

1	Status	Final Text
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8	Correction Number CP-1931	
9	Log Summary: SCOOD3D should be allowed for Planar ROIs in TID 1411 and be more flexible for Volumetric ROIs in TID 1410	
10	Name of Standard	
11	PS3.3, PS3.16 2019e	
12	Rationale for Correction:	
13	TID 1410 allows specification of planar ROIs via the "Image Region" content item, which shall have value type SCOOD. However,	
14	it is also possible to specify a planar ROI using value type SCOOD3D, for example in form of a POLYGON or an ELLIPSE with	
15	co-planar points, as defined in PS3.3 Section C.18.9.1.2.	
16	This is useful, for example, for planar ROIs that may be defined independently of any particular image and be patient-relative, as	
17	well as for tiled representations, such as for whole slide microscopy, where ROIs may span tile boundaries or be defined within or	
18	across in Z stacks.	
19	Add SCOOD3D to TID 1410.	
20	Also, currently the Volumetric ROI (TID 1411) uses only the ELLIPSOID SCOOD3D Graphic Type, since that is the only closed	
21	surface primitive defined as a single content item, as opposed to say, a stack of disks, each of which is coplanar, each defined by	
22	3D rather than 2D image relative coordinates. This can be generalized by increasing the content items multiplicity and conditionally	
23	expanding the range of graphic types.	
24	Clarify that SCOOD3D applies to the Slide Coordinates System as well as the Patient Coordinate System and others.	
25	Correction Wording:	

Amend DICOM PS3.3 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):

### 3 Definitions

#### 3.17 Multi-dimensional Definitions

Reference Coordinate System (RCS) The RCS is the spatial coordinate system in a DICOM Frame of Reference. It is the chosen origin, orientation and spatial scale of an Image IE in a Cartesian space. The RCS is a right-handed Cartesian coordinate system i.e., the vector cross product of a unit vector along the positive x-axis and a unit vector along the positive y-axis is equal to a unit vector along the positive z-axis. The unit length is one millimeter. Typically, the Image IE contains a spatial mapping that specifies the relationship of the image samples to the Cartesian spatial domains of the RCS.

### C.18.9 3D Spatial Coordinates Macro

Table C.18.9-1 specifies the Attributes that convey 3D Spatial Coordinates in an SCOOD3D Content Item.

**Table C.18.9-1. 3D Spatial Coordinates Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Referenced Frame of Reference UID	(3006,0024)	1	Uniquely identifies the Frame of Reference within which the coordinates are defined.  <b>Note</b>  1. There is no requirement that the Frame of Reference be the same for all SCOOD3D Content Items in the same SR SOP Instance, nor is there any requirement that the Frame of Reference Module be present.  2. <b><u>The Frame of Reference may be any type of DICOM Reference Coordinate System, whether it be patient-relative (Patient Based Coordinate System), volume-relative (including acquired and presentation state volumes), or whole slide relative (Slide Coordinate System).</u></b>
Graphic Data	(0070,0022)	1	An ordered set of (x,y,z) triplets (in mm and may be negative) that define a region of interest in the patient-relative Reference Coordinate System defined by Referenced Frame of Reference UID (3006,0024). See Reference Coordinate System (RCS).  See Section C.18.9.1.1 for further explanation.
Graphic Type	(0070,0023)	1	See Section C.18.9.1.2 for Enumerated Values.
Fiducial UID	(0070,031A)	3	The globally unique identifier for this fiducial Item.  <b>Note</b>  The fiducial UID can be used to associate this set of graphics with other Content Items.

#### C.18.9.1 3D Spatial Coordinates Macro Attribute Descriptions

##### C.18.9.1.1 Graphic Data

Graphic Data may be used to associate an anatomic or spatial Concept with a defined set of patient relative 3D locations in a defined Frame of Reference, independent of any image. Graphic Data may be defined explicitly as a single point (i.e., to denote the epicenter of an anatomic site or lesion) or more than one point (i.e., representing a set of points or an open or closed polygon).

### C.18.9.1.2 Graphic Type

This Attribute defines the type of geometry of the region of interest.

#### Enumerated Values:

- POINT** a single location denoted by a single (x,y,z) triplet
- MULTIPOINT** multiple locations each denoted by an (x,y,z) triplet; the points need not be coplanar
- POLYLINE** a series of connected line segments with ordered vertices denoted by (x,y,z) triplets; the points need not be coplanar
- POLYGON** a series of connected line segments with ordered vertices denoted by (x,y,z) triplets, where the first and last vertices shall be the same forming a polygon; the points shall be coplanar
- ELLIPSE** an ellipse defined by four (x,y,z) triplets, the first two triplets specifying the endpoints of the major axis and the second two triplets specifying the endpoints of the minor axis
- ELLIPSOID** a three-dimensional geometric surface whose plane sections are either ellipses or circles and contains three intersecting orthogonal axes, "a", "b", and "c"; the ellipsoid is defined by six (x,y,z) triplets, the first and second triplets specifying the endpoints of axis "a", the third and fourth triplets specifying the endpoints of axis "b", and the fifth and sixth triplets specifying the endpoints of axis "c"

#### Note

1. A circle is a special case of ELLIPSE where the major and minor axis points are equidistant from the center.
2. Coplanar is in the mathematical sense and is not necessarily related to a specific image instance.

Amend DICOM PS3.16 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):

## TID 1410 Planar ROI Measurements and Qualitative Evaluations

This Template provides a general structure to report measurements for some metric, e.g., density, flow, or concentration, and/or qualitative evaluations, over a planar region of interest in an image. The ROI may be specified by an SCOOD on an image, ~~or~~ by a Segmentation Image or by an SCOOD3D defining an area relative to a 3D Frame of Reference.

