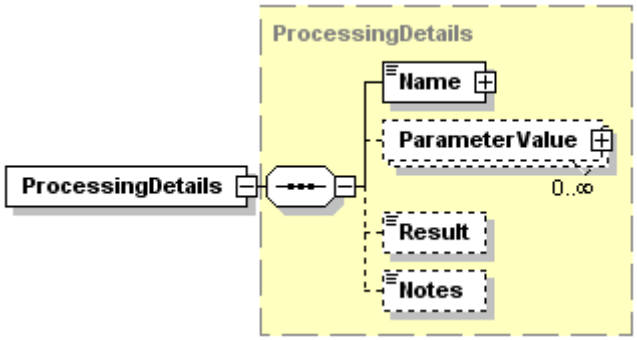
element **BulkDetails/Source**

diagram	
type	**Source**
attributes	Name: source; Type: **xsd:string**; Use: optional; Annotation: attribute: source id as defined in SourceDetails section of MPRD_Dictionary.
annotation	The source provider of data. Example: <Source source="s2"/>

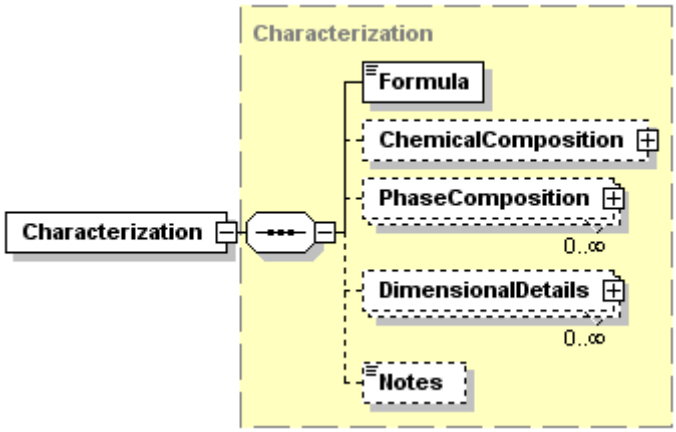
element **BulkDetails/Form**

diagram	
type	**Form**
annotation	Form element describes the form of the bulk material. It includes a description string and a complex element Geometry to describe shape, dimensions and orientation.

element **BulkDetails/ProcessingDetails**

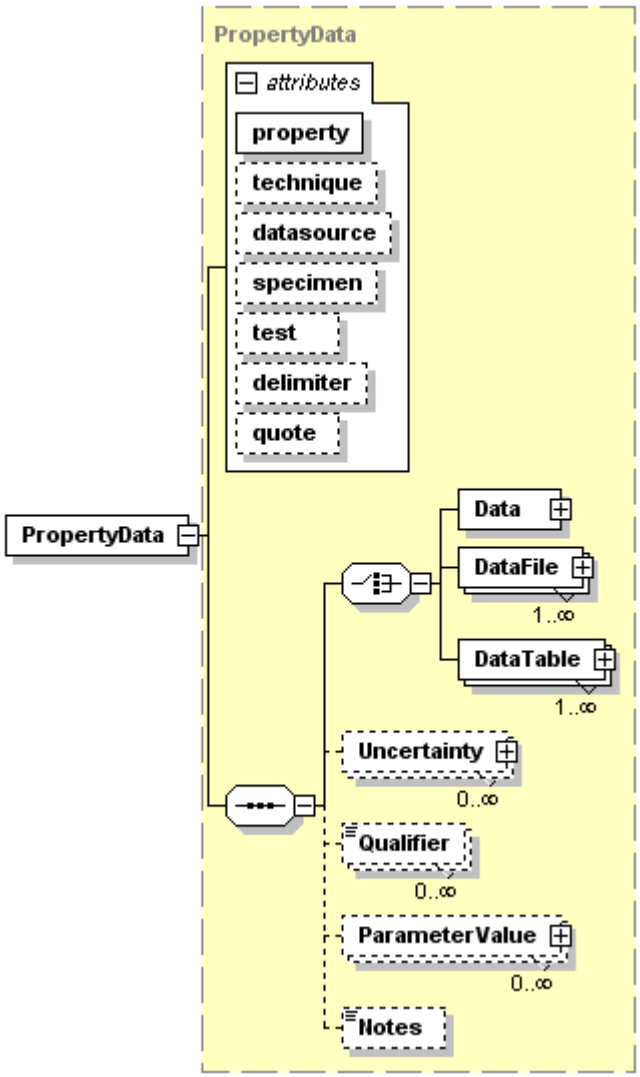
diagram	
type	**ProcessingDetails**
annotation	ProcessingDetails element contains information of the parameters under which the bulk material is being processed. Examples are the testing temperature, pressure.

element **BulkDetails/Characterization**

diagram	
type	**Characterization**
annotation	Characterization element describes the chemical composition of the bulk material.

element **BulkDetails/PropertyData**

diagram



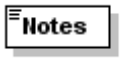
type: extension of **PropertyData**

attributes

Name	Type	Use	Annotation
property	**xsd:string**	required	attribute: property data id as defined in PropertyDetails section of MPRD_Dictionary.
technique	**xsd:string**		attribute: technique id as defined in MeasurementTechniqueDetails section of MPRD_Dictionary.
datasource	**xsd:string**		attribute: data source id as defined in DataSourceDetails section of MPRD_Dictionary.
specimen	**xsd:string**		attribute: specimen id as defined in SpecimenDetails in the Dictionary element.
test	**xsd:string**		attribute: test condition id as defined in TestConditionDetails in Metadata.
delimiter			attribute: delimiter specifies the delimiter that separates multiple values in the Data, Qualifier, Uncertainty, and ParameterValue elements. The default value is a comma (',').
quote	**xsd:string**		attribute: quote specifies the string that is used to quote values in the Data, Qualifier, Uncertainty and ParameterValue elements.

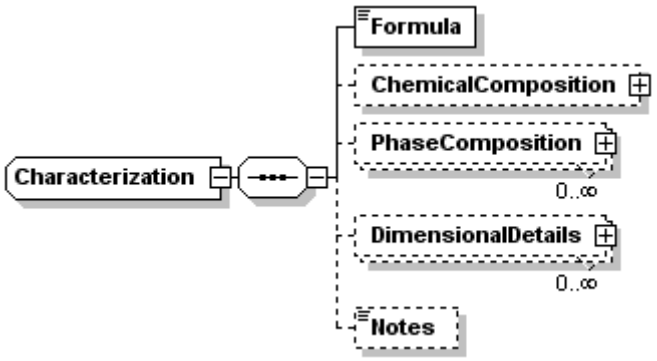
annotation: PropertyData element contains property data for the bulk material. The propertydata includes physical, chemical, mechancal, thermal and electrical data.
Note -Multiple entries in the Data, Qualifier, Uncertainty Value, and ParameterValue elements must be comma delimited and synchronized across elements, i.e., the number of entries in each of these four elements must be equal.

element **BulkDetails/Notes**

diagram	
type	**Notes**

A.2.3 Characterization

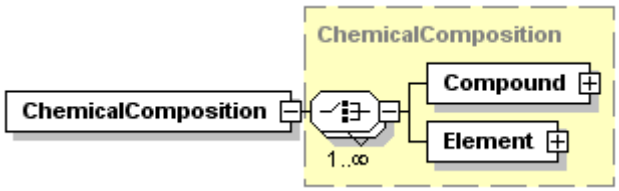
complexType **Characterization**

diagram	
used by	elements **BulkDetails/Characterization ComponentDetails/Characterization**
annotation	Complex-type: containing a description of the chemical composition of the bulk material or component.

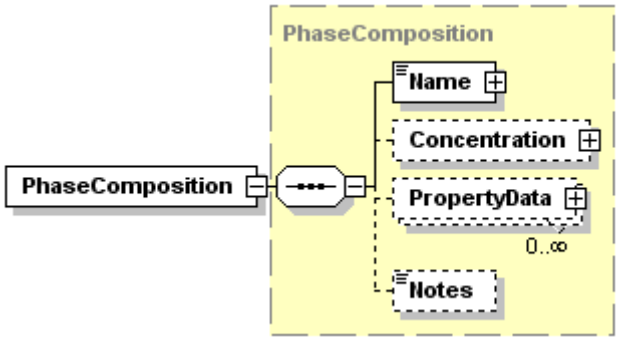
element **Characterization/Formula**

diagram	
type	**Formula**
annotation	Formula contains a string representation of the chemical formula for the bulk material or component.

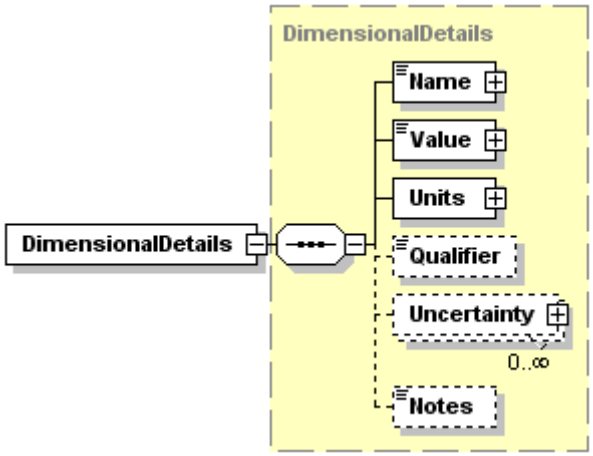
element **Characterization/ChemicalComposition**

diagram	
type	**ChemicalComposition**
annotation	ChemicalComposition contains a description of the compounds and elements that comprise the bulk material or component.

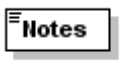
element **Characterization/PhaseComposition**

diagram	
type	**PhaseComposition**
annotation	PhaseComposition contains a description of the phases that comprise the bulk material or component.

element **Characterization/DimensionalDetails**

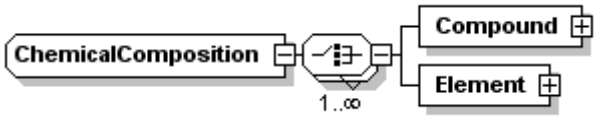
diagram	
type	**DimensionalDetails**
annotation	DimensionalDetails contains information relating to component or bulk material dimensional characteristics such as grain size, porosity, precipitate size and distribution, etc.

element **Characterization/Notes**

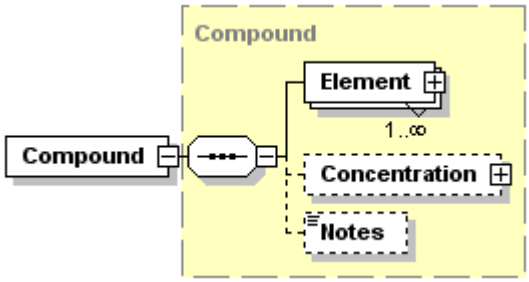
diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the Characterization.

A.2.4 ChemicalComposition

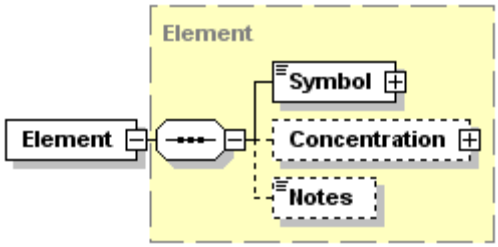
complexType **ChemicalComposition**

diagram	
used by	element **Characterization/ChemicalComposition**
annotation	Complex-type: containing a detailed description of the compounds and elements that comprise the bulk material or component.

element **ChemicalComposition/Compound**

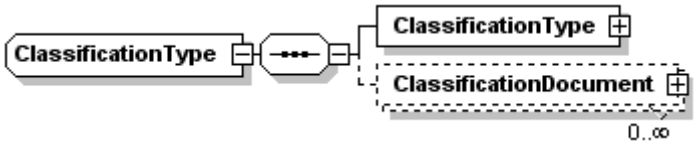
diagram	
type	**Compound**
annotation	Compound contains a description of a compound.

element **ChemicalComposition/Element**

diagram	
type	**Element**
annotation	Element contains chemical element symbols and concentrations.

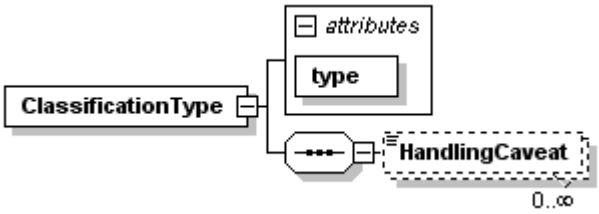
A.2.5 ClassificationType

complexType **ClassificationType**

diagram	
used by	element **DocHeader/ClassificationSummary**

annotation	Complex-type: containing handling restrictions imposed on the overall dataset or each data file for national security, privacy, or other concerns.

element **ClassificationType/ClassificationType**

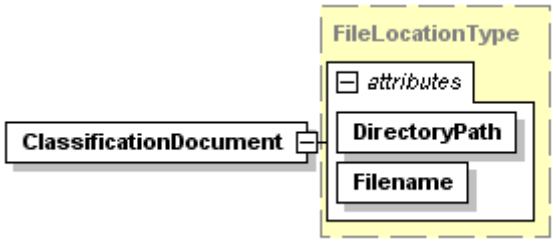
diagram	
attributes	

Name	Type	Use	Annotation
type		required	Name of the handling restrictions.

element **ClassificationType/ClassificationType/HandlingCaveat**

diagram	
type	restriction of **xsd:string**
facets	enumeration FOUO enumeration CNWDR enumeration LIMDIS
annotation	Additional information about the handling restrictions.

element **ClassificationType/ClassificationDocument**

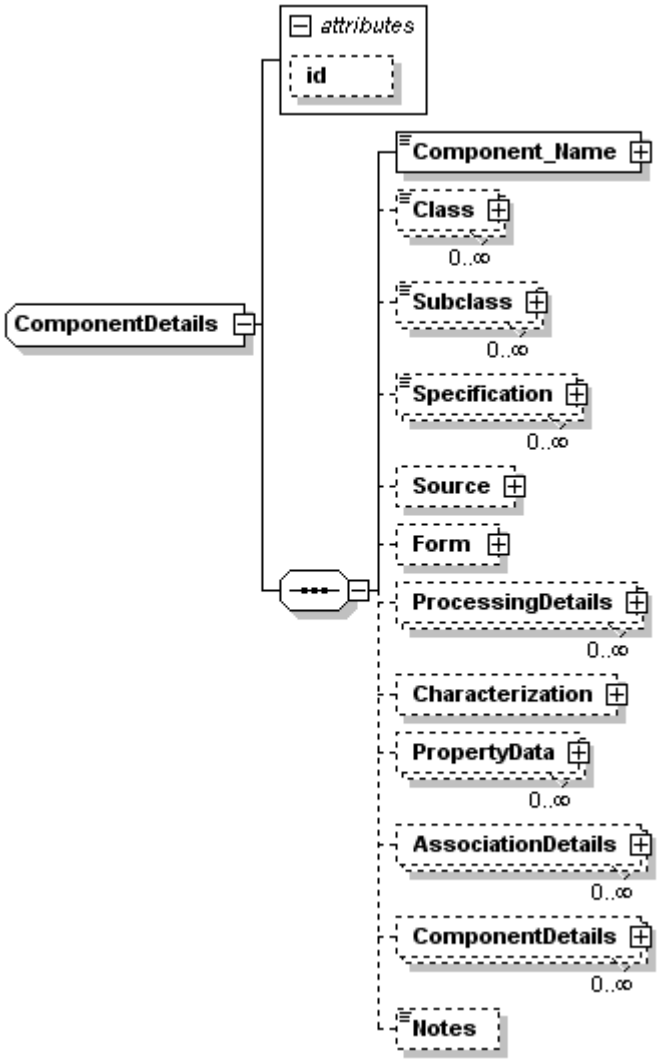
diagram	
type	**FileLocationType**
attributes	

Name	Type	Use	Annotation
DirectoryPath	**xsd:string**	required	Path to the file location. This could be URL, relative, or absolute path.
Filename	**xsd:string**	required	Filename with extension.

A.2.6 ComponentDetails

complexType **ComponentDetails**

diagram



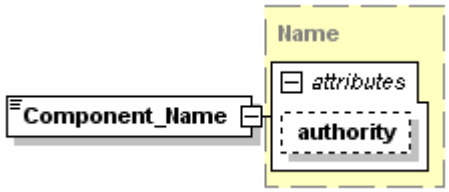
used by: elements **ComponentDetails/ComponentDetails Material/ComponentDetails**

attributes

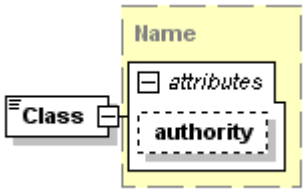
Name	Type	Use	Annotation
id	**xsd:ID**	optional	attribute: id is used in AssociationDetails element. The component id can be paired with other components with relationships defined in Relationship element.

annotation: Complex-type: containing description of components within the bulk material and has one optional attribute, id, which may be used as an identification specifier for the component and is especially useful for complex systems such as composite laminates.

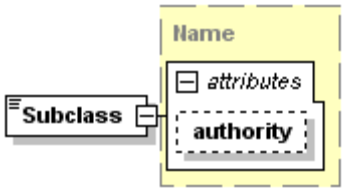
element **ComponentDetails/Component_Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material name as assigned by the authoriative source defined in the authority attribute. Example: Asphalt aggregate.

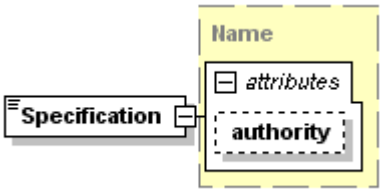
element **ComponentDetails/Class**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material class to which the component material belongs. The Class name is defined by the authorative source. Examples for Class names: - Rock - Soil - Vegetation

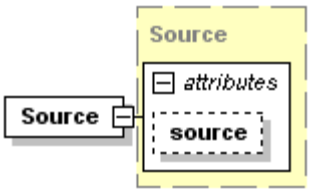
element **ComponentDetails/Subclass**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material subclass to which the component material belongs. The subclass is name is defined by the authorative source. Example subclass Names for Vegetation material class: - Shrub - Tree - Cactus

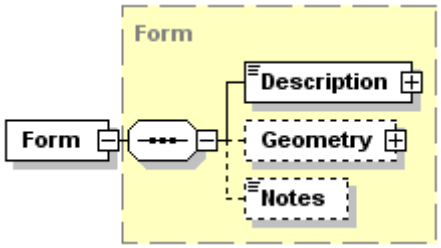
element **ComponentDetails/Specification**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	The material specification code assigned under the authoritative source.

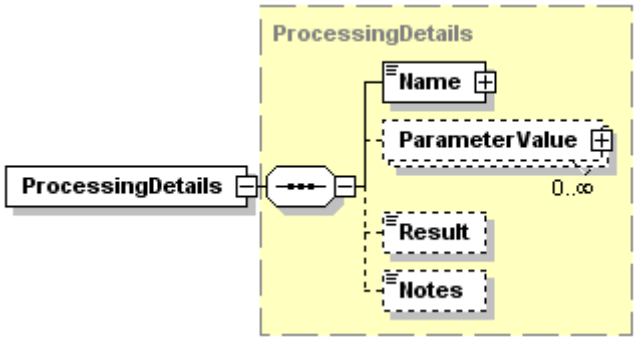
element **ComponentDetails/Source**

diagram	
type	**Source**
attributes	Name: source; Type: **xsd:string**; Use: optional; Annotation: attribute: source id as defined in SourceDetails section of MPRD_Dictionary.
annotation	The source provider of data.

