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Digital Imaging and Communications in Medicine (DICOM)

8 *Supplement 222: Microscopy Bulk Simple Annotations Storage SOP Class*

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44

Scope and Field

46 This Supplement to the DICOM Standard specifies a new DICOM Information Object and Storage SOP Class for storing Microscopy Bulk Simple Annotations (points, open polylines, closed polygons and simple

48 geometric shapes without relationships), which is referred to as the Microscopy Bulk Simple Annotations IOD.

50
Microscopy Bulk Simple Annotations are usually created by machine algorithms from high resolution

52 images of entire tissue sections, e.g., encoded as DICOM Whole Slide Microscopy images. These annotations are distinct from alternative representations appropriate for different use-cases, such as

54 segmented bit planes (which are encoded in DICOM Segmentation Images), and more tractable size human or machine generated contour-based annotations on selected high-power fields or lower resolution

56 or gross specimen images (which are encoded in DICOM Structured Reports using standard templates like TID 1500).

58 No new image encoding mechanism is introduced. The annotations are either 2D image relative (frame or Total Pixel Matrix) or in a 3D Frame of Reference that is shared with a Microscopy Image Storage

60 instance.

No new composition mechanism is added. The annotations are simple and it is anticipated that in future

62 mechanisms such as the Radiotherapy Conceptual Volume mechanism may be re-used to describe boolean relationships, etc., that reference instances of bulk simple annotations, or embed more complex

64 relationships.

66

DICOM PS 3.2 Conformance

Item: Add SOP Class to Table A.1-2

68

Table A.1-2
UID VALUES

UID Value	UID NAME	Category
…		
1.2.840.10008.5.1.4.1.1.91.1	**Microscopy Bulk Simple Annotations Storage SOP Class**	**Transfer**
…		

70

DICOM PS 3.3: Information Object Definitions

72 | **Item: Add definitions:**

3.8 DICOM Information Object

74 | **Annotation**   **Additional information associated with an object.**

Region of Interest (ROI)   **A selected subset of samples within a dataset identified for a particular**
76 | **purpose.**

Segment   **A part of a whole, such as the classification of pixels in an image.**

78 | **Structure Set**   **A set of areas of significance.**

80 | **Item: Change Figure 7-1a. DICOM Model of the Real World:**

Add "Annotations" to be contained in the Series.

82 | **Item: Change Figure A.1-1 DICOM Composite Instance IOD Information Model:**

Add "Annotations" to the same level as Surface.

84 | **Item: Add in Section A.1.4, rows and column to Table A.1-2**

A.1.4   Overview of the Composite IOD Module Content

86

IODs Modules	WS Bulk Smpl Ann
Patient	**M**
Clinical Trial Subject	**U**
General Study	**M**
Patient Study	**U**
Clinical Trial Study	**U**
General Series	**M**
Microscopy Bulk Simple Annotations Series	**M**
Clinical Trial Series	**U**
Frame of Reference	**C**
Microscopy Bulk Simple Annotations	**M**

General Equipment	**M**
Enhanced General Equipment	**M**
ICC Profile	**U**
Common Instance Reference	**M**
SOP Common	**M**

88

Item: Add in the following new section in Annex A

90 **A.87 MICROSCOPY BULK SIMPLE ANNOTATIONS IOD**

A.87.1 Microscopy Bulk Simple Annotations IOD Description

92 The Microscopy Bulk Simple Annotations IOD encodes Microscopy Bulk Simple Annotations into a
collection of points, closed polygons, open polylines and simple geometric shapes. Polygons and polylines
94 are defined by the coordinates of each point. Simple geometric shapes are defined by parameters.

Numeric quantities and color may be associated with annotations.

96 **A.87.2 Microscopy Bulk Simple Annotations IOD Entity-Relationship Model**

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model that directly
98 reference the Microscopy Bulk Simple Annotations IOD.

A.87.3 Microscopy Bulk Simple Annotations IOD Module Table

100 **Table A.87-1. Microscopy Bulk Simple Annotations IOD Modules**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Microscopy Bulk Simple Annotations Series	C.37.1.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	C - Required if Annotation Coordinate Type (006A,0001) is 3D
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Annotation	Microscopy Bulk Simple Annotations	C.37.1.2	M
	ICC Profile	C.11.15	U
	Common Instance Reference	C.12.2	M
	SOP Common	C.12.1	M

102 **Item: Amend Section C.7.3.1.1 to add new modality**

C.7.3.1.1 General Series Attribute Descriptions

104 **C.7.3.1.1.1 Modality**

Defined Terms:

106 **ANN** **Annotation**

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108 | **Item: Add in the following new sections in C** |

110 **C.37** **Annotation Modules**

This Section describes Annotation Modules.