**Table TID 1410. Planar ROI Measurements and Qualitative Evaluations**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (125007, DCM, "Measurement Group")	1	M		
5	>	CONTAINS	SCOOD	EV (111030, DCM, "Image Region")	1	MC	XOR Rows <u>7, 7b</u>	GRAPHIC TYPE = not {MULTIPOINT}
6	>>	SELECTED FROM	IMAGE		1	M		
7	>	CONTAINS	IMAGE	EV (121214, DCM, "Referenced Segmentation Frame")	1	MC	XOR Rows <u>5, 7b</u>	Reference shall be to a Segmentation Image, with a single value specified in Referenced Frame Number, and with a single value specified in Referenced Segment Number
<u>7b</u>	≥	<u>CONTAINS</u>	<u>SCOOD3D</u>	<u>EV (111030, DCM, "Image Region")</u>	<u>1</u>	<u>MC</u>	<u>XOR Rows 5, 7</u>	<u>GRAPHIC TYPE = not {MULTIPOINT, POLYLINE or ELLIPSOID}</u>
8	>	CONTAINS	IMAGE	EV (121233, DCM, "Source image for segmentation")	1	MC	IFF Row 7	

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
9	>	CONTAINS	IMAGE	EV (121200, DCM, "Illustration of ROI")	1	U		

**Content Item Descriptions**

Row 5	To describe an infinitely small area, such as the center of a lesion, a Graphic Type of POINT may be used.
Rows 6, 7	Referenced Frame Number (0008,1160) is an attribute of the IMAGE Content Item, and shall be present with a single value.  If the Referenced Segmentation SOP Instance has Segmentation Type (0062,0001) value BINARY, it identifies the area of defined (measured) region of interest by pixel values in the referenced frame with value 1. For Segmentation Type value FRACTIONAL, the area is computed by an implementation dependent method.  Frame number shall be specified even if the Segmentation SOP Instance has only a single frame.
<b>Row 7b</b>	<b><u>The area may be defined independently of an image by reference to 3D coordinates in any type of DICOM Reference Coordinate System, whether it be patient-relative (Patient Based Coordinate System), volume-relative (including acquired and presentation state volumes), or whole slide relative (Slide Coordinate System).</u></b>
Row 8	Identifies the source image that was segmented to identify the ROI, and whose properties are described in this container.
Row 9	This referenced image may contain a "screen shot" illustrating a rendered version of the ROI.

**TID 1411 Volumetric ROI Measurements and Qualitative Evaluations**

This Template provides a general structure to report measurements for some metric, e.g., density, flow, or concentration, and/or qualitative evaluations, over a volumetric region of interest in a set of images or a Frame of Reference. The volumetric ROI may be specified by a set of SCOODs on an image set representing a volume, by a volumetric Segmentation Image, by a volume defined in a Surface Segmentation, or by a set of SCOOD3Ds defining a volume relative to a 3D Frame of Reference.

**Table TID 1411. Volumetric ROI Measurements and Qualitative Evaluations**

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (125007, DCM, "Measurement Group")	1	M		
5	>	CONTAINS	SCOOD	EV (111030, DCM, "Image Region")	1-n	MC	XOR Rows 7, 10	GRAPHIC TYPE = not {MULTIPOINT}
6	>>	SELECTED FROM	IMAGE		1	M		
7	>	CONTAINS	IMAGE	EV (121191, DCM, "Referenced Segment")	1	MC	XOR Rows 5, 10	Reference shall be to a Segmentation Image or Surface Segmentation object, with a single value specified in Referenced Segment Number
10	>	CONTAINS	SCOOD3D	EV (121231, DCM, "Volume Surface")	1-n	MC	XOR Rows 5, 7	<b><u>If one item, GRAPHIC TYPE = {ELLIPSOID or POINT}</u></b>  <b><u>If more than one item, GRAPHIC TYPE = {POLYGON or ELLIPSE}</u></b>

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
11	>	CONTAINS	IMAGE	EV (121233, DCM, "Source image for segmentation")	1-n	MC	XOR Row 12 and IFF (Row 7 or Row 10)	
12	>	CONTAINS	UIDREF	EV (121232, DCM, "Source series for segmentation")	1	MC	XOR Row 11 and IFF ((Row 7 or Row 10)	
13	>	CONTAINS	IMAGE	EV (121200, DCM, "Illustration of ROI")	1-n	U		

**Content Item Descriptions**

Row 1b	Identifies the session during which the measurements were made. The NCI Thesaurus definition is "time, period, or term devoted to some activity".
Rows 5, 10	To describe an infinitely small volume, such as the center of a lesion, a Graphic Type of POINT may be used.
Rows 6, 7	Referenced Segment Number (0062,000B) is an attribute of the IMAGE Content Item, and shall be present with a single value.  If the Referenced SOP Instance is a Segmentation Image, it shall have a defined Frame of Reference. If it has Segmentation Type (0062,0001) value BINARY, it identifies the volume of defined (measured) region of interest by voxel values in the referenced segment with value 1. If it has Segmentation Type value FRACTIONAL, the volume is defined by an implementation dependent method.  If the referenced SOP Instance is a Surface Segmentation, the referenced segment shall constitute a finite volume. It identifies the volume of the defined (measured) region of interest by the interior of the finite volume.  Segment number shall be specified even if the Segmentation SOP Instance has only a single segment.
<b>Row 10</b>	<b><u>Either a single item describing a closed volumetric surface, or multiple items describing a set of parallel closed coplanar areas (contours) is specified.</u></b>
Row 11	Identifies the source images that were segmented to identify the ROI, when, for example a subset of images in a series was used.
Row 12	Identifies the source series of images that were segmented to identify the ROI, when, for example an entire set of images in a series was used.
Row 13	These referenced images may contain "screen shot" illustrating rendered versions of the ROI.