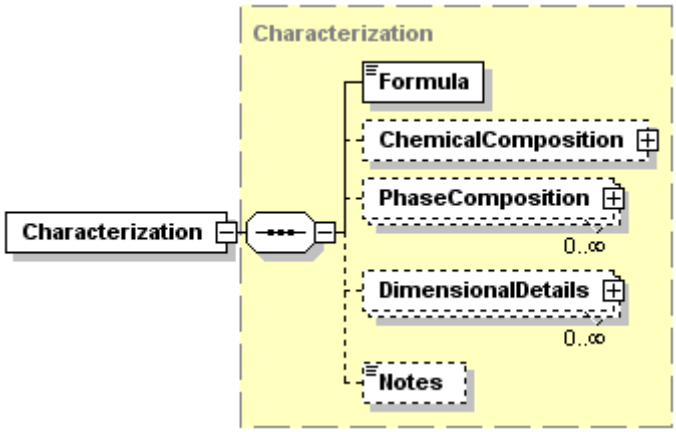
element **ComponentDetails/Form**

diagram	
type	**Form**
annotation	Form element describes the form of the component material. It includes a description string and a complex element Geometry to describe shape, dimensions and orientation.

element **ComponentDetails/ProcessingDetails**

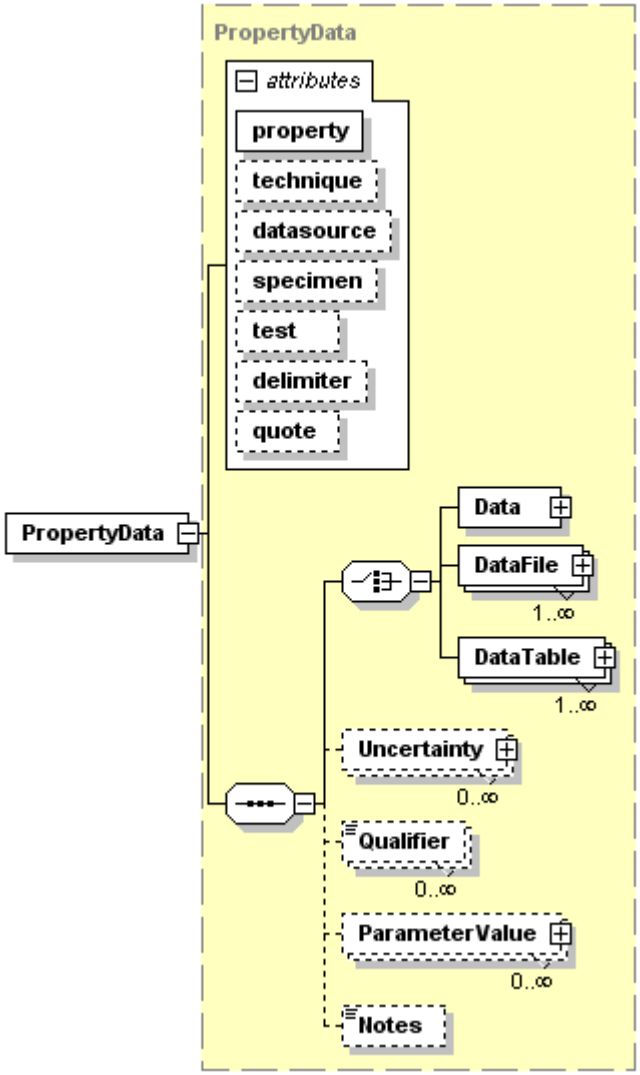
diagram	
type	**ProcessingDetails**
annotation	ProcessingDetails element contains information of the parameters under which the component material is being processed. Examples are the testing temperature, pressure.

element **ComponentDetails/Characterization**

diagram	
type	**Characterization**
annotation	Characterization element describes the chemical composition of the component material.

element **ComponentDetails/PropertyData**

diagram



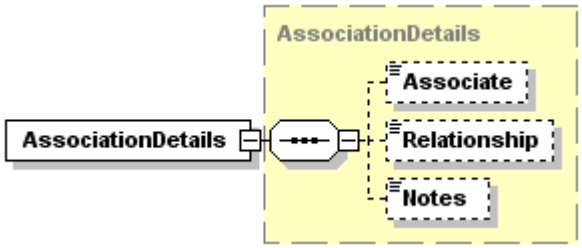
type **PropertyData**

attributes

Name	Type	Use	Annotation
property	**xsd:string**	required	attribute: property data id as defined in PropertyDetails section of MPRD_Dictionary
technique	**xsd:string**		attribute: technique id as defined in MeasurementTechniqueDetails section of MPRD_Dictionary
datasource	**xsd:string**		attribute: data source id as defined in DataSourceDetails section of MPRD_Dictionary
specimen	**xsd:string**		attribute: specimen id as defined in SpecimenDetails in the Dictionary element.
test	**xsd:string**		attribute: test condition id as defined in TestConditionDetails in Metadata.
delimiter			attribute: delimiter specifies the delimiter that separates multiple values in the Data, Qualifier, Uncertainty, and ParameterValue elements. The default value is a comma (',').
quote	**xsd:string**		attribute: quote specifies the string that is used to quote values in the Data, Qualifier, Uncertainty and ParameterValue elements.

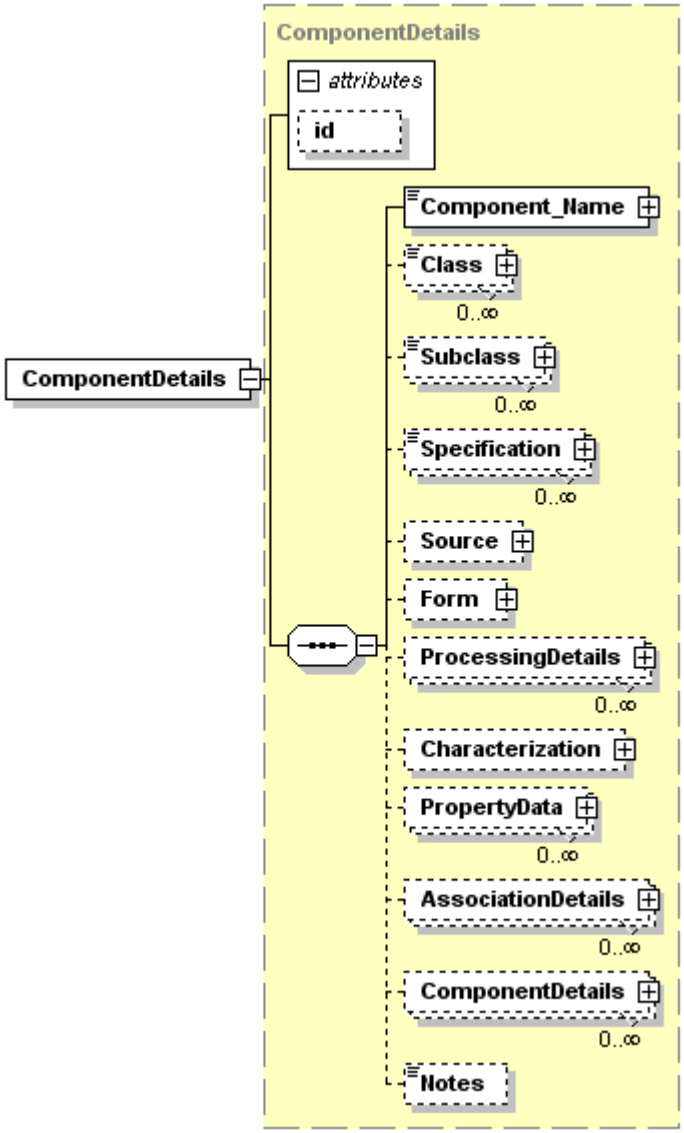
annotation PropertyData contains the property data of the component.

element **ComponentDetails/AssociationDetails**

diagram	
type	**AssociationDetails**
annotation	AssociationDetails contains a description of relationships of the component to other components.

element **ComponentDetails/ComponentDetails**

diagram



type **ComponentDetails**

attributes

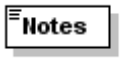
Name	Type	Use	Annotation
id	**xsd:ID**	optional	attribute: id is used in AssociationDetails element. The component id can be paired with other components with relationships defined in Relationship element.

annotation

ComponentDetails contains a description of a component within the component and is used to support encoding of information for complex materials systems such as composites.

element **ComponentDetails/Notes**

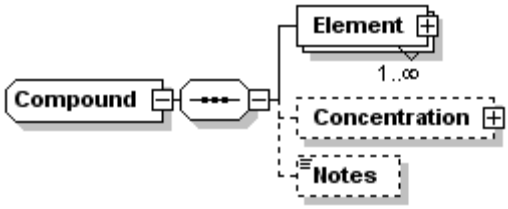
diagram



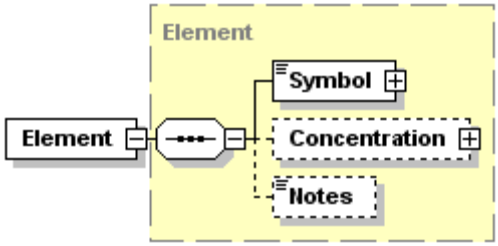
type **Notes**

A.2.7 Compound

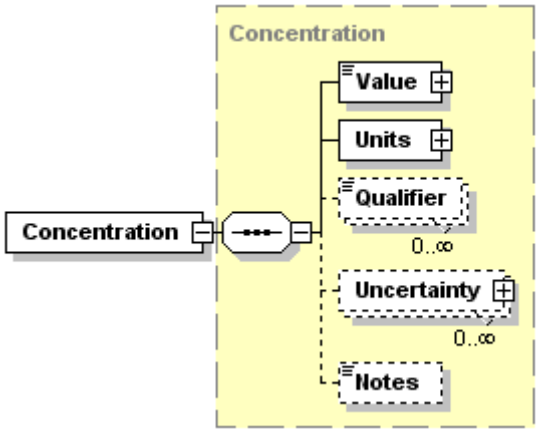
complexType **Compound**

diagram	
used by	element **ChemicalComposition/Compound**
annotation	Complex-type: containing the elemental description of a chemical compound.

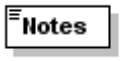
element **Compound/Element**

diagram	
type	**Element**
annotation	Element contains the description of a chemical element.

element **Compound/Concentration**

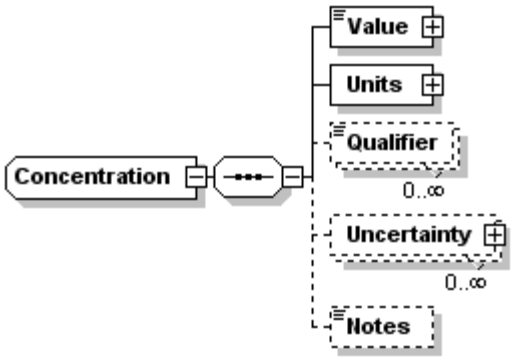
diagram	
type	**Concentration**
annotation	Concentration contains the concentration of the compound.

element **Compound/Notes**

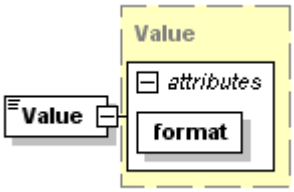
diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the compound.

A.2.8 Concentration

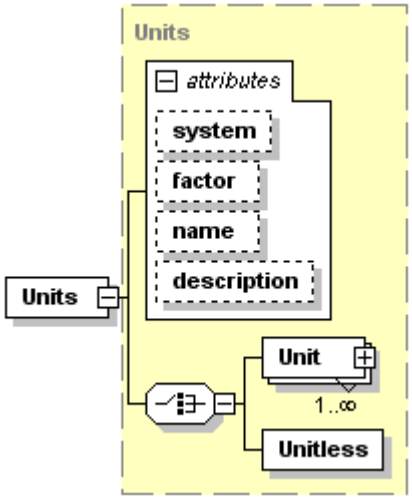
complexType **Concentration**

diagram	
used by	elements **Compound/Concentration Element/Concentration PhaseComposition/Concentration**
annotation	Complex-type: containing concentration value definitions.

element **Concentration/Value**

diagram	
type	**Value**
attributes	Name: format; Type: **DataFormat**; Use: required; Annotation:
annotation	Value contains the value of the concentration and has one required attribute, format, for indicating the format of the value.

element **Concentration/Units**

diagram	
type	**Units**
attributes	

Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s"
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second"

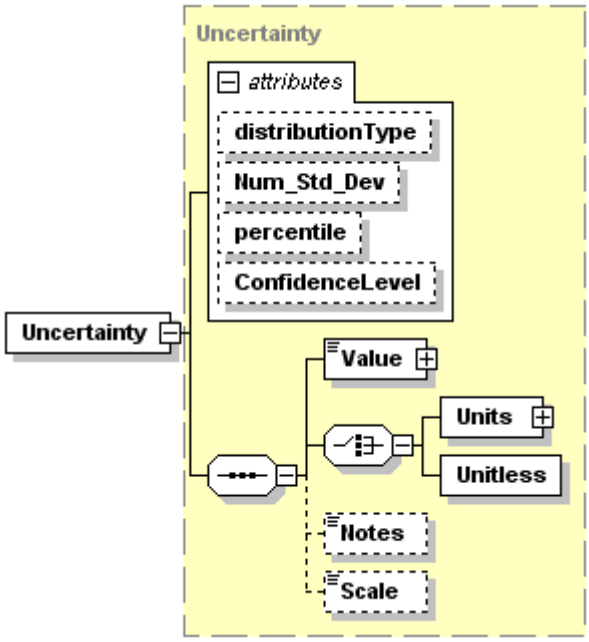
annotation	Units contains the units for the value of the concentration.

element **Concentration/Qualifier**

diagram	
type	**Qualifier**
annotation	Qualifier contains any qualifier pertinent to the value of the concentration (e.g. "min," "max," etc.).

element **Concentration/Uncertainty**

diagram



type **Uncertainty**

attributes

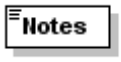
Name	Type	Use	Default	Annotation
distributionType	**xsd:string**	optional	Normal/Gaussian	attribute: distributionType is a description of the nature of the uncertainty value, for example '6 sigma', 'Gaussian' or '2 std dev.'
Num_Std_Dev	**xsd:float**	optional	2	
percentile	**xsd:float**	optional		attribute: percentile is a value indicating the percentage of the data population that have values less than or equal to that expressed by the Uncertainty value.
ConfidenceLevel	**xsd:float**	optional		

annotation

Uncertainty contains the measurement uncertainty(ies) of the data in Value element.

element **Concentration/Notes**

diagram



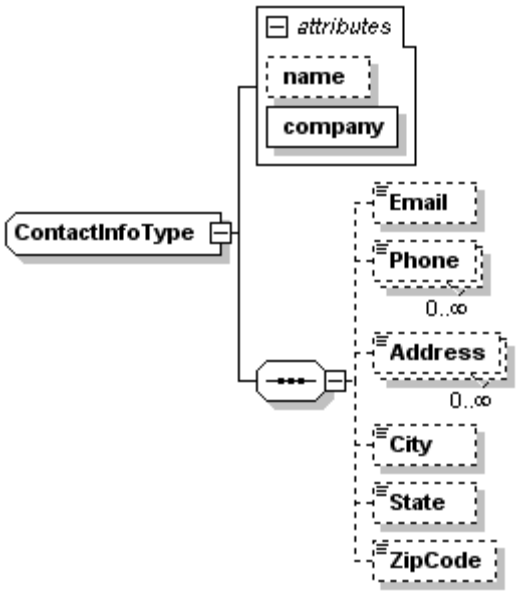
type **Notes**

annotation

Notes contains any additional information concerning the concentration.

A.2.9 ContactInfoType

complexType **ContactInfoType**

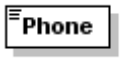
diagram	
used by	elements **DocHeader/GovernmentContact DocHeader/IndustryContact**
attributes	
annotation	Complex-type: containing the identity of, and means to communicate with, person(s) and organization(s) associated with the data set.

Name	Type	Use	Annotation
name	**xsd:string**		
company		required	

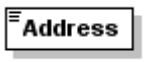
element **ContactInfoType/Email**

diagram	
type	**xsd:string**

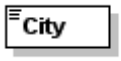
element **ContactInfoType/Phone**

diagram	
type	**xsd:string**

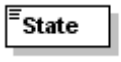
element **ContactInfoType/Address**

diagram	
type	**xsd:string**

element **ContactInfoType/City**

diagram	
type	**xsd:string**

element **ContactInfoType/State**

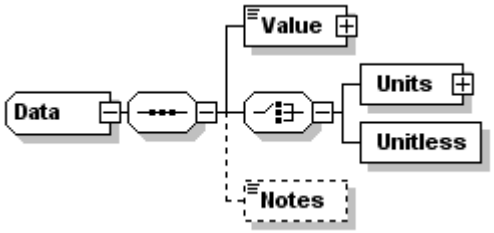
diagram	
type	**xsd:string**

element **ContactInfoType/ZipCode**

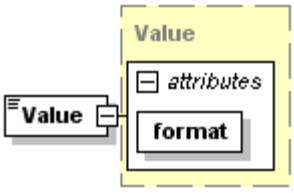
diagram	
type	restriction of **xsd:string**

A.2.10 Data

complexType **Data**

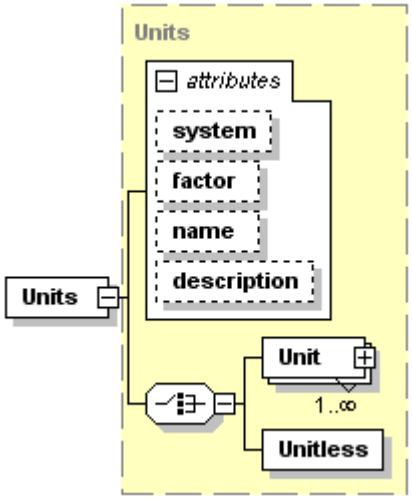
diagram	
used by	elements **ParameterValue/Data PropertyData/Data**

element **Data/Value**

diagram	
type	**Value**
attributes	Name | Type | Use | Annotation format | **DataFormat** | required |
annotation	Value contains the value of the data.

element **Data/Units**

diagram



type **Units**

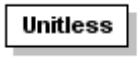
attributes

Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s".
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second".

annotation: Units contains the units for the value of the data.

element **Data/Unitless**

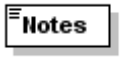
diagram



type **Unitless**

element **Data/Notes**

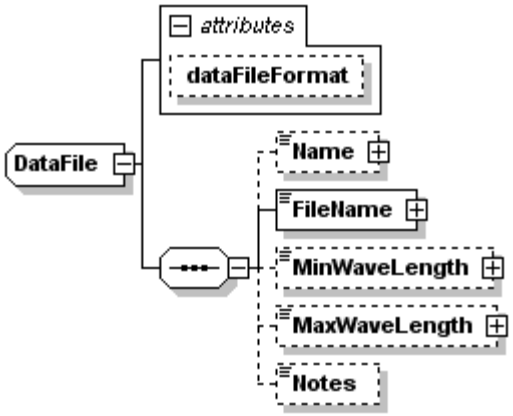
diagram



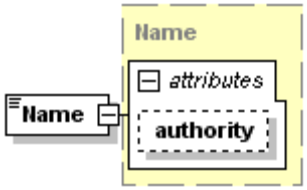
type **Notes**

A.2.11 DataFile

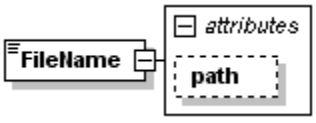
complexType **DataFile**

diagram	
used by	element **PropertyData/DataFile**
attributes	Name: dataFileFormat; Type: **xsd:string**; Use: ; Annotation: dataFileFormat is an ID referenced from Global MPRD_Dictionary where the file format is defined.
annotation	Complex-type: containing references to large data tables external to the XML document.

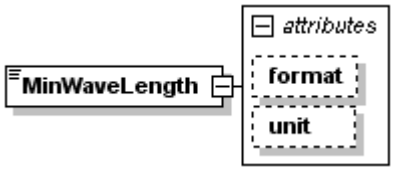
element **DataFile/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **DataFile/FileName**

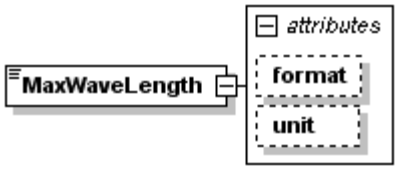
diagram	
type	extension of **xsd:string**
attributes	Name: path; Type: **xsd:string**; Use: optional; Annotation:

element **DataFile/MinWaveLength**

diagram	
type	extension of **xsd:string**
attributes	

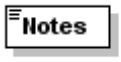
Name	Type	Use	Annotation
format	**DataFormat**		
unit	**xsd:string**		

element **DataFile/MaxWaveLength**

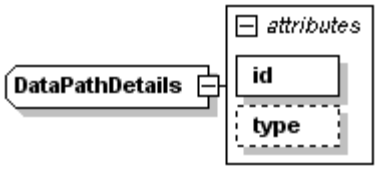
diagram	
type	extension of **xsd:string**
attributes	

Name	Type	Use	Annotation
format	**DataFormat**		
unit	**xsd:string**		

element **DataFile/Notes**

diagram	
type	**Notes**

complexType **DataPathDetails**

diagram	
type	extension of **xsd:string**
used by	element **Dictionary/DataPathDetails**
attributes	

Name	Type	Use	Annotation
id	**xsd:ID**	required	
type	**xsd:string**	optional	

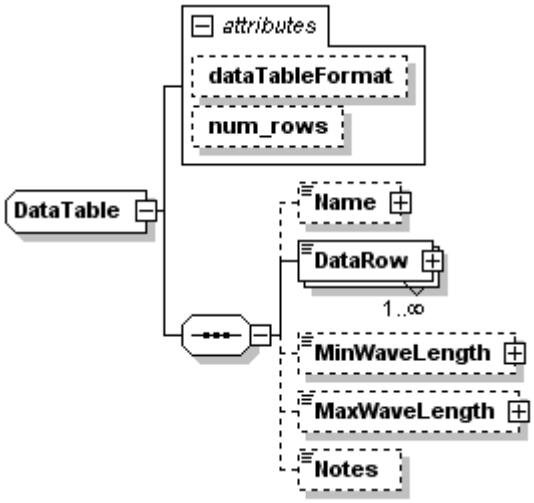
annotation

Complex-type: containing ids and descriptions of data file paths referenced by attribute "path" of complex type "DataFile".