112

C.37.1 **Microscopy Bulk Simple Annotations Modules**

114 This Section describes Microscopy Bulk Simple Annotations Modules.

116 **C.37.1.1** **Microscopy Bulk Simple Annotations Series Module**

Table C.37.1-1 specifies the Attributes that identify and describe general information about a Microscopy
118 Bulk Simple Annotations Series.

Table C.37.1-1
120 **MICROSCOPY BULK SIMPLE ANNOTATIONS SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the instances in this Series. Enumerated Values: ANN See Section C.7.3.1.1.1 for further explanation.
Series Number	(0020,0011)	1	A number that identifies this Series.
Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related. Only a single Item shall be included in this Sequence. Required if a Performed Procedure Step SOP Class was involved in the creation of this Series.
>*Include Table 10-11 "SOP Instance Reference Macro Attributes"*			

122 **C.37.1.2** **Microscopy Bulk Simple Annotations Module**

Table C.37.1-2 specifies the Attributes that describe the Microscopy Bulk Simple Annotations.

124

Table C.37.1-2
MICROSCOPY BULK SIMPLE ANNOTATIONS MODULE ATTRIBUTES

126

Attribute Name	Tag	Type	Attribute Description
Include Table 10-12 "Content Identification Macro Attributes"			
Content Date	(0008,0023)	1	The date the content creation started.
Content Time	(0008,0033)	1	The time the content creation started.
Annotation Coordinate Type	(006A,0001)	1	Whether coordinates are image-relative (2D) or volume-relative (3D). **Enumerated Values:** **2D** relative to individual frame or total image matrix **3D** relative to a Cartesian coordinate system defined by a Frame of Reference
Pixel Origin Interpretation	(0048,0301)	1C	For image-relative coordinates, specifies whether coordinates are to be interpreted relative to the individual frame pixel origins, or relative to the Total Pixel Matrix origin (see Section C.8.12.4.1.4). Required if Annotation Coordinate Type (006A,0001) is 2D. **Enumerated Values:** **FRAME** relative to individual frame **VOLUME** relative to Total Image Matrix Note: The use of the term "VOLUME" to refer to the Total Image Matrix is historical and inherited from Presentation States, and does not refer to 3D coordinates.
Referenced Image Sequence	(0008,1140)	1C	The image to which this annotation object applies. Only a single Item shall be included in this Sequence. Required if Annotation Coordinate Type (006A,0001) is 2D. May be present otherwise.
>*Include Table 10-3 "Image SOP Instance Reference Macro Attributes"*			
Annotation Group Sequence	(006A,0002)	1	Groups of annotations sharing common characteristics, such as graphic type, properties or measurements. One or more Items shall be included in this Sequence.

>Annotation Group Number	(0040,A180)	1	Identification number of the Annotation Group. Uniquely identifies a Annotation Group within this SOP Instance. Shall start at a value of 1, and increase monotonically by 1.
>Annotation Group UID	(006A,0003)	1	Unique identifier of the Annotation Group.
>Annotation Group Label	(006A,0005)	1	User-defined label identifying this Annotation Group. This may be the same as Code Meaning (0008,0104) of Annotation Property Type Code Sequence (006A,000A).
>Annotation Group Description	(006A,0006)	3	User-defined description for this Annotation Group.
>Annotation Group Generation Type	(006A,0007)	1	Type of algorithm used to generate the Annotations. **Enumerated Values:** AUTOMATIC - generated by algorithm without human user assistance SEMIAUTOMATIC - generated by algorithm with human user assistance MANUAL - generated by human user
>Annotation Group Algorithm Identification Sequence	(006A,0008)	1C	The algorithms used to create the annotations in this group. One or more Items shall be included in this Sequence. Required if Annotation Generation Type (006A,0007) is AUTOMATIC or SEMIAUTOMATIC.
>>*Include Table 10-19 "Algorithm Identification Macro Attributes"*			*No Baseline CIDs are defined.*
>Annotation Property Category Code Sequence	(006A,0009)	1	Sequence defining the general category of the property the Annotation Group represents. Only a single Item shall be included in this Sequence.
>>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*BCID 7150 "Segmentation Property Categories".*
>Annotation Property Type Code Sequence	(006A,000A)	1	Sequence defining the specific property the Annotation Group represents. Only a single Item shall be included in this Sequence.
>>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*BCID 8135 "Microscopy Annotation Property Types".*