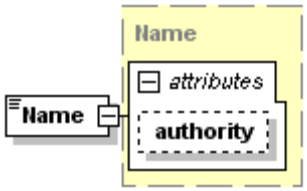
DataPathDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. delimiter and row data format.
Attribute "type" defines the path type, e.g. "URL", "local", "remote", "relative", etc.

A.2.12 DataTable

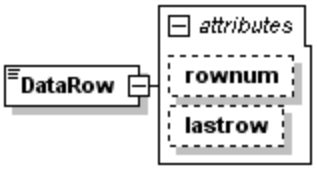
complexType **DataTable**

diagram	
used by	element **PropertyData/DataTable**
attributes	Name / Type / Use / Default / Fixed / Annotation dataTableFormat / **xsd:string** / optional num_rows / **xsd:positiveInteger** / optional
annotation	Complex-type: containing datarows of tabular data within the XML document.

element **DataTable/Name**

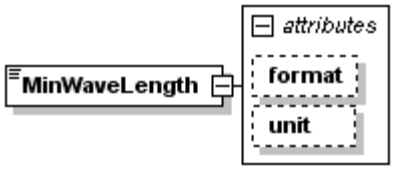
diagram	
type	**Name**
attributes	Name / Type / Use / Annotation authority / **xsd:string** / optional / attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **DataTable/DataRow**

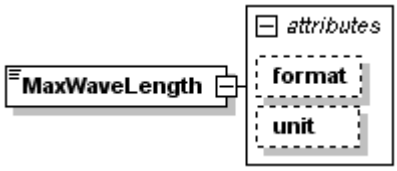
diagram	
type	extension of **xsd:string**
attributes	Name / Type / Use / Annotation rownum / **xsd:unsignedInt** / optional

	lastrow	**xsd:boolean**	optional	

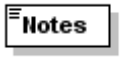
element **DataTable/MinWaveLength**

diagram	
type	extension of **xsd:string**
attributes	Name / Type / Use / Annotation format — **DataFormat** unit — **xsd:string**

element **DataTable/MaxWaveLength**

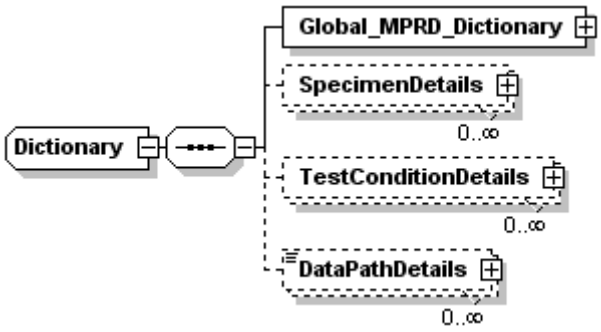
diagram	
type	extension of **xsd:string**
attributes	Name / Type / Use / Annotation format — **DataFormat** unit — **xsd:string**

element **DataTable/Notes**

diagram	
type	**Notes**

A.2.13 Dictionary

complexType **Dictionary**

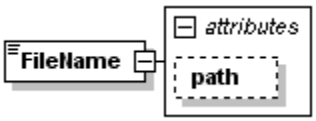
diagram	
used by	element **MPRD_Doc/Dictionary**
annotation	Complex-type: containing local data dictionary and location of external global data dictionary. The

	dictionaries contain details describing ids used in MPRD_Doc.

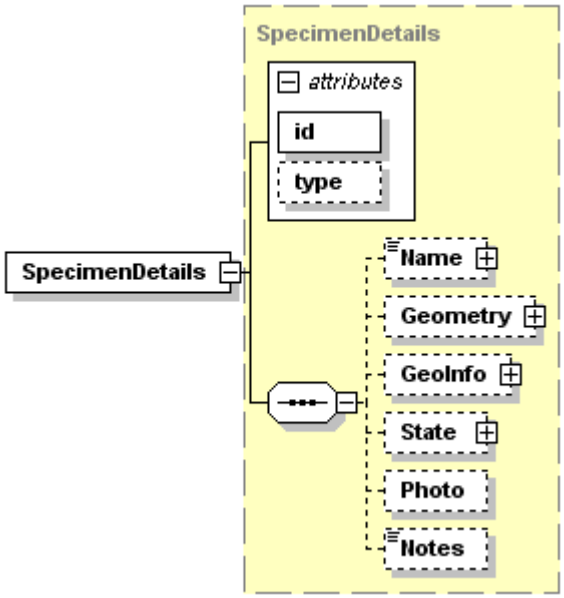
element **Dictionary/Global_MPRD_Dictionary**

diagram	
annotation	Global MPRD_Dictionary file location. This file contains global "id" defintions being referenced by this MPRD_Doc.

element **Dictionary/Global_MPRD_Dictionary/FileName**

diagram	
type	extension of **xsd:string**
attributes	Name: path; Type: **xsd:string**; Use: optional; Annotation:

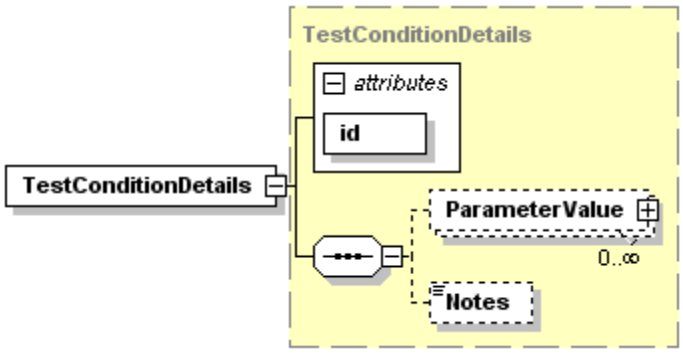
element **Dictionary/SpecimenDetails**

diagram	
type	**SpecimenDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation: Name: type; Type: **xsd:string**; Use: optional; Annotation:
annotation	SpecimenDetais contains ids and descriptions of the specimen materials. The specifics include locations, season, geometry, physical states, photos and any notes. SpecimenDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. delimiter and row data format. Optional attribute "type" specifies the type of the specimen, e.g. "cylindrical," "rectangular," "full cross-section," "pressed," etc. Example:

```
<SpecimenDetails id="sp-granite1">
        <Name authority="Auth3">Granite (fragments and grus)</Name>
        <Geometry>
                <Shape>fragments and grus</Shape>
        </Geometry>
        <GeoInfo>
                <GeoLocation>
                        <Region>North America</Region>
                        <Country>USA</Country>
                        <Territory>California</Territory>
                        <Notes>Riverside Co., Joshua Tree National Park, east of Quail Springs </Notes>
                </GeoLocation>
        </GeoInfo>
</SpecimenDetails>
```

element **Dictionary/TestConditionDetails**

diagram



type **TestConditionDetails**

attributes

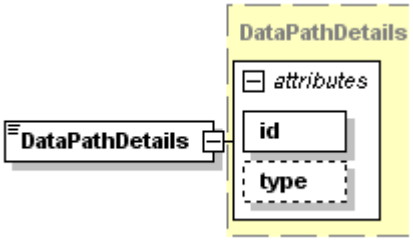
Name	Type	Use	Annotation
id	**xsd:ID**	required	

annotation

TestConditionDetails contiains ids and descriptions of the test conditions referenced by attribute "test" of complex type "PropertyData".

element **Dictionary/DataPathDetails**

diagram



type **DataPathDetails**

attributes

Name	Type	Use	Annotation
id	**xsd:ID**	required	
type	**xsd:string**	optional	

annotation

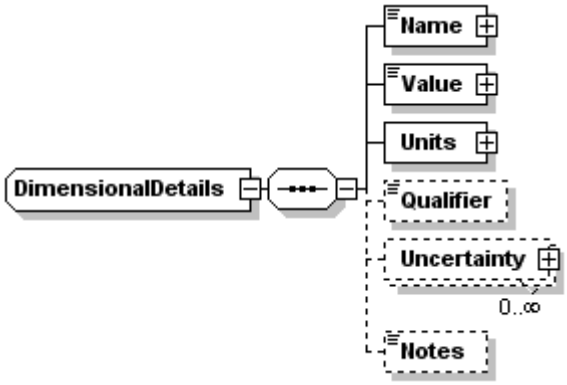
DataPathDetails contains ids and descriptions of data file paths referenced by attribute "path" of complex type "DataFile".

DataPathDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. delimiter and row data format.
Attribute "type" defines the path type, e.g. "URL", "local", "remote", "relative", etc.

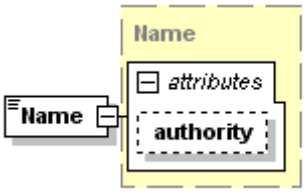
Example:
<DataPathDetails id="local-tecarmy" type="local">..\MPRD_DATA\tecarmy</DataPathDetails>

A.2.14 DimensionalDetails

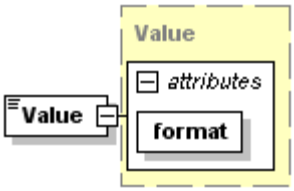
complexType **DimensionalDetails**

diagram	
used by	element **Characterization/DimensionalDetails**
annotation	Complex-type: containing a description of a dimensional characteristic (e.g. grain size, porosity, precipitate size and distribution, etc.) of the bulk material or component and is composed of the following elements.

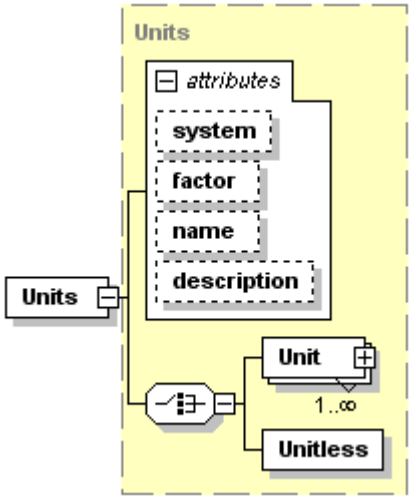
element **DimensionalDetails/Name**

diagram	
type	**Name**
attributes	Name | Type | Use | Annotation authority | **xsd:string** | optional | attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	Name contains the name of the dimensional characteristic under the authoritative source.

element **DimensionalDetails/Value**

diagram	
type	**Value**
attributes	Name | Type | Use | Annotation format | **DataFormat** | required |
annotation	Value contains the value of the dimensional characteristic.

element **DimensionalDetails/Units**

diagram	
type	**Units**
attributes	

Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s".
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second".

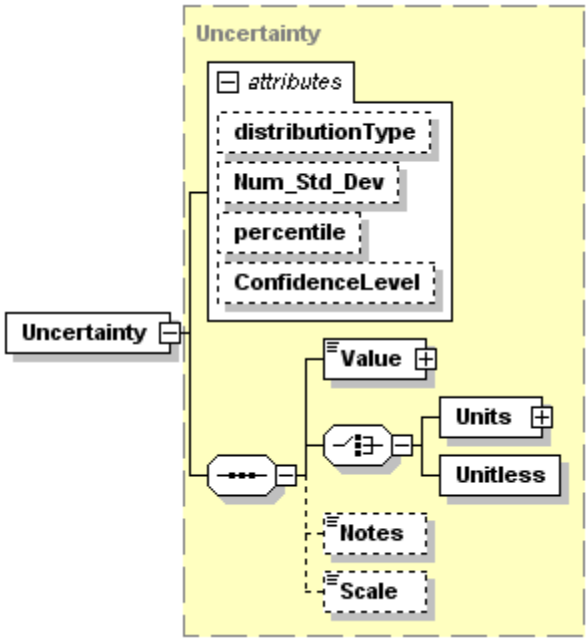
annotation	Units contains the units for the value of the dimensional characteristic.

element **DimensionalDetails/Qualifier**

diagram	
type	**xsd:string**
annotation	Qualifier contains any qualifier pertinent to the value of the dimensional characteristic (e.g. "min," "max," etc.).

element **DimensionalDetails/Uncertainty**

diagram



type **Uncertainty**

attributes

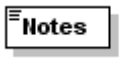
Name	Type	Use	Default	Annotation
distributionType	**xsd:string**	optional	Normal/Gaussian	attribute: distributionType is a description of the nature of the uncertainty value, for example '6 sigma', 'Gaussian' or '2 std dev.'.
Num_Std_Dev	**xsd:float**	optional	2	
percentile	**xsd:float**	optional		attribute: percentile is a value indicating the percentage of the data population that have values less than or equal to that expressed by the Uncertainty value.
ConfidenceLevel	**xsd:float**	optional		

annotation

Uncertainty contains the measurement uncertainty(ies) of the data.

element **DimensionalDetails/Notes**

diagram



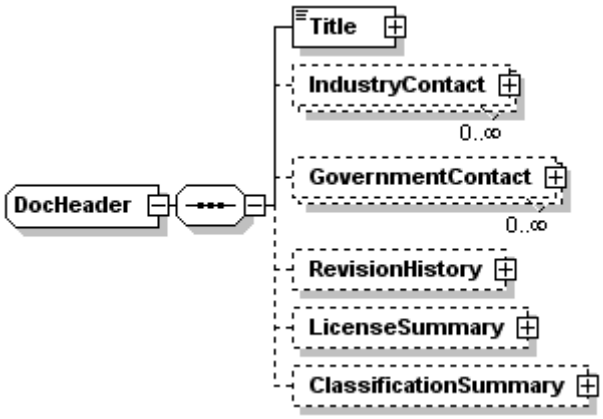
type **Notes**

annotation

Notes contains any additional information concerning the dimensional characteristic.

A.2.15 DocHeader

complexType **DocHeader**

diagram	
used by	element **MPRD_Doc/DocHeader**
annotation	Complex-type: containing MPRD_Doc administrative information.

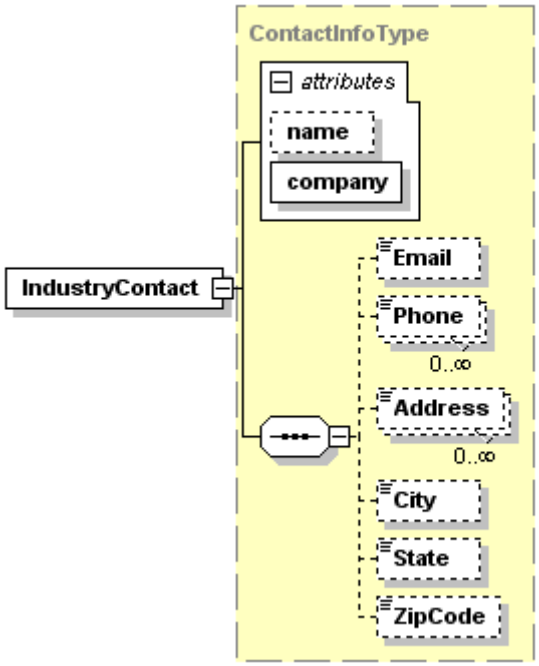
element **DocHeader/Title**

diagram	
type	extension of **xsd:string**
attributes	

Name	Type	Use	Default	Fixed	Annotation
description	**xsd:string**	optional			

element **DocHeader/IndustryContact**

diagram



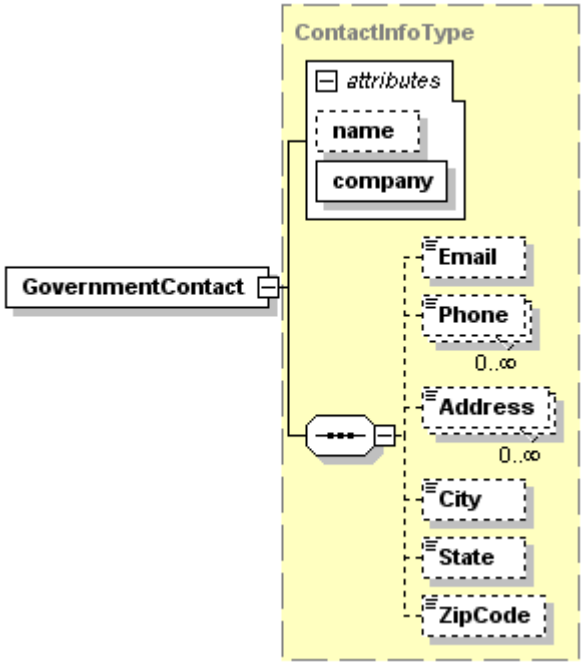
type **ContactInfoType**

attributes

Name	Type	Use	Annotation
name	**xsd:string**		
company		required	

element **DocHeader/GovernmentContact**

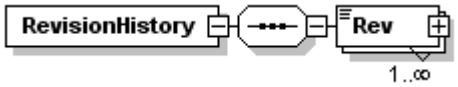
diagram



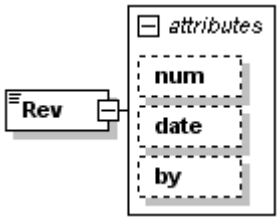
type	**ContactInfoType**
attributes	

Name	Type	Use	Annotation
name	**xsd:string**		
company		required	

element **DocHeader/RevisionHistory**

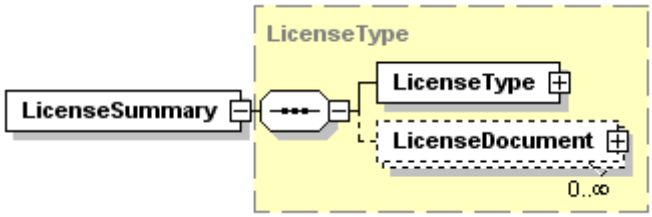
diagram	

element **DocHeader/RevisionHistory/Rev**

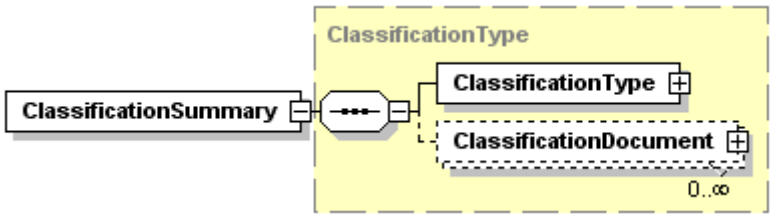
diagram	
type	extension of **xsd:string**
attributes	

Name	Type	Use	Annotation
num	**xsd:string**		
date	**xsd:date**		
by	**xsd:string**		

element **DocHeader/LicenseSummary**

diagram	
type	**LicenseType**
annotation	Restrictions and legal prerequisites for accessing and using the overall dataset.

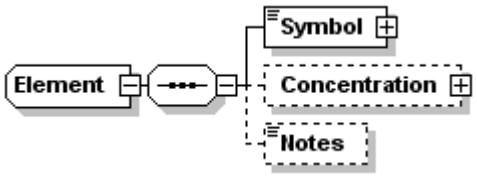
element **DocHeader/ClassificationSummary**

diagram	
type	**ClassificationType**

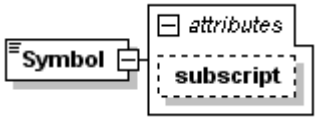
annotation	Handling restrictions imposed on the overall dataset for national security, privacy, or other concerns.

A.2.16 Element

complexType **Element**

diagram	
used by	elements **ChemicalComposition/Element Compound/Element**
annotation	documentation Complex-type: containing chemical element symbols and concentrations.

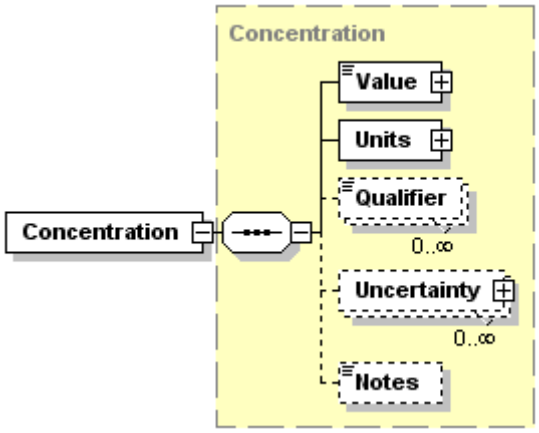
element **Element/Symbol**

diagram	
type	extension of **ChemicalElementSymbol**
facets	enumeration H enumeration He enumeration Li enumeration Be enumeration B enumeration C enumeration N enumeration O enumeration F enumeration Ne enumeration Na enumeration Mg enumeration Al enumeration Si enumeration P enumeration S enumeration Cl enumeration Ar enumeration K enumeration Ca enumeration Sc enumeration Ti enumeration V enumeration Cr enumeration Mn enumeration Fe enumeration Co enumeration Ni enumeration Cu enumeration Zn enumeration Ga enumeration Ge enumeration As enumeration Se enumeration Br enumeration Kr

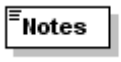
enumeration	Rb
enumeration	Sr
enumeration	Y
enumeration	Zr
enumeration	Nb
enumeration	Mo
enumeration	Tc
enumeration	Ru
enumeration	Rh
enumeration	Pd
enumeration	Ag
enumeration	Cd
enumeration	In
enumeration	Sn
enumeration	Sb
enumeration	Te
enumeration	I
enumeration	Xe
enumeration	Cs
enumeration	Ba
enumeration	La
enumeration	Ce
enumeration	Pr
enumeration	Nd
enumeration	Pm
enumeration	Sm
enumeration	Eu
enumeration	Gd
enumeration	Tb
enumeration	Dy
enumeration	Ho
enumeration	Er
enumeration	Tm
enumeration	Yb
enumeration	Lu
enumeration	Hf
enumeration	Ta
enumeration	W
enumeration	Re
enumeration	Os
enumeration	Ir
enumeration	Pt
enumeration	Au
enumeration	Hg
enumeration	Tl
enumeration	Pb
enumeration	Bi
enumeration	Po
enumeration	At
enumeration	Rn
enumeration	Fr
enumeration	Ra
enumeration	Ac
enumeration	Th
enumeration	Pa
enumeration	U
enumeration	Np
enumeration	Pu
enumeration	Am
enumeration	Cm
enumeration	Bk
enumeration	Cf
enumeration	Es
enumeration	Fm

	enumeration Md enumeration No enumeration Lr enumeration Rf enumeration Db enumeration Sg enumeration Bh enumeration Hs enumeration Mt enumeration Uun enumeration Uuu enumeration Uub enumeration Uuq enumeration Uuh enumeration Uuo
attributes	Name: subscript; Type: **xsd:string**; Use: optional; Default: 1; Fixed: ; Annotation:
annotation	This element declares the content model for Symbol, which contains the symbol for the chemical element. The entry for Symbol is selected from among the strings enumerated by the chemicalElementSymbol datatype. Symbol has one optional attribute, subscript, for indicating the subscript (formula units) of the chemical element.

element **Element/Concentration**

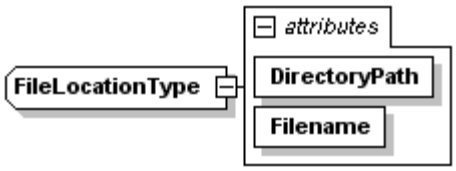
diagram	
type	**Concentration**
annotation	Concentration contains the concentration of the chemical element.

element **Element/Notes**

diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the element.

A.2.17 FileLocationType

complexType **FileLocationType**

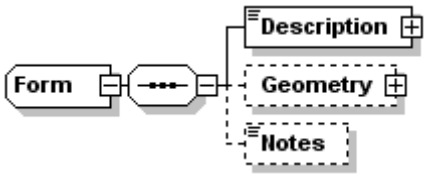
diagram	
used by	elements **ClassificationType/ClassificationDocument LicenseType/LicenseDocument**
attributes	

Name	Type	Use	Annotation
DirectoryPath	**xsd:string**	required	Path to the file location. This could be URL, relative, or absolute path.
Filename	**xsd:string**	required	Filename with extension.

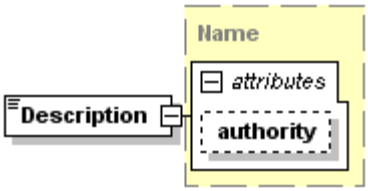
annotation	Complex-type: containing definitions of file name and directory path information.

A.2.18 Form

complexType **Form**

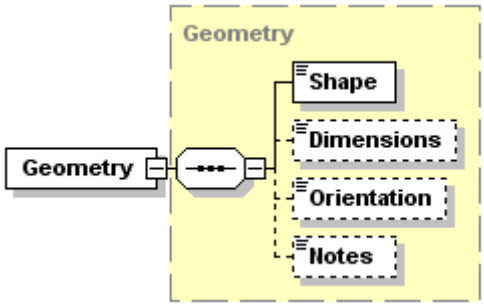
diagram	
used by	elements **BulkDetails/Form ComponentDetails/Form**
annotation	Complex-type: containing the form of the bulk material. It includes a description string and a complex element Geometry to describe shape, dimensions and orientation.

element **Form/Description**

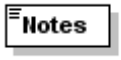
diagram	
type	**Name**
attributes	

Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **Form/Geometry**

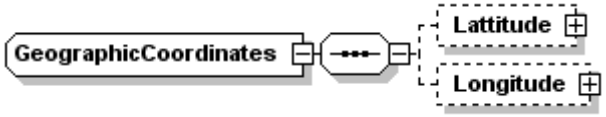
diagram	
type	**Geometry**

element **Form/Notes**

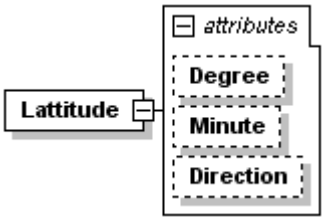
diagram	
type	**Notes**

A.2.19 GeographicCoordinates

complexType **GeographicCoordinates**

diagram	
used by	element **GeographicLocations/Coordinate**
annotation	Complex-type: containing lat-long location definitions.

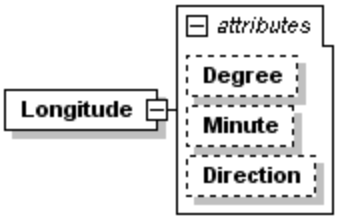
element **GeographicCoordinates/Lattitude**

diagram	

attributes

Name	Type	Use	Annotation
Degree	**xsd:string**		
Minute	**xsd:string**		
Direction			

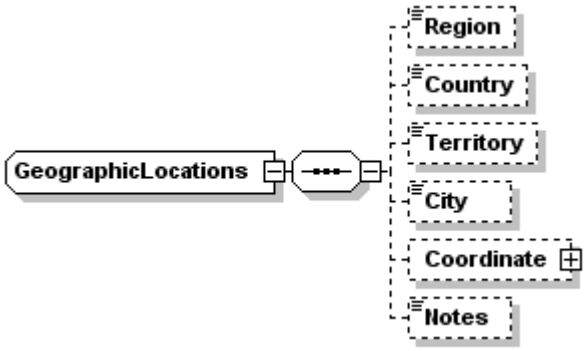
element **GeographicCoordinates/Longitude**

diagram	
attributes	

Name	Type	Use	Annotation
Degree	**xsd:string**		
Minute	**xsd:string**		
Direction			

A.2.20 GeographicLocations

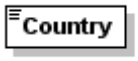
complexType **GeographicLocations**

diagram	
used by	element **SpecimenDetails/GeoInfo/GeoLocation**
annotation	Complex-type: containing geographic location descriptions.

element **GeographicLocations/Region**

diagram	
type	**GeoRegions**
facets	enumeration Oceans enumeration North America enumeration Central America enumeration South America enumeration Europe enumeration Africa enumeration Australia and New Zealand enumeration Antarctica enumeration Asia enumeration Asia Minor and Middle East enumeration Southeast Asia enumeration Other

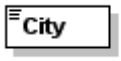
element **GeographicLocations/Country**

diagram	
type	**xsd:string**

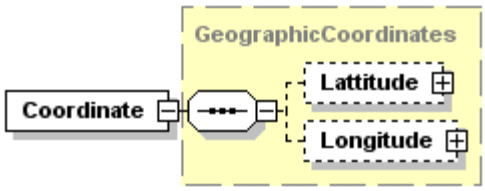
element **GeographicLocations/Territory**

diagram	
type	**xsd:string**

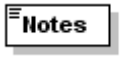
element **GeographicLocations/City**

diagram	
type	**xsd:string**

element **GeographicLocations/Coordinate**

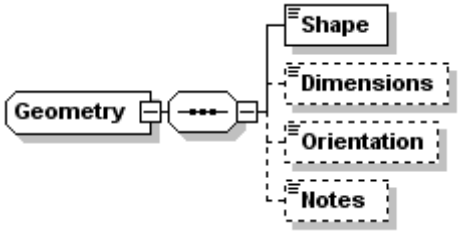
diagram	
type	**GeographicCoordinates**

element **GeographicLocations/Notes**

diagram	
type	**Notes**

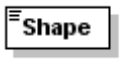
A.2.21 Geometry

complexType **Geometry**

diagram	

used by	elements **Form/Geometry SpecimenDetails/Geometry**
annotation	Complex-type: containing a description of the geometry of the bulk material, component or specimen and is composed of the following elements. - Shape is a string describing the shape of the bulk material or component and must occur once and only once within the Geometry element. - Dimensions is a string describing the dimensions of the bulk material or component and may occur once or not at all within the Geometry element. - Orientation is a string describing the orientation of the bulk material or component and may occur once or not at all within the Geometry element. - Notes contains any additional information concerning the geometry and may occur once or not at all within the Geometry element.

element **Geometry/Shape**

diagram	
type	**xsd:string**

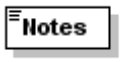
element **Geometry/Dimensions**

diagram	
type	**xsd:string**

element **Geometry/Orientation**

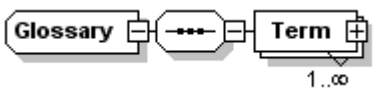
diagram	
type	**xsd:string**

element **Geometry/Notes**

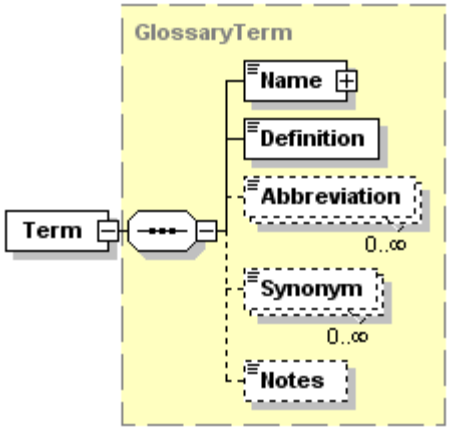
diagram	
type	**Notes**

A.2.22 Glossary

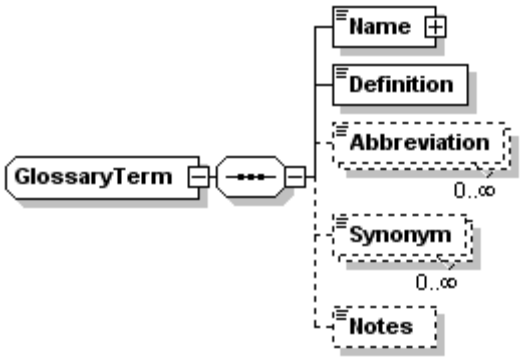
complexType **Glossary**

diagram	
annotation	Complex-type: containing descriptions of material and property terms used in the document.

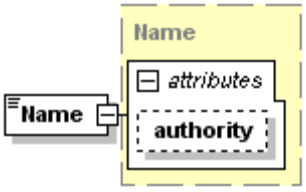
element **Glossary/Term**

diagram	
type	**GlossaryTerm**

complexType **GlossaryTerm**

diagram	
used by	element **Glossary/Term**
annotation	Complex-type: containing definitions for GlossaryTerms.

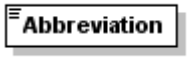
element **GlossaryTerm/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	documentation: Name contains the term's name.

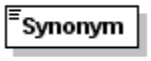
element **GlossaryTerm/Definition**

diagram	
type	**xsd:string**
annotation	Definition contains the term's definition.

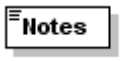
element **GlossaryTerm/Abbreviation**

diagram	
type	**xsd:string**
annotation	Abbreviation contains the term's abbreviation(s).

element **GlossaryTerm/Synonym**

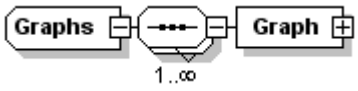
diagram	
type	**xsd:string**
annotation	Synonym contains the term's synonym(s).

element **GlossaryTerm/Notes**

diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the term.

A.2.23 Graphs

complexType **Graphs**

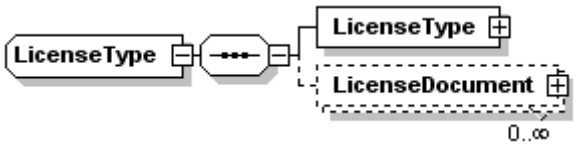
diagram	
annotation	Complex-type: containing graph definition using the W3C's Scalable Vector Graphics markup language (SVG) for describing two dimensional graphics and allows for three types of graphical objects: vector graphics shapes, images, and text. For more information concerning SVG, see the documentation at http://www.w3.org/TR/SVG/.

element **Graphs/Graph**

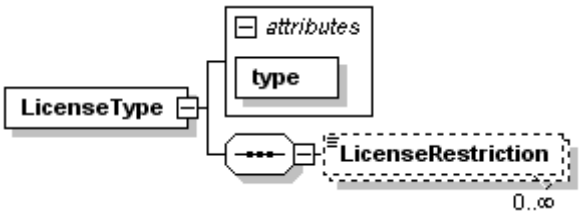
diagram	

A.2.24 LicenseType

complexType **LicenseType**

diagram	
used by	element **DocHeader/LicenseSummary**
annotation	Complex-type: containing restrictions and legal prerequisites for accessing and using the overall dataset or each data file.

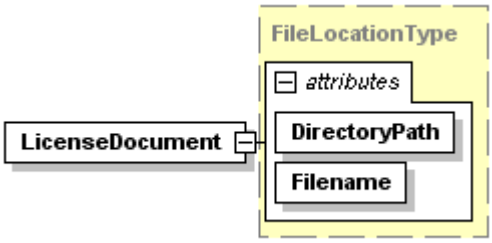
element **LicenseType/LicenseType**

diagram	
attributes	Name: type; Type: ; Use: required; Annotation: Name of the license owner.

element **LicenseType/LicenseType/LicenseRestriction**

diagram	
type	**xsd:string**
annotation	Additional information on license restrictions.

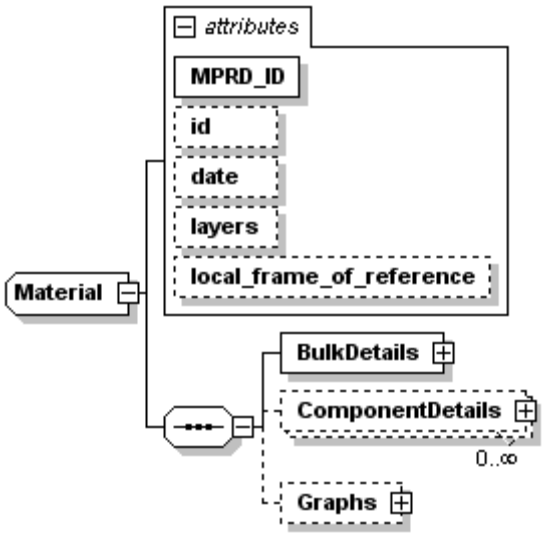
element **LicenseType/LicenseDocument**

diagram	
type	**FileLocationType**
attributes	Name: DirectoryPath; Type: **xsd:string**; Use: required; Annotation: Path to the file location. This could be URL, relative, or absolute path. Name: Filename; Type: **xsd:string**; Use: required; Annotation: Filename with extension.
annotation	License document(s) describing the license restrictions.

A.2.25 Material

complexType **Material**

diagram



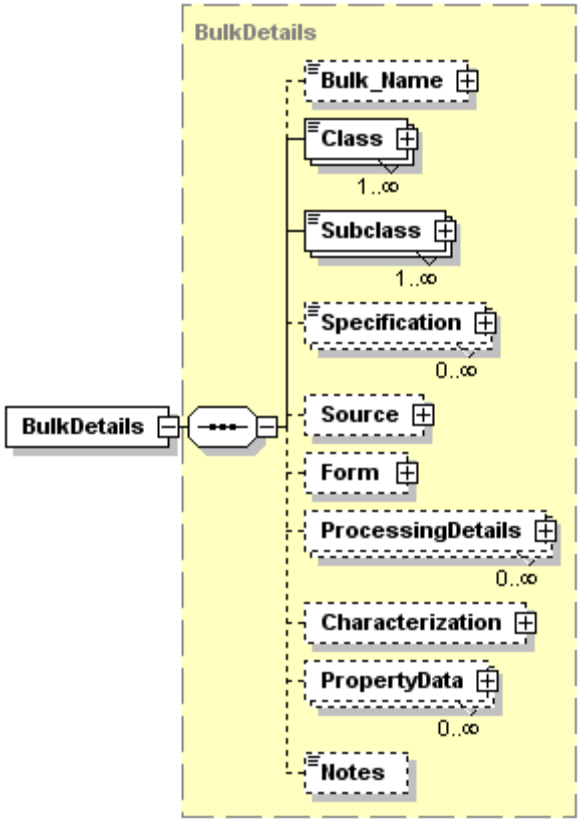
used by element **MPRD_Doc/Material**

attributes

Name	Type	Use	Annotation
MPRD_ID		required	attribute: human readable unique ID that identify the material using the following rule: [Class]_[Subclass]_[Name]] [Name] is the same as the Bulk_Name element under BulkDetails. [Class] is the same as the Class element under BulkDetails. [Subclass] is the same as the Subclass element under BulkDetails. Examples: - Vegetation_Tree_Sierra Lodgepole Pine - Liquid_Water_Distilled - Construction_Roof_Red Concrete Tile
id	**xsd:ID**	optional	attribute: a unique sequential index or a computer generated globally unique identification (GUID). This id will be used in managing the material database.
date	**xsd:string**	optional	attribute: the date the material is last updated.
layers	**xsd:integer**	optional	attribute: may be used to indicate the number of layers in complex systems such as composite laminates.
local_frame_of_reference	**xsd:string**	optional	attribute: may be used as an identification specifier for the local material orientation relative to the global frame of reference, which is especially useful for complex systems such as anisotropic materials.

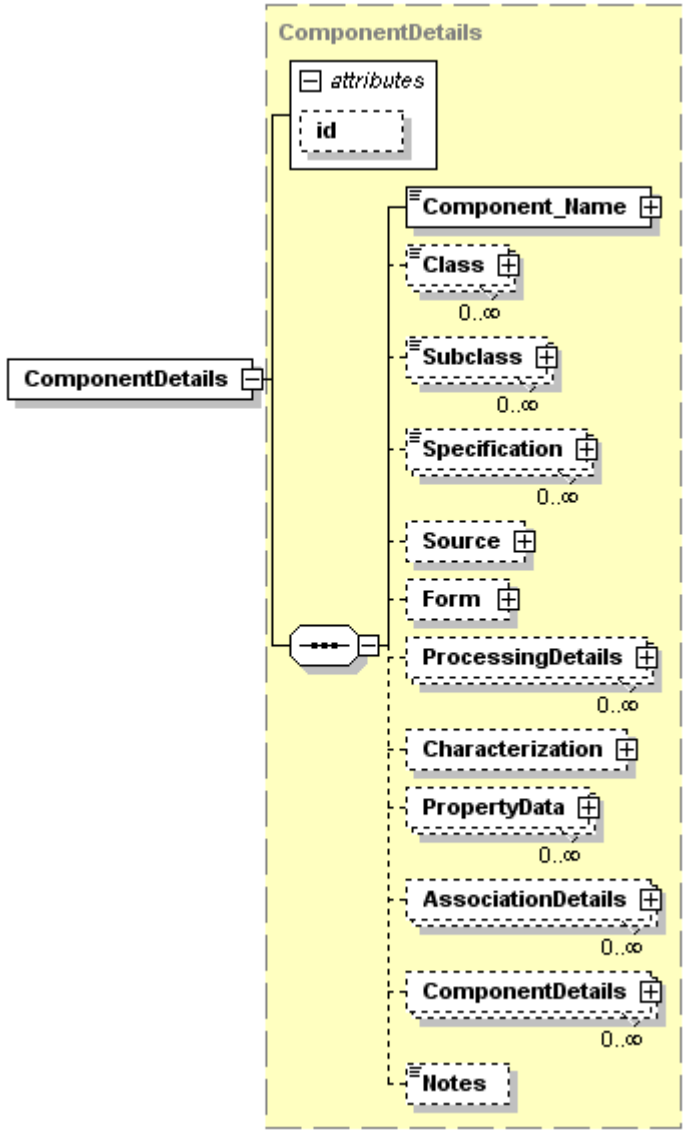
annotation Complex-type: containing MPRD _Doc material definitions.

element **Material/BulkDetails**

diagram	
type	**BulkDetails**

element **Material/ComponentDetails**

diagram



type **ComponentDetails**

attributes

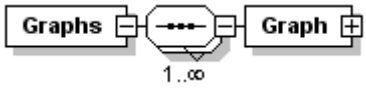
Name	Type	Use	Annotation
id	**xsd:ID**	optional	attribute: id is used in AssociationDetails element. The component id can be paired with other components with relationships defined in Relationship element.

annotation

ComponentDetails contains description of components within the bulk material and has one optional attribute, id, which may be used as an identification specifier for the component and is especially useful for complex systems such as composite laminates.

element **Material/Graphs**

diagram



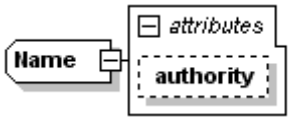
annotation	Graph uses the W3C's Scalable Vector Graphics markup language (SVG) for describing two dimensional graphics and allows for three types of graphical objects: vector graphics shapes, images, and text. For more information concerning SVG, see the documentation at http://www.w3.org/TR/SVG/.

element **Material/Graphs/Graph**

diagram	

A.2.26 Name

complexType **Name**

diagram	
type	extension of **xsd:string**
used by	elements **BulkDetails/Bulk_Name BulkDetails/Class ComponentDetails/Class ComponentDetails/Component_Name Form/Description Term/Name SpecimenDetails/Name ProcessingDetails/Name PhaseComposition/Name GlossaryTerm/Name DimensionalDetails/Name DataTable/Name DataFile/Name ComponentDetails/Specification BulkDetails/Specification ComponentDetails/Subclass BulkDetails/Subclass**

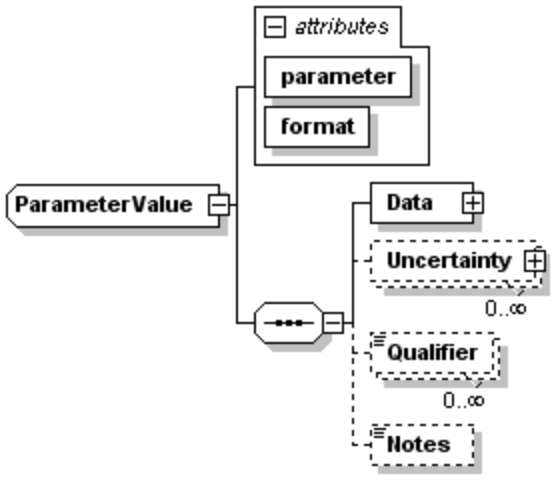
attributes

Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

annotation	Complex-type: containing material name as assigned by the authoriative source defined in the authority attribute.