>>Annotation Property Type Modifier Code Sequence	(006A,000B)	3	Sequence defining the modifier of the property type of this Annotation Group. One or more Items are permitted in this Sequence.
>>>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*No Baseline CID is defined.*
>Number of Annotations	(006A,000C)	1	The number of Annotations in this Annotation Group. Each point, polyline or polygon, ellipse or rectangle is counted as one Annotation.
>Graphic Type	(0070,0023)	1	The shape of the Annotations in this Annotation Group. See Section C.37.1.2.1.1. Enumerated Values: **POINT** a single location denoted by a single coordinate **POLYLINE** a series of connected line segments with ordered vertices denoted by coordinates forming an open polyline; the points shall be coplanar **POLYGON** a series of connected line segments with ordered vertices denoted by coordinates, where the first and last vertices are not the same but are implicitly joined to form a closed polygon; the points shall be coplanar **ELLIPSE** an ellipse defined by four coordinates, the first two points specifying the endpoints of the major axis and the second two points specifying the endpoints of the minor axis of an ellipse; the points shall be coplanar **RECTANGLE** a rectangle defined by four coordinates, the first being the top left hand corner (when viewed from the top surface of the slide towards the bottom), then the top right hand corner, then the bottom right hand corner and finally the bottom left hand corner; the points shall be coplanar Note: Individual annotations in the same group are not required to be in the same plane.

>Annotation Applies to All Optical Paths	(006A,000D)	1	Whether the annotations in this Annotation Group apply to all the optical paths within the corresponding images. Enumerated Values: **YES** the annotations apply to all optical paths **NO** the annotations apply only to the specified optical path(s)
>Referenced Optical Path Identifier	(006A,000E)	1C	Identifies one or more optical paths to which this annotation applies. Refers to the same value in Optical Path Identifier (0048,0106) within the Optical Path Sequence (0048,0105) in the images to which this annotation applies. More than one value may be present if the annotations apply to more than one (but not all) Optical Paths. Required if Annotation Applies to All Optical Paths (006A,000D) is NO.
>Annotation Applies to All Z Planes	(006A,000F)	1C	Whether the annotations in this Annotation Group apply to the full thickness of the tissue on the slide. I.e., they are applicable regardless of the focal plane, in the case that images were acquired with multiple focal planes (Z-stacks). **Enumerated Values:** **YES** the annotations apply to the full thickness **NO** the annotations apply only to the specified Z plane Note: When the value is NO, the Z plane will be specified either in Common Z Coordinate Value (006A,0010) if all the coordinates are in the same Z plane(s), or in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) if not. Required if Annotation Coordinate Type (006A,0001) is 3D.

>Common Z Coordinate Value	(006A,0010)	1C	The Z coordinate(s) common to all points in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022), in mm in the Slide Coordinate System (Section C.8.12.2.1.1) associated with the Frame of Reference.
			More than one value may be present if the annotations apply to more than one (but not all) Z planes.
			Required if Annotation Coordinate Type (006A,0001) is 3D, and all points in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) are in the same Z plane(s).
			Note: This requirement means that it is mandatory to factor out the commonality, i.e., it is not permitted to send Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) with (X, Y, Z) triplets where all the Z values are the same. For annotations of images that only have a single Z plane, or where all the points in an annotation group are coplanar and in the same Z plane, this condition will always be satisfied. Annotations in different Z planes can be separated into separate Annotation Groups in order to allow this condition to be satisfied, but using separate Annotation Groups is not required.
			See Section C.37.1.2.1.1.
>Point Coordinates Data	(0066,0016)	1C	The coordinates of one or more points that define the annotations (whether single points or polygons), encoded in (X, Y) or (X, Y, Z) order.
			Required if Double Point Coordinates Data (0066,0022) is not present.
			For each point, two coordinates (X, Y) shall be encoded if Common Z Coordinate Value (006A,0010) is present, otherwise three coordinates (X, Y, Z) shall be encoded.
			See Section C.37.1.2.1.1.