A.2.27 ParameterValue

complexType **ParameterValue**

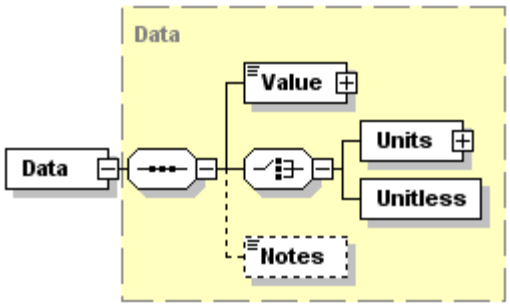
diagram	
used by	elements **ProcessingDetails/ParameterValue PropertyData/ParameterValue TestConditionDetails/ParameterValue**

attributes

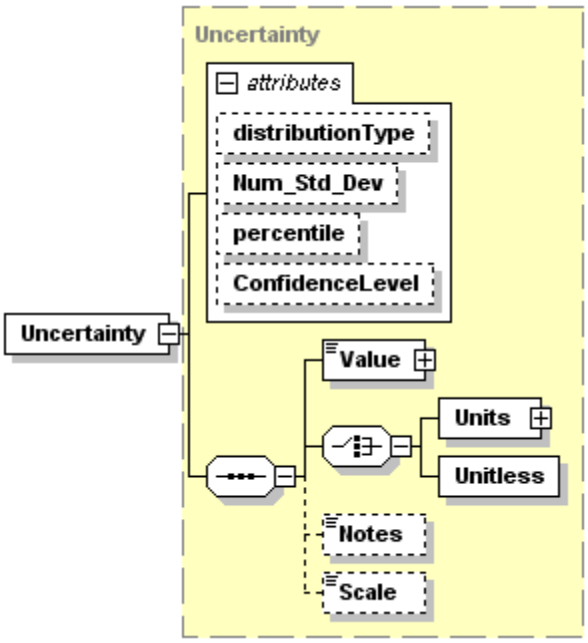
Name	Type	Use	Annotation
parameter	**xsd:string**	required	attribute: parameter references an id attribute specified in a ParameterDetails element in MPRD dictionary.
format	**DataFormat**	required	attribute: format indicates the format of the value. If used, "mixed" indicates that the not all of the parameter values are of the same type (e.g. a "No Break"

					value for an otherwise numeric set of test results). If used, then the "format" attribute on each "Data" item should be individually set.
annotation	Complex-type: containing the values of parameters.				

element **ParameterValue/Data**

diagram	
type	**Data**
annotation	Data contains the parameter data.

element **ParameterValue/Uncertainty**

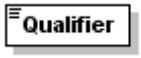
diagram	
type	**Uncertainty**

attributes

Name	Type	Use	Default	Annotation
distributionType	**xsd:string**	optional	Normal/Gaussian	attribute: distributionType is a description of the nature of the uncertainty value, for example '6 sigma', 'Gaussian' or '2 std dev.'.
Num_Std_Dev	**xsd:float**	optional	2	
percentile	**xsd:float**	optional		attribute: percentile is a value indicating the percentage of the data population that have values less than or equal to that expressed by the Uncertainty value.
ConfidenceLevel	**xsd:float**	optional		

annotation	Uncertainty contains the measurement uncertainty(ies) of the data in ParameterValue and may occur once or not at all within the ParameterValue element.

element **ParameterValue/Qualifier**

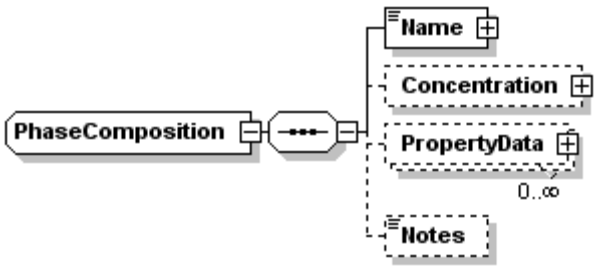
diagram	
type	**Qualifier**
annotation	Qualifier contains any qualifier(s) pertinent to the data in ParameterValue(e.g."min," "max," etc.) and may occur zero or more times within the PropertyData element.

element **ParameterValue/Notes**

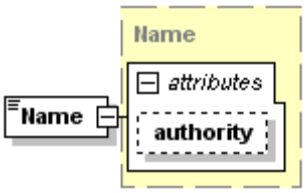
diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the property data.

A.2.28 PhaseComposition

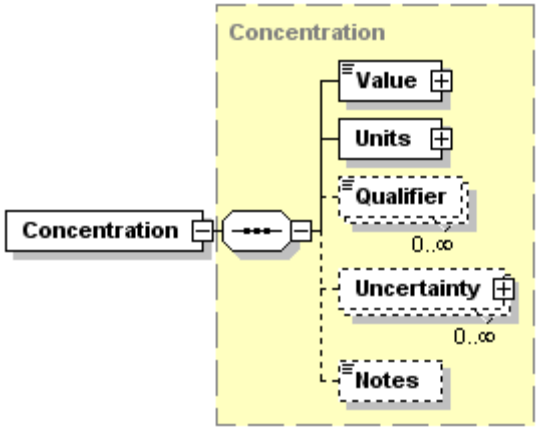
complexType **PhaseComposition**

diagram	
used by	element **Characterization/PhaseComposition**
annotation	Complex-type: containing a description of a phase that comprises the bulk material or component and is composed of the following elements.

element **PhaseComposition/Name**

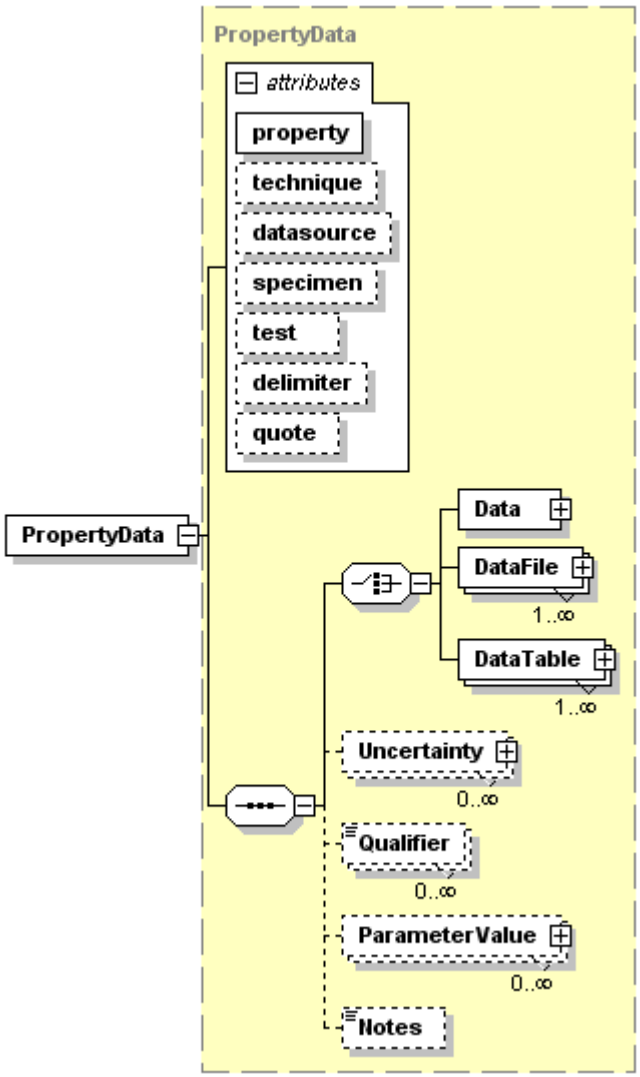
diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	Name contains the name of the phase.

element **PhaseComposition/Concentration**

diagram	
type	**Concentration**
annotation	Concentration contains the concentration of the phase.

element **PhaseComposition/PropertyData**

diagram



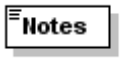
type **PropertyData**

attributes

Name	Type	Use	Annotation
property	**xsd:string**	required	attribute: property data id as defined in PropertyDetails section of MPRD_Dictionary.
technique	**xsd:string**		attribute: technique id as defined in MeasurementTechniqueDetails section of MPRD_Dictionary.
datasource	**xsd:string**		attribute: data source id as defined in DataSourceDetails section of MPRD_Dictionary.
specimen	**xsd:string**		attribute: specimen id as defined in SpecimenDetails in the Dictionary element.
test	**xsd:string**		attribute: test condition id as defined in TestConditionDetails in Metadata.
delimiter			attribute: delimiter specifies the delimiter that separates multiple values in the Data, Qualifier, Uncertainty, and ParameterValue elements. The default value is a comma (',').
quote	**xsd:string**		attribute: quote specifies the string that is used to quote values in the Data, Qualifier, Uncertainty and ParameterValue elements.

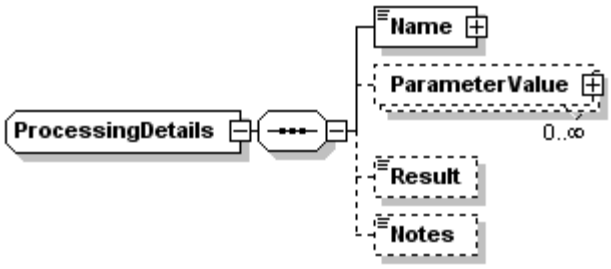
annotation PropertyData contains property data for the phase.

element **PhaseComposition/Notes**

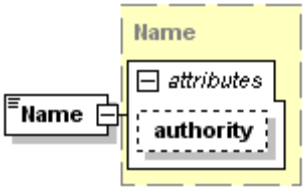
diagram	
type	**Notes**
annotation	Notes contains any additional information concerning the phase.

A.2.29 ProcessingDetails

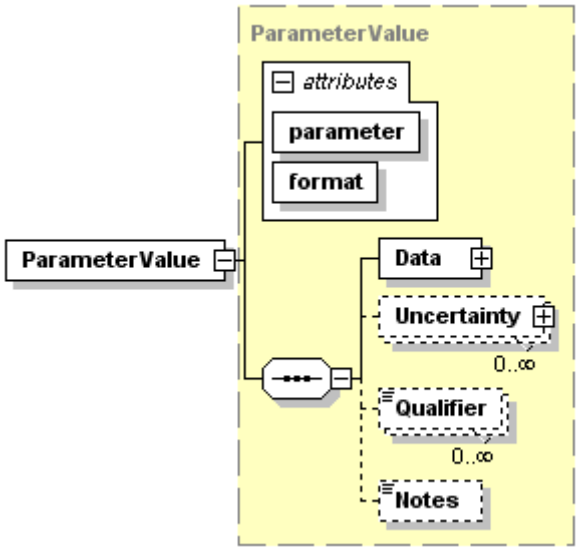
complexType **ProcessingDetails**

diagram	
used by	elements **BulkDetails/ProcessingDetails ComponentDetails/ProcessingDetails**
annotation	Complex-type: containing a description of a processing step for the bulk material or component.

element **ProcessingDetails/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.
annotation	Name contains the name of the processing step.

element **ProcessingDetails/ParameterValue**

diagram	
type	**ParameterValue**
attributes	Name / Type / Use / Annotation parameter / **xsd:string** / required / attribute: parameter references an id attribute specified in a ParameterDetails element in MPRD dictionary. format / **DataFormat** / required / attribute: format indicates the format of the value. If used, "mixed" indicates that the not all of the parameter values are of the same type (e.g. a "No Break" value for an otherwise numeric set of test results). If used, then the "format" attribute on each "Data" item should be individually set.
annotation	ParameterValue contains the value of a parameter under which the processing step occurred.

element **ProcessingDetails/Result**

diagram	Result
type	**xsd:string**
annotation	Result is a string that contains a description of the outcome or result of the processing step.

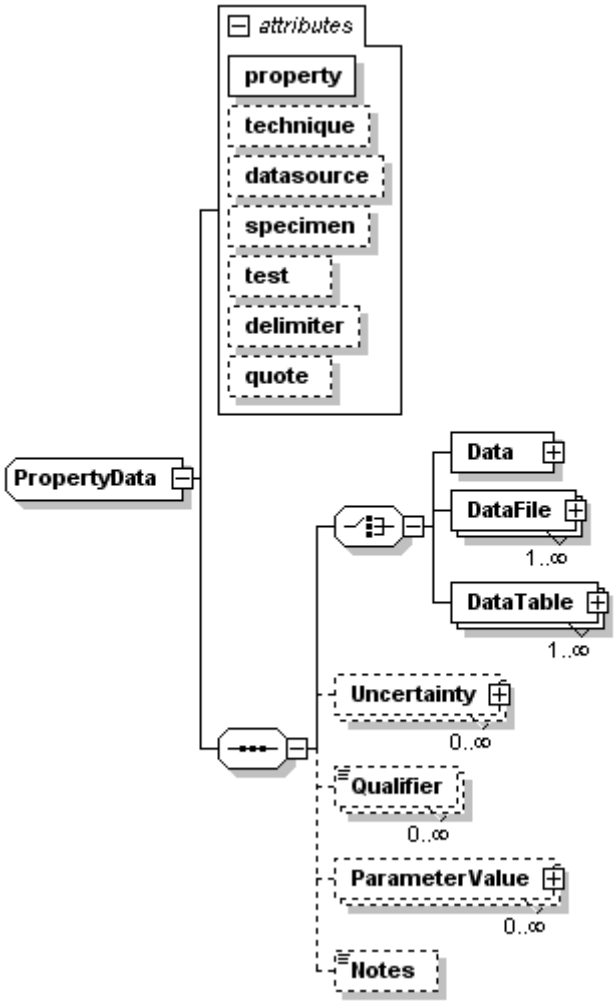
element **ProcessingDetails/Notes**

diagram	Notes
type	**Notes**
annotation	Notes contains any additional information concerning the processing step.

A.2.30 PropertyData

complexType **PropertyData**

diagram



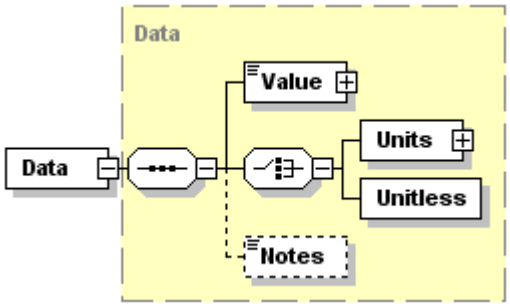
used by — elements **BulkDetails/PropertyData ComponentDetails/PropertyData PhaseComposition/PropertyData**

attributes

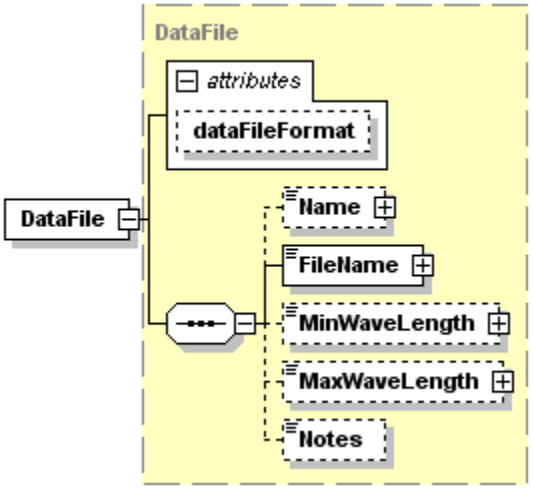
Name	Type	Use	Annotation
property	**xsd:string**	required	attribute: property data id as defined in PropertyDetails section of MPRD_Dictionary.
technique	**xsd:string**		attribute: technique id as defined in MeasurementTechniqueDetails section of MPRD_Dictionary.
datasource	**xsd:string**		attribute: data source id as defined in DataSourceDetails section of MPRD_Dictionary.
specimen	**xsd:string**		attribute: specimen id as defined in SpecimenDetails in the Dictionary element.
test	**xsd:string**		attribute: test condition id as defined in TestConditionDetails in Metadata.
delimiter			attribute: delimiter specifies the delimiter that separates multiple values in the Data, Qualifier, Uncertainty, and ParameterValue elements. The default value is a comma (',').
quote	**xsd:string**		attribute: quote specifies the string that is used to quote values in the Data, Qualifier, Uncertainty and ParameterValue elements.

annotation — Complex-type: containing material property data.

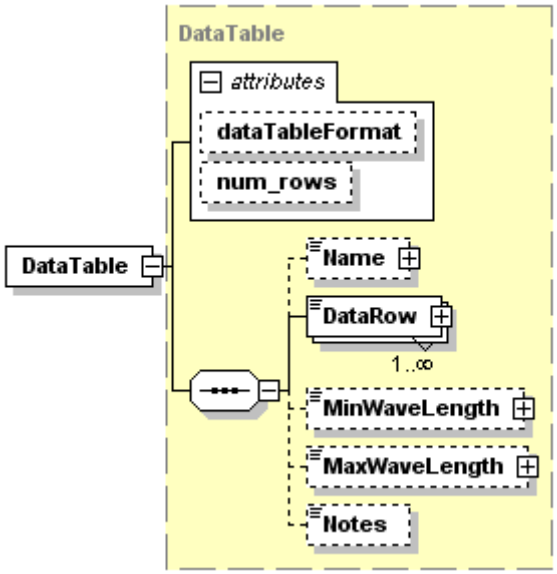
element **PropertyData/Data**

diagram	
type	**Data**
annotation	documentation Data contains property data. Data could be a single value or a series of values separated by delimiters.

element **PropertyData/DataFile**

diagram	
type	**DataFile**
attributes	Name: dataFileFormat; Type: **xsd:string**; Use: ; Annotation: dataFileFormat is an ID referenced from Global MPRD_Dictionary where the file format is defined.
annotation	DataFile contains references to large data tables external to the XML document. This construct can be used for large radiometry data such as per band spectral response.

element **PropertyData/DataTable**

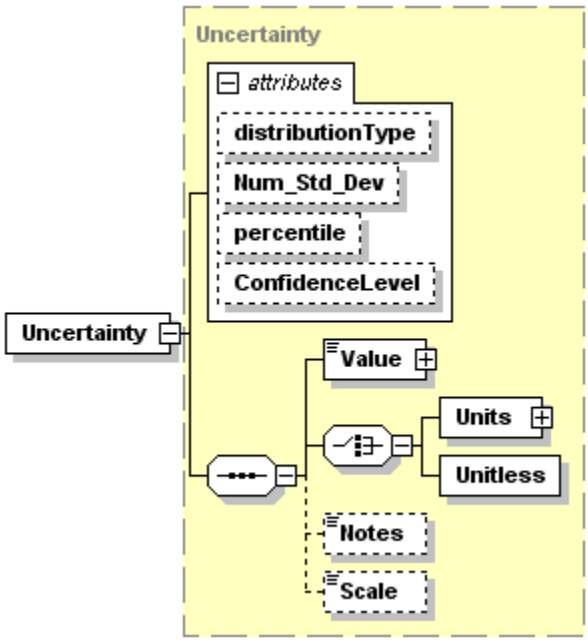
diagram	
type	**DataTable**

attributes

Name	Type	Use	Annotation
dataTableFormat	**xsd:string**	optional	
num_rows	**xsd:positiveInteger**	optional	

annotation: DataTable contains datarows of tabular data within the XML document. This construct can be used for small radiometry data such as per band spectral response.

element **PropertyData/Uncertainty**

diagram	
type	**Uncertainty**

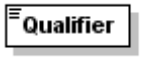
attributes

Name	Type	Use	Default	Annotation
distributionType	**xsd:string**	optional	Normal/Gaussian	attribute: distributionType is a description of the nature of the uncertainty value, for example '6 sigma', 'Gaussian' or '2 std dev.'.
Num_Std_Dev	**xsd:float**	optional	2	
percentile	**xsd:float**	optional		attribute: percentile is a value indicating the percentage of the data population that have values less than or equal to that expressed by the Uncertainty value.
ConfidenceLevel	**xsd:float**	optional		

annotation: Uncertainty contains the measurement uncertainty(ies) of the data in Data element.

element **PropertyData/Qualifier**

diagram

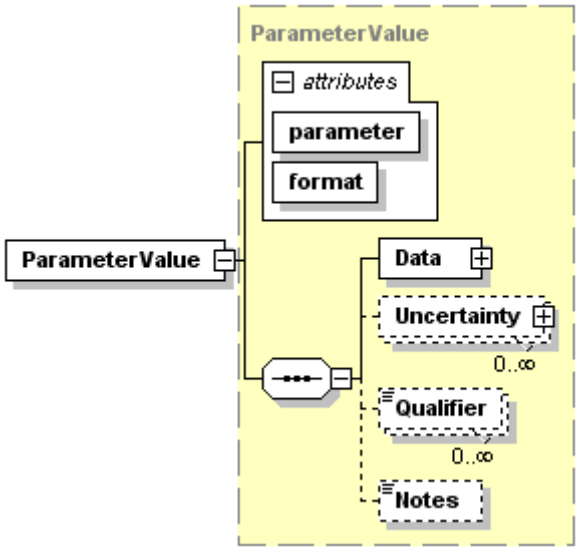


type: **Qualifier**

annotation: Qualifier contains any qualifier(s) pertinent to the data in Data (e.g. "min," "max," etc.) and may occur once or not at all within the PropertyData element.

element **PropertyData/ParameterValue**

diagram



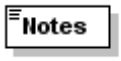
type: **ParameterValue**

attributes

Name	Type	Use	Annotation
parameter	**xsd:string**	required	attribute: parameter references an id attribute specified in a ParameterDetails element in MPRD dictionary.
format	**DataFormat**	required	attribute: format indicates the format of the value. If used, "mixed" indicates that the not all of the parameter values are of the same type (e.g. a "No Break" value for an otherwise numeric set of test results). If used, then the "format" attribute on each "Data" item should be individually set.

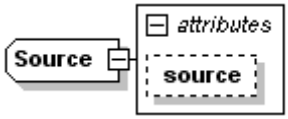
annotation: ParameterValue contains the value(s) of a parameter under which the data were determined.

element **PropertyData/Notes**

diagram	
type	**Notes**
annotation	documentation Notes contains any additional information concerning the property data.

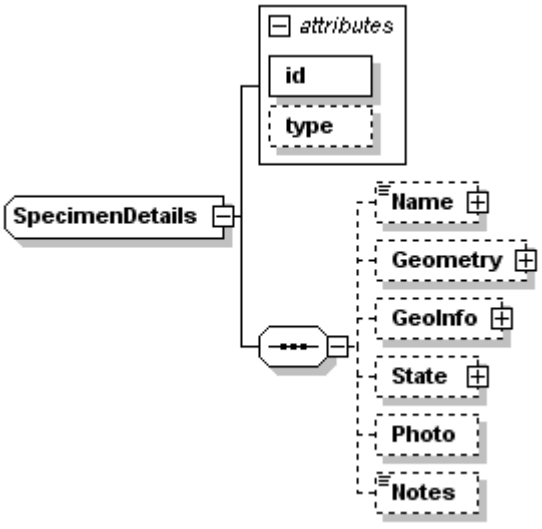
A.2.31 Source

complexType **Source**

diagram	
used by	elements **BulkDetails/Source ComponentDetails/Source**
attributes	Name: source; Type: **xsd:string**; Use: optional; Annotation: attribute: source id as defined in SourceDetails section of MPRD_Dictionary.
annotation	Complex-type: containing the source provider of data.

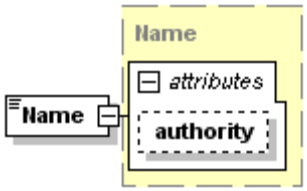
A.2.32 SpecimenDetails

complexType **SpecimenDetails**

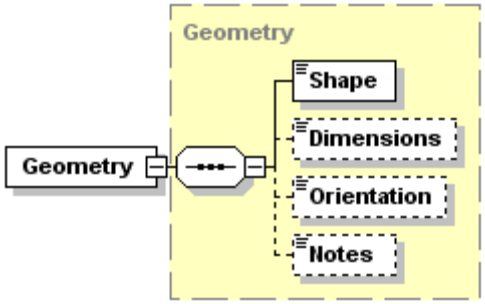
diagram	
used by	element **Dictionary/SpecimenDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation: Name: type; Type: **xsd:string**; Use: optional; Annotation:
annotation	Complex-type: containg ids and descriptions of the specimen materials. The specifics include locations, season, geometry, physical states, photos and any notes. SpecimenDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. delimiter and row data format. Optional attribute "type" specifies the type of the specimen, e.g. "cylindrical," "rectangular," "full cross-section," "pressed,"

	etc.

element **SpecimenDetails/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

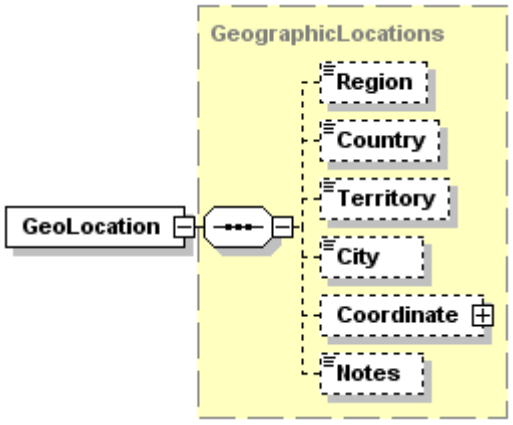
element **SpecimenDetails/Geometry**

diagram	
type	**Geometry**

element **SpecimenDetails/GeoInfo**

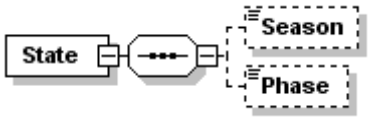
diagram	

element **SpecimenDetails/GeoInfo/GeoLocation**

diagram	

type	**GeographicLocations**

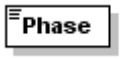
element **SpecimenDetails/State**

diagram	

element **SpecimenDetails/State/Season**

diagram	
type	restriction of **xsd:string**
facets	enumeration: Spring enumeration: Summer enumeration: Autumn enumeration: Winter enumeration:

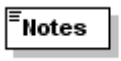
element **SpecimenDetails/State/Phase**

diagram	
type	**xsd:string**

element **SpecimenDetails/Photo**

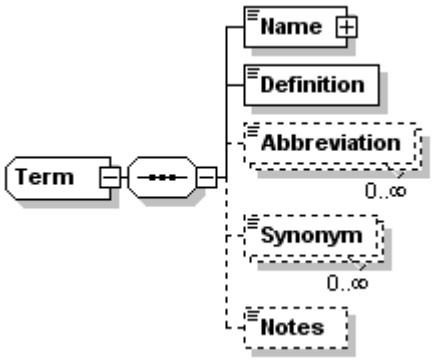
diagram	

element **SpecimenDetails/Notes**

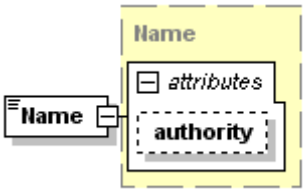
diagram	
type	**Notes**

A.2.33 Term

complexType **Term**

diagram	
used by	element **MPRD_Doc/Glossary/Terms**

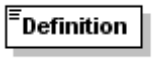
element **Term/Name**

diagram	
type	**Name**

attributes

Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

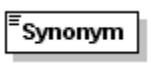
element **Term/Definition**

diagram	
type	**xsd:string**

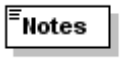
element **Term/Abbreviation**

diagram	
type	**xsd:string**

element **Term/Synonym**

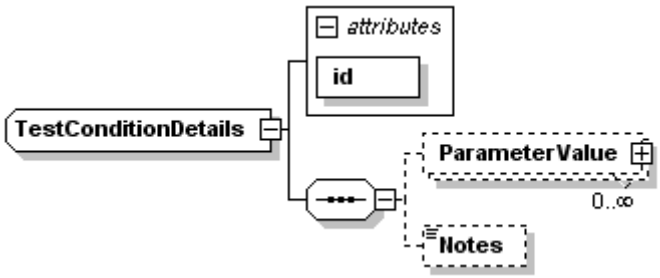
diagram	
type	**xsd:string**

element **Term/Notes**

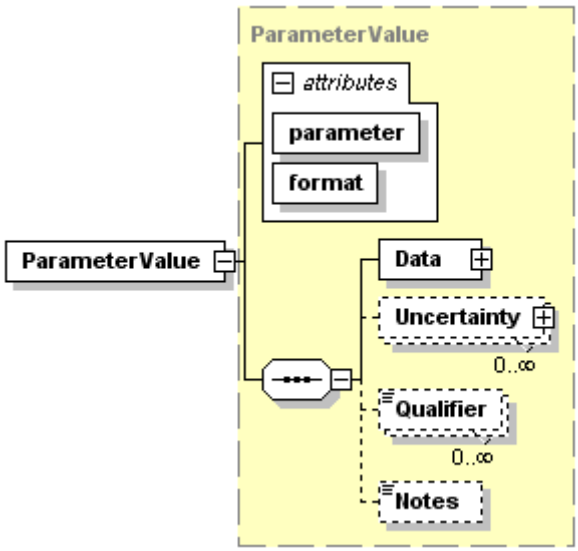
diagram	
type	**Notes**

A.2.34 TestConditionDetails

complexType **TestConditionDetails**

diagram	
used by	element **Dictionary/TestConditionDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation:
annotation	Complex-type:contiaing a description of the test conditions referenced by the PropertyData element.

element **TestConditionDetails/ParameterValue**

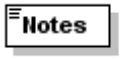
diagram	
type	**ParameterValue**

attributes

Name	Type	Use	Annotation
parameter	**xsd:string**	required	attribute: parameter references an id attribute specified in a ParameterDetails element in MPRD dictionary.
format	**DataFormat**	required	attribute: format indicates the format of the value. If used, "mixed" indicates that the not all of the parameter values are of the same type (e.g. a "No Break" value for an otherwise numeric set of test results). If used, then the

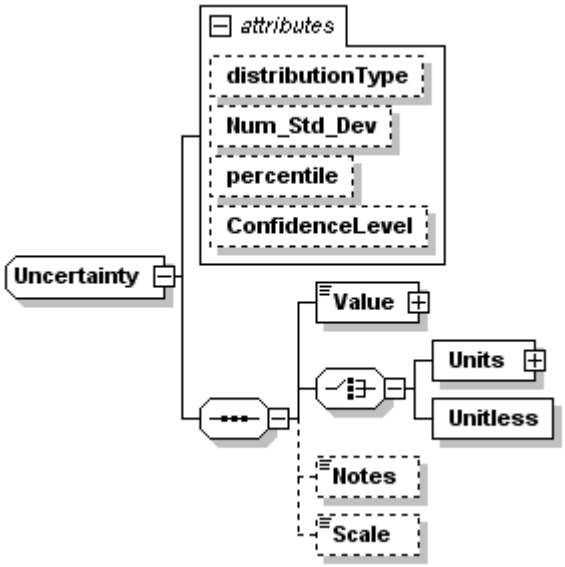
				"format" attribute on each "Data" item should be individually set.

element **TestConditionDetails/Notes**

diagram	
type	**Notes**

A.2.35 Uncertainty

complexType **Uncertainty**

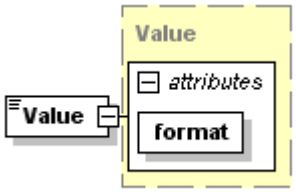
diagram	
used by	elements **Concentration/Uncertainty DimensionalDetails/Uncertainty ParameterValue/Uncertainty PropertyData/Uncertainty**

attributes

Name	Type	Use	Default	Annotation
distributionType	**xsd:string**	optional	Normal/Gaussian	attribute: distributionType is a description of the nature of the uncertainty value, for example '6 sigma', 'Gaussian' or '2 std dev.'
Num_Std_Dev	**xsd:float**	optional	2	
percentile	**xsd:float**	optional		attribute: percentile is a value indicating the percentage of the data population that have values less than or equal to that expressed by the Uncertainty value.
ConfidenceLevel	**xsd:float**	optional		

annotation: ComplexType: containing a description of the measurement uncertainty of the data.
An uncertainty of 2 standard deviations below the mean for a normally distributed dataset would have a uncertainty percentile of 5%, and 2 standard deviations above the mean would be 95%.

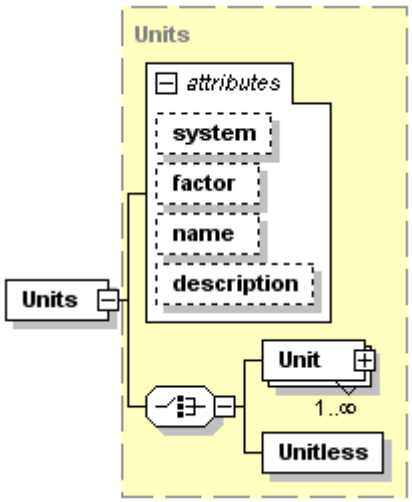
element **Uncertainty/Value**

diagram	
type	**Value**
attributes	

Name	Type	Use	Default	Fixed	Annotation
format	**DataFormat**	required			

annotation	Value contains the value of the uncertainty.

element **Uncertainty/Units**

diagram	
type	**Units**
attributes	

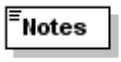
Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s"
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second"

annotation	Units contains the units for the value of the uncertainty.

element **Uncertainty/Unitless**

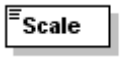
diagram	
type	**Unitless**

element **Uncertainty/Notes**

diagram 

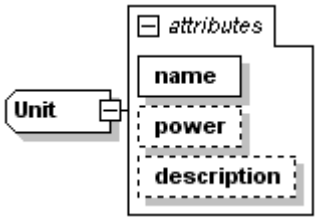
type **Notes**

element **Uncertainty/Scale**

diagram	
type	restriction of **xsd:string**
facets	enumeration Linear enumeration Logarithmic

A.2.36 Unit

complexType **Unit**

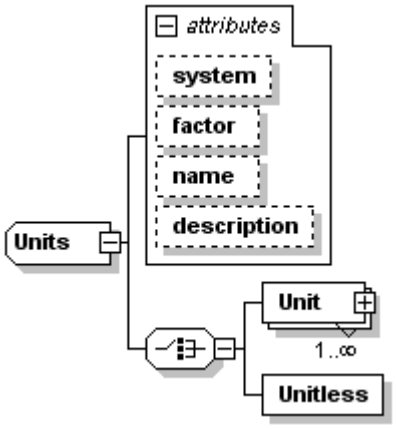
diagram	
used by	element **Units/Unit**
attributes	Name / Type / Use / Annotation name / / required / unit abbreviation. For example "s" for seconds power / **xsd:decimal** / / attribute: power is used to indicate the exponent for Unit. description / **xsd:string** / / attribute: description is used to describe Unit. For example "Seconds".
annotation	Complex-type: containing unit definitions.

complexType **Unitless**

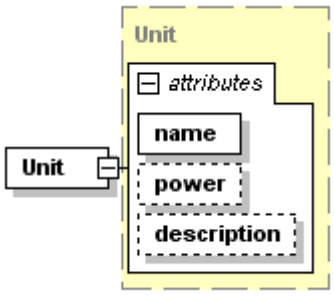
diagram	
used by	elements **Data/Unitless Uncertainty/Unitless Units/Unitless**
annotation	Complex-type: declaring the element value has no unit.

A.2.37 Units

complexType **Units**

diagram	
used by	elements **Concentration/Units Data/Units DimensionalDetails/Units Uncertainty/Units**
attributes	Name / Type / Use / Annotation system / **xsd:string** / / attribute: system is used to indicate the units system, such as "SI." factor / **xsd:float** / / attribute: factor is used to indicate a constant multiplier in floating point format. name / **xsd:string** / / attribute: name is used to indicate the name of the units. For example: "m/s". description / **xsd:string** / / attribute: description is used to describe the units. For example: "meter per second".
annotation	Complex-type: containing unit definitions. Example: <Units system="SI" name="W/m-K" description="watt per meter Kelvin "> <Unit name="W" power="1" description="watt"/> <Unit name="m" power="-1" description="meter"/> <Unit name="K" power="-1" description="Kelvin"/> </Units>

element **Units/Unit**

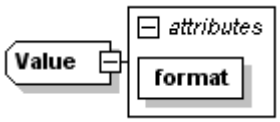
diagram	
type	**Unit**
attributes	Name / Type / Use / Annotation name / / required / unit abbreviation. For example "s" for seconds. power / **xsd:decimal** / / attribute: power is used to indicate the exponent for Unit. description / **xsd:string** / / attribute: description is used to describe Unit. For example "Seconds".
annotation	Multiple Unit elements are multiplied together to form the units. Division is specified by using setting the power attribute of Unit equal to "-1."

element **Units/Unitless**

diagram	
type	**Unitless**

A.2.38 Value

complexType **Value**

diagram	
type	extension of **xsd:string**
used by	elements **Concentration/Value Data/Value DimensionalDetails/Value Uncertainty/Value**
attributes	Name: format; Type: **DataFormat**; Use: required; Default: ; Fixed: ; Annotation:
annotation	Complex-type: containing a string representing a value.

A.3 MPRD Doc Simple Types

A.3.1 ChemicalElementSymbol

simpleType **ChemicalElementSymbol**

type	restriction of **xsd:string**
used by	element **Element/Symbol**
facets	enumeration H enumeration He enumeration Li enumeration Be enumeration B enumeration C enumeration N enumeration O enumeration F enumeration Ne enumeration Na enumeration Mg enumeration Al enumeration Si enumeration P enumeration S enumeration Cl enumeration Ar enumeration K enumeration Ca enumeration Sc enumeration Ti enumeration V enumeration Cr enumeration Mn enumeration Fe enumeration Co enumeration Ni enumeration Cu enumeration Zn enumeration Ga enumeration Ge enumeration As enumeration Se enumeration Br enumeration Kr enumeration Rb enumeration Sr enumeration Y enumeration Zr enumeration Nb enumeration Mo enumeration Tc enumeration Ru enumeration Rh enumeration Pd enumeration Ag enumeration Cd enumeration In enumeration Sn enumeration Sb enumeration Te enumeration I enumeration Xe enumeration Cs

	enumeration	Ba
	enumeration	La
	enumeration	Ce
	enumeration	Pr
	enumeration	Nd
	enumeration	Pm
	enumeration	Sm
	enumeration	Eu
	enumeration	Gd
	enumeration	Tb
	enumeration	Dy
	enumeration	Ho
	enumeration	Er
	enumeration	Tm
	enumeration	Yb
	enumeration	Lu
	enumeration	Hf
	enumeration	Ta
	enumeration	W
	enumeration	Re
	enumeration	Os
	enumeration	Ir
	enumeration	Pt
	enumeration	Au
	enumeration	Hg
	enumeration	Tl
	enumeration	Pb
	enumeration	Bi
	enumeration	Po
	enumeration	At
	enumeration	Rn
	enumeration	Fr
	enumeration	Ra
	enumeration	Ac
	enumeration	Th
	enumeration	Pa
	enumeration	U
	enumeration	Np
	enumeration	Pu
	enumeration	Am
	enumeration	Cm
	enumeration	Bk
	enumeration	Cf
	enumeration	Es
	enumeration	Fm
	enumeration	Md
	enumeration	No
	enumeration	Lr
	enumeration	Rf
	enumeration	Db
	enumeration	Sg
	enumeration	Bh
	enumeration	Hs
	enumeration	Mt
	enumeration	Uun
	enumeration	Uuu
	enumeration	Uub
	enumeration	Uuq
	enumeration	Uuh
	enumeration	Uuo
annotation	Simple-type: enumerates the valid strings representing chemical elements, which may be used in the Symbol element.	

A.3.2 DataFormat

simpleType **DataFormat**

type	restriction of **xsd:string**
used by	attributes **DataFile/MinWaveLength/@format DataFile/MaxWaveLength/@format DataTable/MinWaveLength/@format DataTable/MaxWaveLength/@format ParameterValue/@format Value/@format**
facets	enumeration: float enumeration: integer enumeration: string enumeration: exponential enumeration: mixed
annotation	DataFormat defines a simple type for element values. It is enumerated with "float," "integer," "string,", "exponential" and "mixed". "mixed" is only used for a group of data where each individual member of the group can be given a unique format.

A.3.3 Formula

simpleType **Formula**

type	**xsd:string**
used by	element **Characterization/Formula**
annotation	Simple-type:containing a string representation of the chemical formula for the bulk material or component.

A.3.4 GeoRegions

simpleType **GeoRegions**

type	restriction of **xsd:string**
used by	element **GeographicLocations/Region**
facets	enumeration: Oceans enumeration: North America enumeration: Central America enumeration: South America enumeration: Europe enumeration: Africa enumeration: Australia and New Zealand enumeration: Antarctica enumeration: Asia enumeration: Asia Minor and Middle East enumeration: Southeast Asia enumeration: Other
annotation	simple-type: enumerates main geographic regions.