>Double Point Coordinates Data	(0066,0022)	1C	The coordinates of one or more points that define the annotations (whether single points or polygons), encoded in (X, Y) or (X, Y, Z) order.
			Required if Point Coordinates Data (0066,0016) is not present.
			For each point, two coordinates (X, Y) shall be encoded if Common Z Coordinate Value (006A,0010) is present, otherwise three coordinates (X, Y, Z) shall be encoded.
			See Section C.37.1.2.1.1.
>Long Primitive Point Index List	(0066,0040)	1C	A list of point indices. See Section C.37.1.2.1.1.
			Required if Graphic Type (0070,0023) is POLYLINE or POLYGON.
>Recommended Display CIELab Value	(0062,000D)	3	Default triplet value in which it is recommended that the Annotation Group be rendered. The units are specified in PCS-Values, and the value is encoded as CIELab.
			See Section C.10.7.1.1.
>Measurements Sequence	(0066,0121)	3	Measurements for some or all Annotations in the Annotation Group. Each Item describes one type of measurement.
			See Section C.37.1.2.1.2.
			One or more Items are permitted in this Sequence.
>>Concept Name Code Sequence	(0040,A043)	1	Defines the type of measurement stored in this Item.
			Only a single Item shall be included in this Sequence.
>>>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			DCID 8136 "Microscopy Measurement Types"
>>Measurement Units Code Sequence	(0040,08EA)	1	Units of measurement for the value in this Item.
			Only a single Item shall be included in this Sequence.
>>>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*DCID 82 "Units of Measurement".*

>>Measurement Values Sequence	(0066,0132)	1	The measurement values for the Annotation Group. One or more Items shall be included in this Sequence.
>>>Floating Point Values	(0066,0125)	1	Measurement values for annotations stored in this Annotation Group. If Annotation Index List (006A,0011) is present, measurement values are stored for a subset of annotations, and the number of values shall match the number and order of indices in Annotation Index List (006A,0011). If Annotation Index List (006A,0011) is absent, measurement values are stored for every annotation in Long Primitive Point Index List (0066,0040), if present, and the number of values shall match the number and order of annotations in Long Primitive Point Index List (0066,0040) . If Annotation Index List (006A,0011) and Long Primitive Point Index List (0066,0040) are absent, measurement values are stored for every annotation stored in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022), and the number of values shall match the value of Number of Annotations (006A,000C). See Section C.37.1.2.1.2.
>>>Annotation Index List	(006A,0011)	1C	List of indices referencing annotations identified in Long Primitive Point Index List (0066,0040) or successive points stored in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) for which measurement values shall be stored. Required if Measurement Values stored in Floating Point Values (0066,0125) are associated with only a subset of annotations. See Section C.37.1.2.1.2.

128 **C.37.1.2.1 Microscopy Bulk Simple Annotations Module Attributes**

C.37.1.2.1.1 Type, Points, Polygons, Parameterized and Rotated Shapes and Indices

130 All the Annotations in a single Item of Annotation Group Sequence (006A,0002) share the same value for Graphic Type (0070,0023).

132 If Annotation Coordinate Type (006A,0001) is 2D, then the coordinates are interpreted as image-relative, either relative to an individual frame or the Total Pixel Matrix, with units of pixels, as defined in C.10.4

134 Displayed Area Module. If Pixel Origin Interpretation (0048,0301) is FRAME, then a single frame of a single image shall be specified in Referenced Image Sequence (0008,1140). If Pixel Origin Interpretation

136 (0048,0301) is VOLUME, then a single image shall be specified in Referenced Image Sequence
(0008,1140) without a subset of frames designated, and the coordinates are relative to the Total Image
138 Matrix of that image. The referenced image shall not be an instance of a Concatenation; i.e., in the case of
Concatenations, references shall be relative to the SOP Instance UID of Concatenation Source
140 (0020,0242).

Notes: 1. The referenced image need not be any particular resolution layer of a WSI pyramid. I.e., it may
142 or may not be the highest resolution layer. The user may annotate images that are not at the
highest resolution, but such annotations may be projected onto any resolution layer that is
144 available (or computed). If the referenced image is no longer stored or accessible, the ability to
project the annotations onto other layers may be lost.

146 2. A reference to a single frame means that all annotations in this instance are on that frame; no
mechanism is provided to span frames, or to specify more than one frame.

148 If Annotation Coordinate Type (006A,0001) is 3D, then the coordinates are interpreted as volume relative,
with units of mm, in the Cartesian space defined by the Frame of Reference UID.

150 Note: A single referenced image may be specified even if Annotation Coordinate Type (006A,0001) is
3D. It need not be any particular resolution layer of a WSI pyramid, but may be interpreted as a
152 suitable layer on which to render, select from or otherwise apply the annotation. In particular, it
may not be the highest resolution layer. Regardless, the annotations are applicable to any image
154 in the same Frame of Reference.

If the Annotations are points, then

156 • Graphic Type (0070,0023) shall have a value of POINT.
• All the points in the group shall be encoded in Point Coordinates Data (0066,0016) or Double
158 Point Coordinates Data (0066,0022), concatenated one after another, with Z factored out into
Common Z Coordinate Value (006A,0010), if common.
160 • Long Primitive Point Index List (0066,0040) shall not be present, because there is no need for a
separate index of each annotation.
162 • Number of Annotations (006A,000C) will contain the number of points, which shall also be the
number of coordinate tuples in Point Coordinates Data (0066,0016) or Double Point Coordinates
164 Data (0066,0022).

If the Annotations are open polylines, then

166 • Graphic Type (0070,0023) shall have a value of POLYLINE.
• The points of each polyline shall be encoded in Point Coordinates Data (0066,0016) or Double
168 Point Coordinates Data (0066,0022), concatenated one after another, with Z factored out into
Common Z Coordinate Value (006A,0010), if common.
170 • The order of the encoded points is from the first point to the last point of the polyline.
• The index in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022)
172 of each successive polyline is encoded in Long Primitive Point Index List (0066,0040), which shall
contain Number of Annotations (006A,000C) values.

174 If the Annotations are closed polygons, then

• Graphic Type (0070,0023) shall have a value of POLYGON.
176 • The points of each polygon shall be encoded in Point Coordinates Data (0066,0016) or Double
Point Coordinates Data (0066,0022), concatenated one after another, with Z factored out into
178 Common Z Coordinate Value (006A,0010), if common.

180 · The order of the encoded points is from the first point to the last point of the polygon. The first point and the last point shall not be the same, but rather they are implicitly joined to close the polygon.

182 · The index in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) of each successive polygon is encoded in Long Primitive Point Index List (0066,0040), which shall
184 contain Number of Annotations (006A,000C) values.

Note: This closed polygon representation differs from that used in Presentation States
186 (C.10.5.1.2 Graphic Data and Graphic Type) and Structured Reports (C.18.6.1 Spatial Coordinates Macro Attribute Descriptions and C.18.9.1 3D Spatial Coordinates Macro Attribute
188 Descriptions), none of which are implicitly closed, and required replication of the first point as the last point.

190 If the Annotations are circles or ellipses, then

· Graphic Type (0070,0023) shall have a value of ELLIPSE.
192 · The end points of the major and minor axes of the ellipses in the group shall be encoded in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022), with Z factored out
194 into Common Z Coordinate Value (006A,0010) if common.

· Long Primitive Point Index List (0066,0040) shall not be present, because the index of each
196 annotation can be computed. Number of Annotations (006A,000C) will contain the number of ellipses, which shall also be one quarter of the number of coordinate tuples in Point Coordinates
198 Data (0066,0016) or Double Point Coordinates Data (0066,0022).

Note: If the length of the major and minor axes are the same, then the ellipse is a circle; a simpler (e.g.,
200 2 point) encoding of a circle is not defined, since the plane of the circle would be unspecified without a third point.

202 If the Annotations are squares or rectangles, then

· Graphic Type (0070,0023) shall have a value of RECTANGLE.
204 · All the corner points of the rectangles in the group shall be encoded in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022), with Z factored out into Common Z
206 Coordinate Value (006A,0010) if common.

· Long Primitive Point Index List (0066,0040) shall not be present, because the index of each
208 annotation can be computed. Number of Annotations (006A,000C) will contain the number of rectangles, which shall also be one quarter of the number of coordinate tuples in Point
210 Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022).

Note: If the lengths of the perpendicular edges are the same, then the rectangle is a square. This
212 rectangle representation is the same as if the rectangle were encoded as an implicitly closed polygon, except that the number of points is fixed and Long Primitive Point Index List (0066,0040)
214 is absent. A simpler (e.g., 2 point TLHC, BRHC) encoding of a rectangle is not defined, since the plane of the rectangle would then be unspecified without a third point.

216 The index used in Long Primitive Point Index List (0066,0040) of the first value of the first coordinate tuple in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) shall be 1.

218 The polylines and polygons encoded in Point Coordinates Data (0066,0016) or Double Point Coordinates Data (0066,0022) shall be in the same order as Long Primitive Point Index List (0066,0040). I.e., the
220 values of Long Primitive Point Index List (0066,0040) are strictly increasing.

Note: This means that the first value of Long Primitive Point Index List (0066,0040) is always 1.