A.3.5 Notes

simpleType **Notes**

type	**xsd:string**
used by	elements **Term/Notes Uncertainty/Notes TestConditionDetails/Notes SpecimenDetails/Notes PropertyData/Notes ProcessingDetails/Notes PhaseComposition/Notes ParameterValue/Notes GlossaryTerm/Notes Geometry/Notes GeographicLocations/Notes Form/Notes Element/Notes DimensionalDetails/Notes DataTable/Notes DataFile/Notes Data/Notes Concentration/Notes Compound/Notes ComponentDetails/Notes Characterization/Notes BulkDetails/Notes AssociationDetails/Notes**
annotation	Simple-type: containing a string representing descriptive notes.

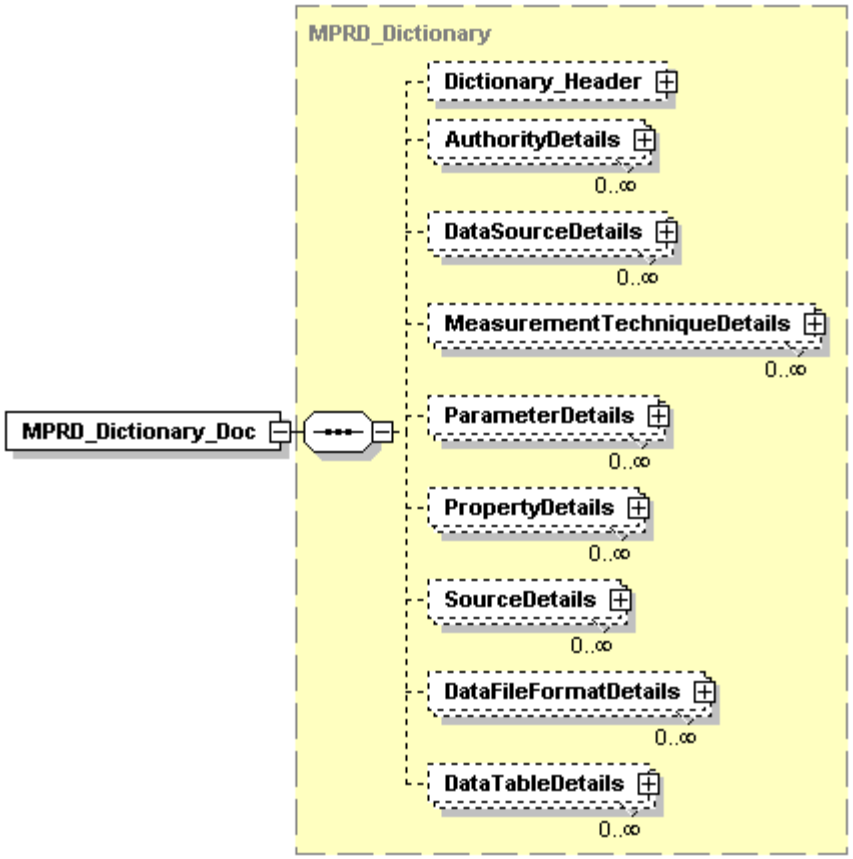
A.3.6 Qualifier

simpleType **Qualifier**

type	**xsd:string**
used by	elements **Concentration/Qualifier ParameterValue/Qualifier PropertyData/Qualifier**
annotation	Simple-type: containing string representing a qualifier.

A.4 MPRD_Dictionary_Doc Elements

element **MPRD_Dictionary_Doc**

diagram	
type	**MPRD_Dictionary**
annotation	MPRD Dictionary Root Document. This document contains ids and descriptions of authorities, data sources, measurement techniques, parameters, data properties, material sources, and data file and table formats. The ids are to be used in conjunction with MPRD_Doc.

Dictionary_Header is the document header containing document title, revision history, and other administrative information (contact info, licensing, security, etc.).

AuthorityDetails element contains the details for each authority id that may be referenced by any MPRD Document. Authority is a person or an organization that defines the name, terms, or nomenclature used in the MPRD.

DataSourceDetails element contains the details for each data source id that may be referenced by any MPRD Document. Data source is a person or an organization provides a particular material property data per property in a material.

MeasurementTechnique element contains the details for each measurement technique id that may be referenced by any MPRD Document. Measurement technique is a description of a method used in measuring the property data.

ParameterDetails element contains the details for each parameter id that may be referenced by any MPRD Document. Parameter is a measured environmental condition

under which the property data is being measured. Parameter examples would be temperature, pressure, elevation, etc.

PropertyDetails element contains the details for each property id that may be referenced by any MPRD Document. Property is the measured/quantified behavior of the material under a given parameter condition. Property examples would be reflectivity, thermal conductivity, specific gravity, etc.

SourceDetails element contains the details for each source id that may be referenced by any MPRD Document. Source is a person or organization that provides the material property for each material in a MPRD Document.

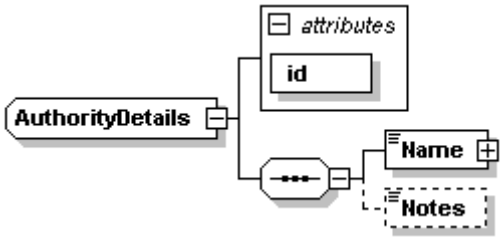
DataFileFormatDetails element contains the details for each data file format id that may be referenced by any MPRD Document. Data file format describes the format of a data file so the data can be read and loaded for use. Large tables of radiometry (spectral) data for a material may be tabulated in a separate file, such as ASCII or binary file.

DataTableDetails element contains the details for each data table id that may be referenced by any MPRD Document. Data table describes the format of a table so the data can be read and loaded for use. Small and medium tables of radiometry (spectral) data for a material may be tabulated internally within a MPRD Document.

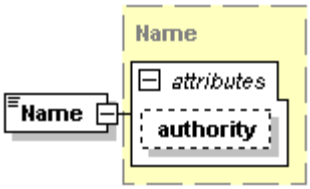
A.5 MPRD_Dictionary_Doc Complex Types

A.5.1 AuthorityDetails

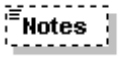
complexType **AuthorityDetails**

diagram	
used by	element **MPRD_Dictionary/AuthorityDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation:
annotation	Complex-type: AuthorityDetails contains ids and descriptions of authorities (usually organizations) referenced by attribute "authority" of complex datatype "Name" in MPRD schema. AuthorityDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the Authority defined under the authority. Notes contains any additional information concerning the Authority.

element **AuthorityDetails/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

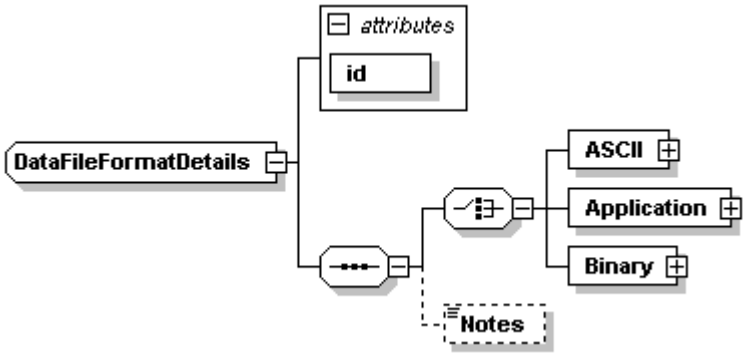
element **AuthorityDetails/Notes**

diagram	
type	**Notes**

A.5.2 DataFileFormatDetails

complexType **DataFileFormatDetails**

diagram



used by element **MPRD_Dictionary/DataFileFormatDetails**

attributes

Name	Type	Use	Annotation
id	**xsd:ID**	required	

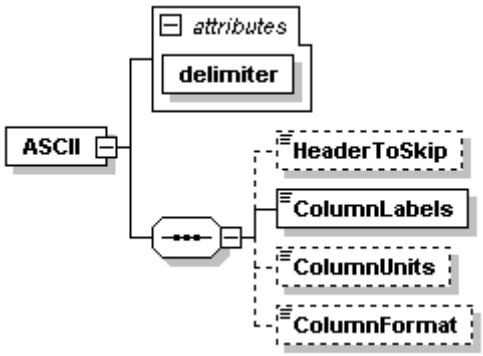
annotation

Complex-type: DataFileFormatDetails contains ids and descriptions of data files referenced by attribute "dataFileFormat" of complex type "DataFile" in MPRD schema.

DataFileFormatDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document.
ASCII element defines format for ASCII files. It defines the header labels of the tabular data, the corresponding units for the header labels, the row data delimiter and row data format.
Application element defines format based on file types. It defines the header labels of the tabular data, the corresponding units for the header labels, the row data format.
Binary element defines format for Binary files. It defines the header and record byte size, and data definition per record, record and file tokens in HEX.
Notes contains any additional information concerning the data file format.

element **DataFileFormatDetails/ASCII**

diagram



attributes

Name	Type	Use	Annotation
delimiter	**xsd:string**	required	

annotation

Definition for ASCII text file type file including CSV file. Typically the file has several lines of header to be skipped. The data is arranged in columns and seprated by "delimiter" character such as ",", ";", "tab", etc.

The "ColumnLabels" is a list of text labels that define the table. Use "delimiter" character between labels. For example: "WaveLength","Reflectivity".

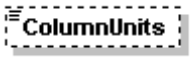
element **DataFileFormatDetails/ASCII/HeaderToSkip**

diagram	
type	**xsd:integer**

element **DataFileFormatDetails/ASCII/ColumnLabels**

diagram	
type	**xsd:string**

element **DataFileFormatDetails/ASCII/ColumnUnits**

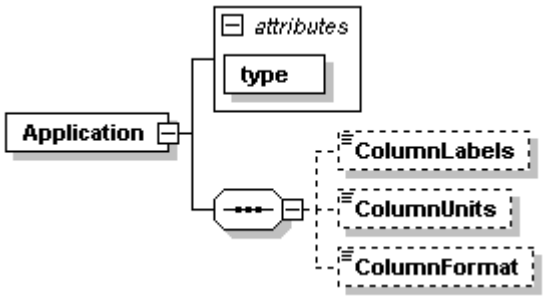
diagram	
type	**xsd:string**

element **DataFileFormatDetails/ASCII/ColumnFormat**

diagram	
type	**xsd:string**

element **DataFileFormatDetails/Application**

diagram



attributes

Name	Type	Use	Default	Fixed	Annotation
type	**derived by: xsd:string**	required			

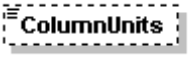
annotation: Definition for known "Application" file such as XLS or DBF data files.

element **DataFileFormatDetails/Application/ColumnLabels**

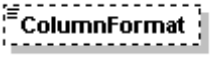
diagram	

type	**xsd:string**

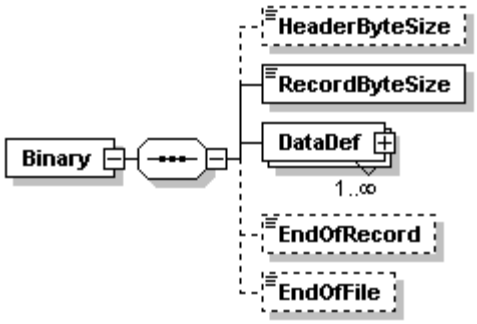
element **DataFileFormatDetails/Application/ColumnUnits**

diagram	
type	**xsd:string**

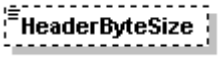
element **DataFileFormatDetails/Application/ColumnFormat**

diagram	
type	**xsd:string**

element **DataFileFormatDetails/Binary**

diagram	
annotation	Defintion for "Binary" data files. A record consists of a group of data. For example, a record would contain a pair of wavelength and reflectivity values. "DataType" is to specify the numerical representative of the data. For example "float", "integer".

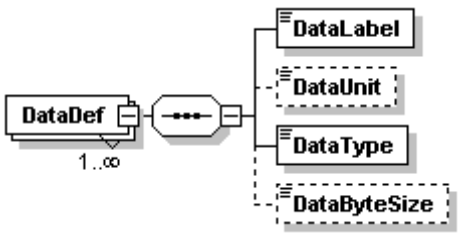
element **DataFileFormatDetails/Binary/HeaderByteSize**

diagram	
type	**xsd:integer**

element **DataFileFormatDetails/Binary/RecordByteSize**

diagram	
type	**xsd:integer**

element **DataFileFormatDetails/Binary/DataDef**

diagram	

element **DataFileFormatDetails/Binary/DataDef/DataLabel**

diagram	
type	**xsd:string**

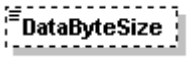
element **DataFileFormatDetails/Binary/DataDef/DataUnit**

diagram	
type	**xsd:string**

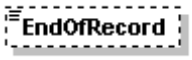
element **DataFileFormatDetails/Binary/DataDef/DataType**

diagram	
type	restriction of **xsd:string**
facets	enumeration: FLOAT enumeration: INTEGER enumeration: UNSIGNED_INT enumeration: LONG enumeration: UNSIGNED_LONG

element **DataFileFormatDetails/Binary/DataDef/DataByteSize**

diagram	
type	**xsd:integer**

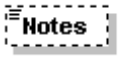
element **DataFileFormatDetails/Binary/EndOfRecord**

diagram	
type	**xsd:string**

element **DataFileFormatDetails/Binary/EndOfFile**

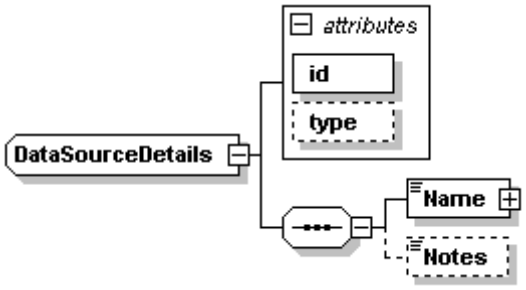
diagram	
type	**xsd:string**

element **DataFileFormatDetails/Notes**

diagram	
type	**Notes**

A.5.3 DataSourceDetails

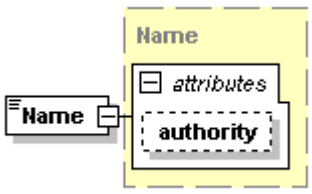
complexType **DataSourceDetails**

diagram	
used by	element **MPRD_Dictionary/DataSourceDetails**
attributes	

Name	Type	Use	Annotation
id	**xsd:ID**	required	
type	**xsd:string**	optional	

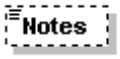
annotation	Complex-type: DataSourceDetails contains ids and descriptions of data sources (usually organizations) referenced by attribute "datasource" of complex datatype "PropertyData" in MPRD schema. DataSourceDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. DataSourceDetails also has one optional attribute, type, for specifying the type of the data source (examples include "unpublished report," "journal," "handbook," etc.). Name contains the name of the data source defined under the authority. Notes contains any additional information concerning the data source.

element **DataSourceDetails/Name**

diagram	
type	**Name**
attributes	

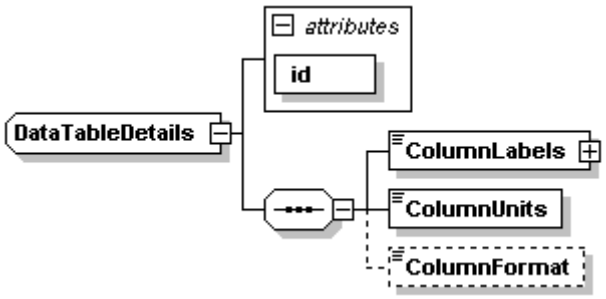
Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **DataSourceDetails/Notes**

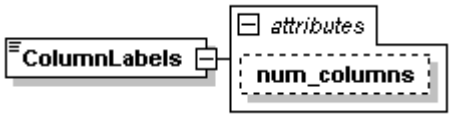
diagram	
type	**Notes**

A.5.4 DataTableDetails

complexType **DataTableDetails**

diagram	
used by	element **MPRD_Dictionary/DataTableDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation:
annotation	Complex-type: DataTableDetails contains ids and descriptions of data tables referenced by attribute "dataTableFormat" of complex type "DataTable" in MPRD schema. DataTableDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. It defines the header labels of the tabular data, the corresponding units for the header labels, and the row data format.

element **DataTableDetails/ColumnLabels**

diagram	
type	extension of **xsd:string**
attributes	Name: num_columns; Type: **xsd:integer**; Use: optional; Annotation:

element **DataTableDetails/ColumnUnits**

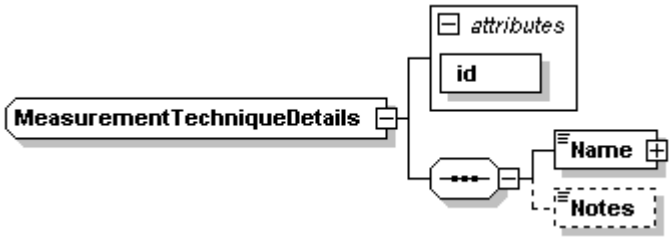
diagram	
type	**xsd:string**

element **DataTableDetails/ColumnFormat**

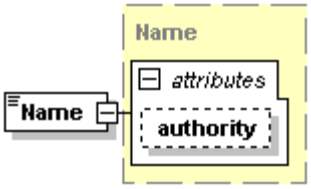
diagram	
type	**xsd:string**

A.5.5 MeasurementTechniqueDetails

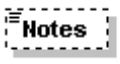
complexType **MeasurementTechniqueDetails**

diagram	
used by	element **MPRD_Dictionary/MeasurementTechniqueDetails**
attributes	Name: id; Type: **xsd:ID**; Use: required; Annotation:
annotation	Complex-type: MeasurementTechniqueDetails contains ids and descriptions of measurement techniques referenced by attribute "technique" of complex datatype "PropertyData" in MPRD schema. MeasurementTechniqueDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the measurement technique defined under the authority. Notes contains any additional information concerning the measurement technique.

element **MeasurementTechniqueDetails/Name**

diagram	
type	**Name**
attributes	Name: authority; Type: **xsd:string**; Use: optional; Annotation: attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **MeasurementTechniqueDetails/Notes**

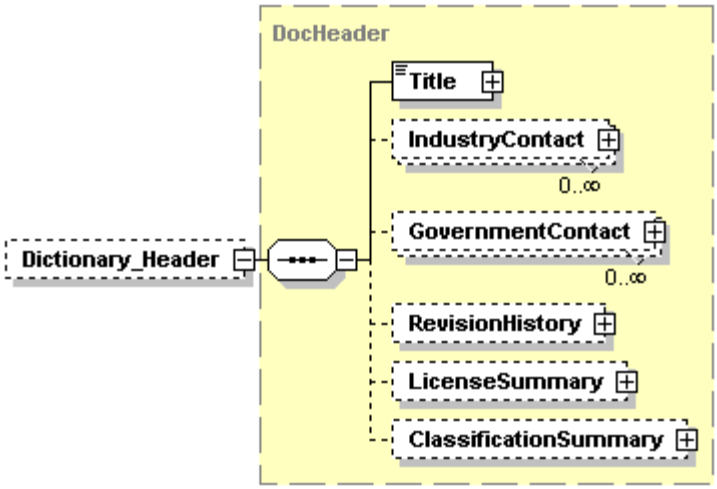
diagram	
type	**Notes**

A.5.6 MPRD_Dictionary

complexType **MPRD_Dictionary**

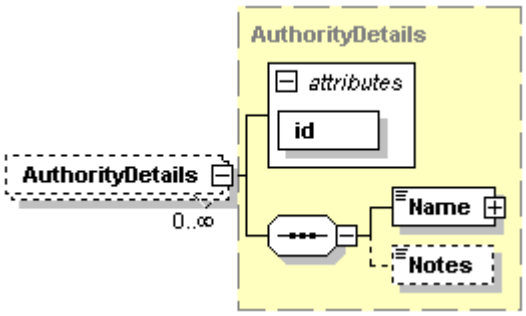
diagram	
used by	element **MPRD_Dictionary_Doc**
annotation	Complex-type: MPRD_Dictionary is the main complex datatype for MPRD dictionary document.

element **MPRD_Dictionary/Dictionary_Header**

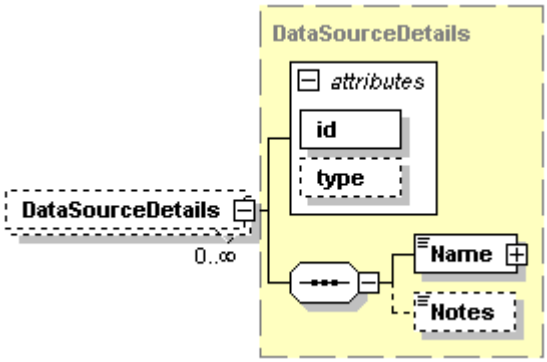
diagram	
type	**DocHeader**

annotation	MPRD Dictionary administrative information.