222 Open polylines and implicitly closed polygons shall have their vertices encoded in Point Coordinates Data
     (0066,0016) or Double Point Coordinates Data (0066,0022) in clockwise winding order when viewed from
224 the top surface of the slide towards the bottom, per C.8.12.2.1 Slide Coordinates Attribute Descriptions.
     The line segments shall not cross (i.e., shall be simple polygons, not complex polygons), and shall not
226 contain holes (i.e., the keyhole technique described for RT Structure Sets C.8.8.6.3 Representing Inner
     and Outer Contours on an Image, shall not be used).

228 The plane of the coplanar points is not required to correspond to an image plane or be parallel to the slide
     surface; the points are only required to be coplanar in a geometric sense (i.e., they need not all have the
230 same Z coordinate value).

C.37.1.2.1.2 Measurements

232 For each Annotation Group, optionally one or more measurements may be defined, either for every
     Annotation or a subset of Annotations. Measurements are described by coded type and unit.

234 When there is a measurement for every Annotation, then Floating Point Values (0066,0125) contains the
     corresponding values for each of the Annotations. When there are measurements for only a subset of
236 Annotations, then Floating Point Values (0066,0125) contains measurement values for the Annotations
     that are referenced in Annotation Index List (006A,0011).

238 More than one Measurements Sequence (0066,0121) Item may be used, for example to encode different
     types of measurements, or to encode different components of a measurement that is a tuple.

240 Within one Annotation Group the types of measurements are the same for all Annotations within that
     group.

242

Amend DICOM PS 3.3 Annex F.3.2.2 Directory Information Module:

244 **Table F.3-3. Directory Information Module Attributes**

Attribute Name	Tag	Type	Attribute Description
…	…	…	…
>Directory Record Type	(0004,1430)	1	… Enumerated Values: … **ANNOTATION** …

246 | **Amend DICOM PS 3.3 F.4 Basic Directory IOD Information Model as follows:** |
     | --- |

Table F.4-1. Relationship Between Directory Records

248

Directory Record Type	Section	Directory Record Types that may be included in the next lower-level directory Entity
(Root Directory Entity)		PATIENT, HANGING PROTOCOL, PALETTE, IMPLANT, IMPLANT ASSY, IMPLANT GROUP, PRIVATE
PATIENT	F.5.1	STUDY, HL7 STRUC DOC, PRIVATE
STUDY	F.5.2	SERIES, PRIVATE
SERIES	F.5.3	IMAGE, RT DOSE, RT STRUCTURE SET, RT PLAN, RT TREAT RECORD, PRESENTATION, WAVEFORM, SR DOCUMENT, KEY OBJECT DOC, SPECTROSCOPY, RAW DATA, REGISTRATION, FIDUCIAL, ENCAP DOC, VALUE MAP, STEREOMETRIC, PLAN, MEASUREMENT, SURFACE, **ANNOTATION,** PRIVATE
…	…	…
SURFACE	F.5.42	PRIVATE
SURFACE SCAN	F.5.43	PRIVATE
ANNOTATION	**F.5.47**	**PRIVATE**
…	…	…

250 | **Item: Change Figure F.4-1 Basic Directory IOD Information Model:**

Add "Annotation DR" to the same level as Surface Scan.

252 | **Item: Add in the following new sections in F.5**

F.5.47 Microscopy Bulk Simple Annotations Directory Record Definition

254   The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "ANNOTATION". Table F.5-47 lists the set of keys with their associated Types for such a Directory Record Type. The
256   description of these keys may be found in the Modules related to the Annotation IE of the Microscopy Bulk Simple Annotations IOD. This Directory Record shall be used to reference a Microscopy Bulk Simple Annotations SOP Instance.
258   This type of Directory Record may reference a Lower-Level Directory Entity that includes one or more Directory Records as defined in Table F.4-1.

260   **Table F.5-47. Microscopy Bulk Simple Annotations Keys**

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used in one of the keys.
Content Date	(0008,0023)	1	The date the content creation started.
Content Time	(0008,0033)	1	The time the content creation started.

Key	Tag	Type	Attribute Description
Include Table 10-12 "Content Identification Macro Attributes"			
Any other Attribute of the Microscopy Bulk Simple Annotations IE Modules		3	

262   Note

264   Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key
        (see Table F.3-3), it is not duplicated in this list of keys.

266

DICOM PS3.4: Service Class Specifications

268 **Amend DICOM PS 3.4 Annex B.5 Standard SOP Classes as follows:**

Table B.5-1. Standard SOP Classes

270

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)
…	…	…
Microscopy Bulk Simple Annotations Storage	**1.2.840.10008.5.1.4.1.1.91.1**	**Microscopy Bulk Simple Annotations IOD**
…	…	…

272

DICOM PS 3.6: Data Dictionary

274

Amend DICOM PS 3.6 – Data Dictionary – Section 6 Registry of DICOM Data Elements as follows:

276 ## Table 6-1. Registry of DICOM Data Elements

Tag	Name	Keyword	VR	VM	
(0066,0022)	Double Point Coordinates Data	DoublePointCoordinatesData	OD	1	
(006A,0001)	Annotation Coordinate Type	AnnotationCoordinateType	CS	1	
(006A,0002)	Annotation Group Sequence	AnnotationGroupSequence	SQ	1	
(006A,0003)	Annotation Group UID	AnnotationGroupUID	UI	1	
(006A,0005)	Annotation Group Label	AnnotationGroupLabel	LO	1	
(006A,0006)	Annotation Group Description	AnnotationGroupDescription	UT	1	
(006A,0007)	Annotation Group Generation Type	AnnotationGroupGenerationType	CS	1	
(006A,0008)	Annotation Group Algorithm Identification Sequence	AnnotationGroupAlgorithmIdentificationSequence	SQ	1	
(006A,0009)	Annotation Property Category Code Sequence	AnnotationPropertyCategoryCodeSequence	SQ	1	
(006A,000A)	Annotation Property Type Code Sequence	AnnotationPropertyTypeCodeSequence	SQ	1	
(006A,000B)	Annotation Property Type Modifier Code Sequence	AnnotationPropertyTypeModifierCodeSequence	SQ	1	
(006A,000C)	Number of Annotations	NumberOfAnnotations	UL	1	
(006A,000D)	Annotation Applies to All Optical Paths	AnnotationAppliesToAllOpticalPaths	CS	1	
(006A,000E)	Referenced Optical Path Identifier	ReferencedOpticalPathIdentifier	SH	1-n	
(006A,000F)	Annotation Applies to All Z Planes	AnnotationAppliesToAllZPlanes	CS	1	

Tag	Name	Keyword	VR	VM	
(006A,0010)	Common Z Coordinate Value	CommonZCoordinateValue	FD	1-n	
(006A,0011)	Annotation Index List	AnnotationIndexList	OL	1	

278

Amend DICOM PS 3.6 - Data Dictionary - Annex A - Registry of DICOM Unique Identifiers (UIDs) as
280 **follows:**

Table A-1. UID Values

282

UID Value	UID Name	UID Type	Part
…	…	…	…
1.2.840.10008.5.1.4.1.1.91.1	**Microscopy Bulk Simple Annotations Storage**	**SOP Class**	**PS 3.3**
…	…	…	…

Table A-3. Context Group UID Values

284

Context UID	Context Identifier	Context Group Name
…	…	…
1.2.840.10008.6.1.1365	**CID 8135**	**Microscopy Annotation Property Types**
1.2.840.10008.6.1.1366	**CID 8136**	**Microscopy Measurement Types**
…	…	…

286   **DICOM PS 3.15: Security and System Management Profiles**

Amend: C.2 Creator RSA Digital Signature Profile:

288   …

xx.   any attributes of the Microscopy Bulk Simple Annotations Module that are present

290   …

Amend: E.1 Application Level Confidentiality Profiles:

292   **Table E.1-1. Application Level Confidentiality Profile Attributes**

Attribute Name	Tag	Retd. (from PS3.6)	In Std. Comp. IOD (from PS3.3)	Basic Prof.	Rtn. Safe Priv. Opt.	Rtn. UIDs Opt.	Rtn. Dev. Id. Opt.	Rtn. Inst. Id. Opt.	Rtn. Pat. Chars. Opt.	Rtn. Long. Full Dates Opt.	Rtn. Long. Modif. Dates Opt.	Clean Desc. Opt.	Clean Struct. Cont. Opt.	Clean Graph. Opt.
Annotation Group Label	**(006A,0005)**	**N**	**Y**	**D**								**C**		
Annotation Group Description	**(006A,0006)**	**N**	**Y**	**X**								**C**		
Annotation Group UID	**(006A,0003)**	**N**	**Y**	**D**		**K**								

294

296   **DICOM PS 3.16: Content Mapping Resource**

Item: Add in Section B DCMR Context Groups (Normative)

298   # CID 8135 Microscopy Annotation Property Types

Type: **Extensible**
300 **Version:**   **20210712**

Table CID 8135. Microscopy Annotation Property Types

Coding Scheme Designator	Code Value	Code Meaning
SCT	4421005	Cell
SCT	84640000	Nucleus