element **MPRD_Dictionary/AuthorityDetails**

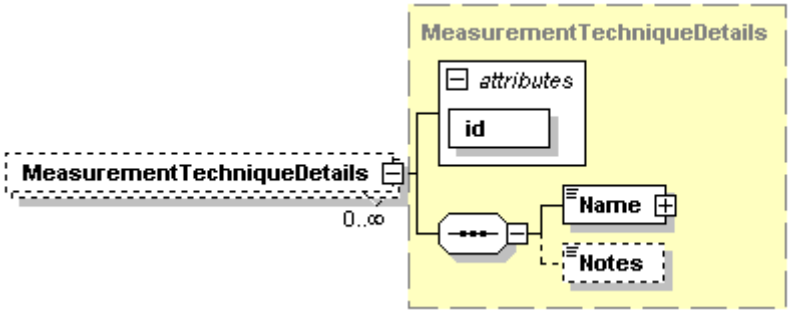
diagram	
type	**AuthorityDetails**
attributes	Name / Type / Use / Annotation id / **xsd:ID** / required /
annotation	AuthorityDetails contains ids and descriptions of authorities (usually organizations) referenced by attribute "authority" of complex datatype "Name" in MPRD schema. AuthorityDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the Authority defined under the authority. Notes contains any additional information concerning the Authority. Example: <AuthorityDetails id="Auth6"> <Name>FEIS</Name> <Notes>Fire Effects Information System (USDA forest service)</Notes> </AuthorityDetails>

element **MPRD_Dictionary/DataSourceDetails**

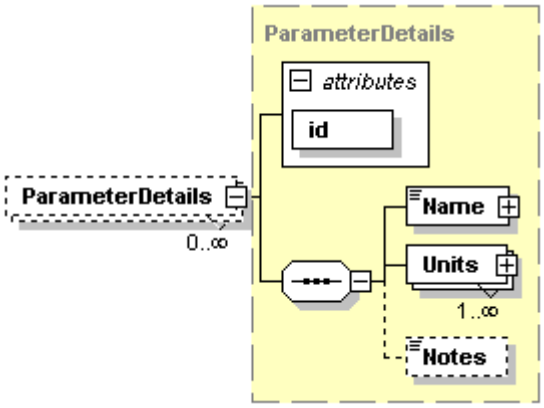
diagram	
type	**DataSourceDetails**
attributes	Name / Type / Use / Annotation id / **xsd:ID** / required / type / **xsd:string** / optional /
annotation	DataSourceDetails contains ids and descriptions of data sources (usually organizations) referenced by attribute "datasource" of complex datatype "PropertyData" in MPRD schema. DataSourceDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. DataSourceDetails also has one optional attribute, type, for specifying the type of the data source (examples include

	"unpublished report," "journal," "handbook," etc.) Name contains the name of the data source defined under the authority. Notes contains any additional information concerning the data source. Example: <DataSourceDetails id="ds1" type="internet engineering references"> <Name>engineering toolbox</Name> <Notes>http://www.engineeringtoolbox.com</Notes> </DataSourceDetails>

element **MPRD_Dictionary/MeasurementTechniqueDetails**

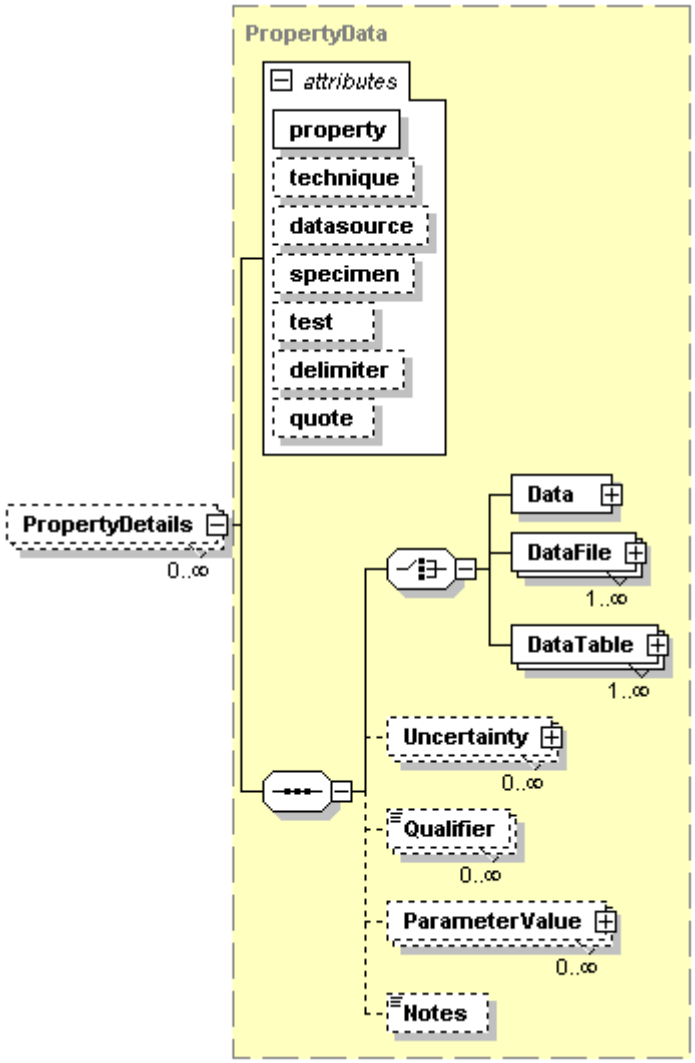
diagram	
type	**MeasurementTechniqueDetails**
attributes	Name | Type | Use | Annotation id | **xsd:ID** | required |
annotation	MeasurementTechniqueDetails contains ids and descriptions of measurement techniques referenced by attribute "technique" of complex datatype "PropertyData" in MPRD schema. MeasurementTechniqueDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the measurement technique defined under the authority. Notes contains any additional information concerning the measurement technique. Example: <MeasurementTechniqueDetails id="mt1"> <Name>Literature survey</Name> <Notes>The authors cite V.R. Pujari et al., "Development of Improved Processing and Evaluation Methods for High Reliability Structural Ceramics for Advanced Heat Engine Applications, Phase I," final report, ORNL/Sub/89-SB182/1, NTIS Rept. No. DE93-040528, August (1993), and summarize the procedure as follows. "The cylindrical buttonhead specimens were machined to ORNL design with a gauge diameter of 6.0±0.1 mm. ...50 mm diameter, 150 mm long specimens... were machined as many flexure bars (3 mm by 4 mm by 50 mm) for assessment of the properties across the 50-mm section."</Notes> </MeasurementTechniqueDetails>

element **MPRD_Dictionary/ParameterDetails**

diagram	
type	**ParameterDetails**
attributes	Name | Type | Use | Annotation id | **xsd:ID** | required |
annotation	ParameterDetails contains ids and descriptions of testing parameters referenced by attribute of complex type "ParameterValue" in MPRD schema. ParameterDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the parameter defined under the authority. Units contains units for the parmater. There can be multiple units or no unit (unitless) definitions describing the parameter's units. Notes contains any additional information concerning the parameter. Example: <ParameterDetails id="pa1"> <Name>Test Temperature</Name> <Units name="C" description="degree Celsius"> <Unit name="C" power="1" description="degree Celsius"/> </Units> <Units name="F" description="degree Fahrenheit"> <Unit name="F" power="1" description="degree Fahrenheit"/> </Units> </ParameterDetails>

element **MPRD_Dictionary/PropertyDetails**

diagram



type **PropertyData**

attributes

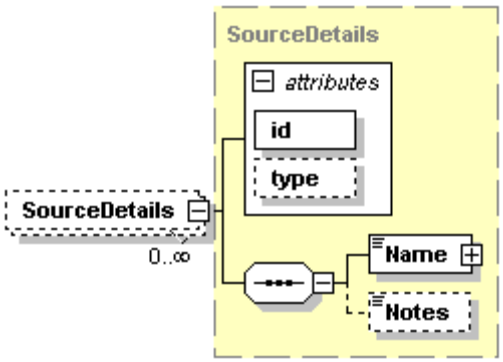
Name	Type	Use	Annotation
property	**xsd:string**	required	attribute: property data id as defined in PropertyDetails section of MPRD_Dictionary.
technique	**xsd:string**		attribute: technique id as defined in MeasurementTechniqueDetails section of MPRD_Dictionary.
datasource	**xsd:string**		attribute: data source id as defined in DataSourceDetails section of MPRD_Dictionary.
specimen	**xsd:string**		attribute: specimen id as defined in SpecimenDetails in the Dictionary element.
test	**xsd:string**		attribute: test condition id as defined in TestConditionDetails in Metadata.
delimiter	**derived by: xsd:string**		attribute: delimiter specifies the delimiter that separates multiple values in the Data, Qualifier, Uncertainty, and ParameterValue elements. The default value is a comma (',').
quote	**xsd:string**		attribute: quote specifies the string that is used to quote values in the Data, Qualifier, Uncertainty and ParameterValue elements.

annotation

PropertyDetails contains ids and descriptions of physical, chemical, mechanical, thermal, electrical and radiometric properties referenced by attribute "property" of complex type "PropertyData" in MPRD schema.
PropertyDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the

	MPRD_Dictionay xml document. Optional attribute type contains the type of the property: "physical", "chemical", "electrical", "thermal", " mechanical" or "radiometric", etc. Name contains the name of the property defined under the authority. Units contains units for the parmater. There can be multiple units or no unit (unitless) definitions describing the property's units. Notes contains any additional information concerning the property. Example: <PropertyDetails id="physic-d" type="physical"> <Name>density</Name> <Units system="SI" name="kg/m^3" description="kilogram per cubic meter"> <Unit name="kg" power="1" description="kilogram"/> <Unit name="m" power="3" description="meter"/> </Units> <Notes>The density is defined as a mediums mass per unit volume.</Notes> </PropertyDetails>

element **MPRD_Dictionary/SourceDetails**

diagram	
type	**SourceDetails**

attributes

Name	Type	Use	Default	Fixed	Annotation
id	**xsd:ID**	required			
type	**xsd:string**	optional			

annotation

SourceDetails contains ids and descriptions of source of the material referenced by attribute "source" of complex type "Source" in MPRD schema.

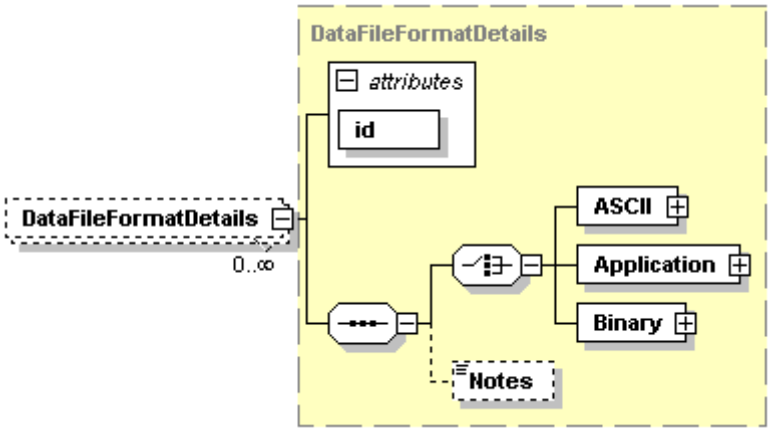
SourceDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document.
Optional attribute type contains the type of the source: "government", "industry", "academic", etc.
Name contains the name of the source defined under the authority.
Notes contains any additional information concerning the source.

Example:

<SourceDetails id="s1" type="Government Source">
<Name>AFRL-MESA</Name>
<Notes>AFRL Mesa provides this data under NAVAIR AWTD Joint IPT Program</Notes>
</SourceDetails>

element **MPRD_Dictionary/DataFileFormatDetails**

diagram



type **DataFileFormatDetails**

attributes

Name	Type	Use	Annotation
id	**xsd:ID**	required	

annotation

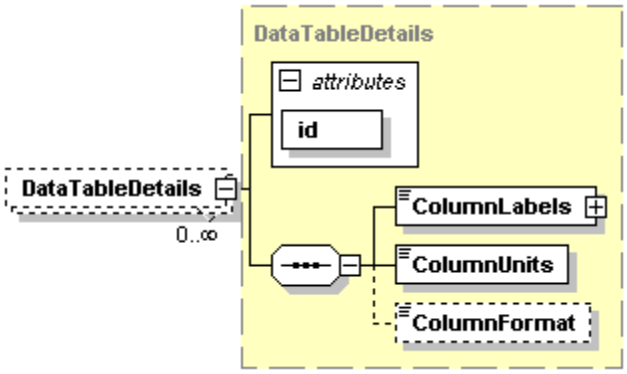
DataFileFormatDetails contains ids and descriptions of data files referenced by attribute "dataFileFormat" of complex type "DataFile" in MPRD schema.

DataFileFormatDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document.
ASCII element defines format for ASCII files. It defines the header labels of the tabular data, the corresponding units for the header labels, the row data delimiter and row data format.
Application element defines format based on file types. It defines the header labels of the tabular data, the corresponding units for the header labels, the row data format.
Binary element defines format for Bianry files. It defines the header and record byte size, and data, record and file tokens.
Notes contains any additional information concerning the data file format.

Example:

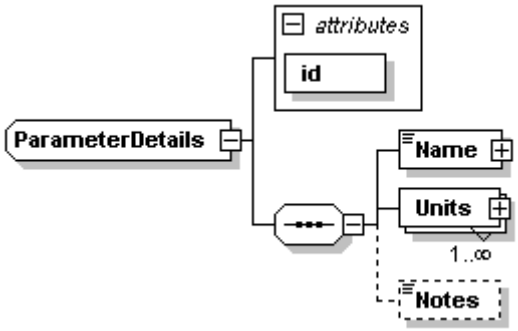
```
<DataFileFormatDetails id="ascii-1">
        <ASCII delimiter=",">
                <HeaderToSkip>5</HeaderToSkip>
                <ColumnLabels>Wavelength,Reflectance</ColumnLabels>
                <ColumnUnits>nm,%</ColumnUnits>
                <ColumnFormat>float,float</ColumnFormat>
        </ASCII>
</DataFileFormatDetails>
```

element **MPRD_Dictionary/DataTableDetails**

diagram	
type	**DataTableDetails**
attributes	Name / Type / Use / Annotation id / **xsd:ID** / required /
annotation	DataTableDetails contains ids and descriptions of data tables referenced by attribute "dataTableFormat" of complex type "DataTable" in MPRD schema. DataTableDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. It defines the header labels of the tabular data, the corresponding units for the header labels, and the row data format. Example: <DataTableDetails id="tbl1"> <ColumnLabels num_columns="2">wavelength,reflectance</ColumnLabels> <ColumnUnits>um,%</ColumnUnits> <ColumnFormat>float,float</ColumnFormat> </DataTableDetails>

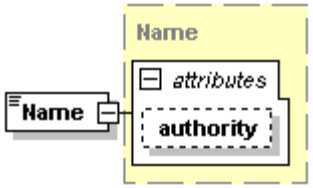
A.5.7 ParameterDetails

complexType **ParameterDetails**

diagram	
used by	element **MPRD_Dictionary/ParameterDetails**
attributes	Name / Type / Use / Annotation id / **xsd:ID** / required /
annotation	Complex-type: ParameterDetails contains ids and descriptions of testing parameters referenced by attribute of complex type "ParameterValue" in MPRD schema. ParameterDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the parameter defined under the authority. Units contains units for the parmater. There can be multiple units or no unit (unitless) definitions describing the

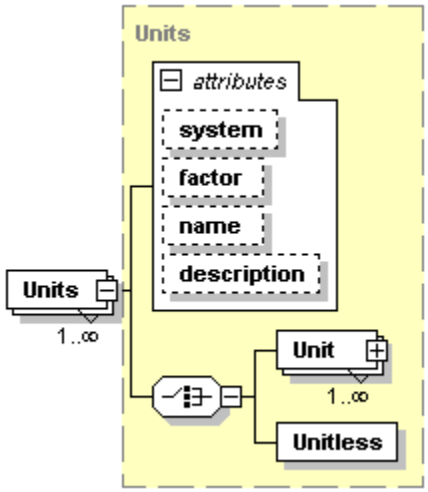
	parameter's units. Notes contains any additional information concerning the parameter.

element **ParameterDetails/Name**

diagram	
type	**Name**
attributes	

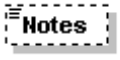
Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **ParameterDetails/Units**

diagram	
type	**Units**
attributes	

Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s".
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second".

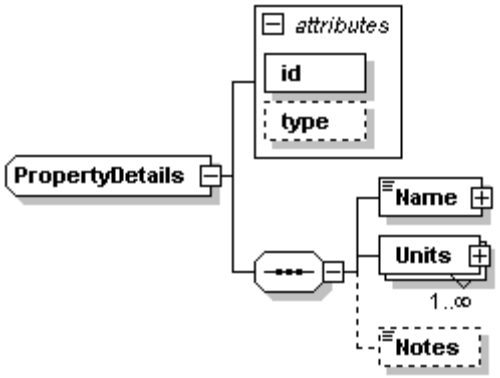
element **ParameterDetails/Notes**

diagram	
type	**Notes**

A.5.8 PropertyDetails

complexType **PropertyDetails**

diagram



attributes

Name	Type	Use	Annotation
id	**xsd:ID**	required	
type	**xsd:string**	optional	

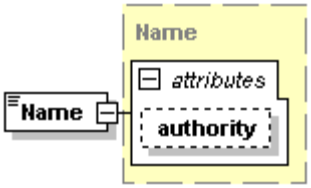
annotation

Complex-type: PropertyDetails contains ids and descriptions of physical, chemical, mechanical, thermal, electrical and radiometric properties referenced by attribute "property" of complex type "PropertyData" in MPRD schema.

PropertyDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document.
Optional attribute type contains the type of the property: "physical", "chemical", "electrical", "thermal", " mechanical" or "radiometric", etc.
Name contains the name of the property defined under the authority.
Units contains units for the parmater. There can be multiple units or no unit (unitless) definitions describing the property's units.
Notes contains any additional information concerning the property.

element **PropertyDetails/Name**

diagram

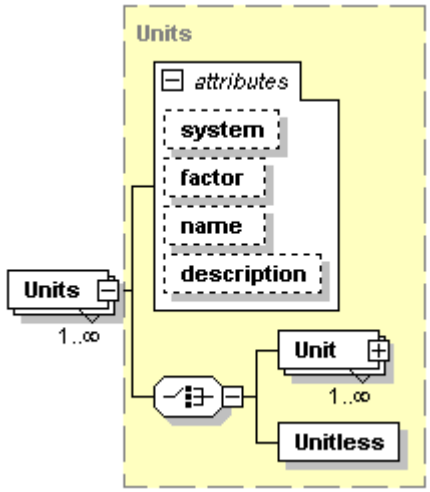


type **Name**

attributes

Name	Type	Use	Annotation
authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

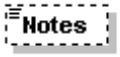
element **PropertyDetails/Units**

diagram	
type	**Units**

attributes

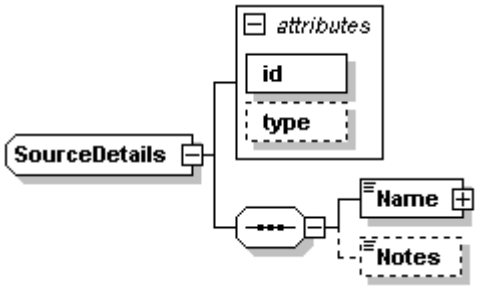
Name	Type	Use	Annotation
system	**xsd:string**		attribute: system is used to indicate the units system, such as "SI."
factor	**xsd:float**		attribute: factor is used to indicate a constant multiplier in floating point format.
name	**xsd:string**		attribute: name is used to indicate the name of the units. For example: "m/s".
description	**xsd:string**		attribute: description is used to describe the units. For example: "meter per second".

element **PropertyDetails/Notes**

diagram	
type	**Notes**

A.5.9 SourceDetails

complexType **SourceDetails**

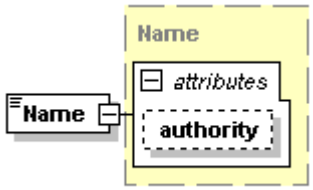
diagram	
used by	element **MPRD_Dictionary/SourceDetails**

attributes

Name	Type	Use	Annotation
id	**xsd:ID**	required	
type	**xsd:string**	optional	

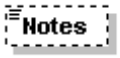
annotation	Complex-type: SourceDetails contains ids and descriptions of source of the material referenced by MPRD xml documents. Example: <SourceDetails id="s1" type="Government Source"> <Name>AFRL-MESA</Name> <Notes>AFRL Mesa provides this data under NAVAIR AWTD Joint IPT Program</Notes> </SourceDetails> SourceDetails has one required attribute, id, which may be arbitrarily assigned but must be unique in the MPRD_Dictionay xml document. Name contains the name of the source defined under the authority. Notes contains any additional information concerning the source.

element **SourceDetails/Name**

diagram	
type	**Name**

attributes	Name	Type	Use	Annotation
	authority	**xsd:string**	optional	attribute: authority id as defined in AuthorityDetails section of MPRD_Dictionary.

element **SourceDetails/Notes**

diagram	
type	**Notes**