302

Ed. Note. CRS Request #762327 to add to DICOM SNOMED subset 84640000, 4421005

304

CID 8136 Microscopy Measurement Types

306 **Type:**   **Extensible**
Version: **20210712**

308   **Table CID 8136. Microscopy Measurement Types**

Coding Scheme Designator	Code Value	Code Meaning
SCT	42798000	Area

310 **Item: Add +/- update definitions in Annex D**

Code Value	Code Meaning	Definition	Notes
...			
ANN	**Annotation**	**A device, process or method that produces annotations.**	
RTSTRUCT	Radiotherapy Structure Set	A device, process or method that produces Radiotherapy Structure Sets.	
RWV	Real World Value Map	A device, process or method that produces mappings between image pixel values and some real-world values.	
SEG	Segmentation	An image processing device, process or method that performs segmentation.	
SM	Slide Microscopy	An acquisition device, process or method that performs slide microscopy.	
...			

312

314   **DICOM PS 3.17: Explanatory Information**

Item: Add the following Section

316

VVVV   Microscopy Bulk Simple Annotations (Informative)

318 **VVVV.1   Introduction**

An annotation algorithm produces individual annotations that are either:

320   • single points (e.g., centroids),
       • open polylines,
322   • closed polylines (polygons) entirely enclosing a structure, or
       • circles, ellipses or rectangles (e.g., bounding boxes).

324 **VVVV.2   Encoding Example**

This section illustrates the usage of the Microscopy Bulk Simple Annotations Module (PS3.3 C.37.1.2) in
326 the context of the Microscopy Bulk Simple Annotations IOD.

The example consists of:

328   • Group of Polygons "1" outlining nuclei, consisting of:

330   ○ 86 polygons
                - Point Coordinates Data (0066,0016) => describes the coordinates for all points in
332   the polygons.
       • Encoding of Annotation Property that the cell structure is a nucleus
334   • Encoding of Measurement Values
           ○ For storing measurement values like area values on specific polygons, the following are
336   present:
                - Measurements Sequence (0066,0121), which contains an Item for each type of
338   measurement, in this case area
                - Measurement Values Sequence (0066,0132), which contains an item containing an
340   array of area measurements for all of the polygons

342 Table VVVV.2-1 shows the encoding of the Microscopy Bulk Simple Annotations Module for the example
above.

344

Table VVVV.2-1. Example of the Microscopy Bulk Simple Annotations Module

Name	Tag	Value	Comment
...			
Frame of Reference UID	(0020,0052)	1.2.3.4....	
...			
Annotation Coordinate Type	(006A,0001)	3D	
Annotation Group Sequence	(006A,0002)		
> Annotation Group Number	(0040,A180)	1	
> Point Coordinates Data	(0066,0016)	0.66675,0.032,0.6665,0.03225,0.6665,0.03275,0.66675,0.033,0.66725,0.033,0.66725,0.03275,0.6675,0.0325,0.6675,0.03225,0.66725,0.032,...	
> Long Primitive Point Index List	(0066,0040)	0x00000001,0x00000013,0x0000008d,...	
> Measurements Sequence	(0066,0121)		
>> Measurement Units Code Sequence	(0040,08EA)	({pixels}, UCUM, "pixels")	
>> Concept Name Code Sequence	(0040,A043)	(42798000, SCT, "Area")	
>> Measurement Values Sequence	(0066,0132)		
>>>Floating Point Values	(0066,0125)	20.0,559.0,24.0, ...	
> Annotation Group UID	(006A,0003)	1.2.3.4.5....	
> Annotation Group Label	(006A,0005)	NUCLEI	
> Annotation Group Description	(006A,0006)	Nuclei detected on H&E	
> Annotation Group Generation Type	(006A,0007)	AUTOMATIC	
> Annotation Group Algorithm Identification Sequence	(006A,0008)		
>> Algorithm Family Code Sequence	(0066,002F)	(C16309,NCIt,"Artificial Intelligence")	
>> Algorithm Name	(0066,0036)	Acme Nucleus Detector	
>> Algorithm Version	(0066,0031)	1.0	
> Annotation Property Category Code Sequence	(006A,0009)	(4421005, SCT, "Cell Structure")	
> Annotation Property Type Code Sequence	(006A,000A)	(84640000, SCT, "Nucleus")	
> Number of Annotations	(006A,000C)	0x00000056	
> Annotation Applies to All Optical Paths	(006A,000D)	YES	
> Annotation Applies to All Z Planes	(006A,000F)	NO	
> Common Z Coordinate Value	(006A,0010)	0	
> Graphic Type	(0070,0023)	POLYGON	

346