

# DICOM Correction Proposal

STATUS	Letter Ballot
Date of Last Update	2024/08/24
Person Assigned	Christof Schadt
Submitter Name	Kari Jyrkkälä <kari.jyrkkala@varian.com>
Submission Date	2024/02/29

Correction Number	CP-2401
Log Summary:	Ion Range Surface Compensator
Name of Standard	PS3.3, PS3.6, PS3.16
Rationale for Correction:	<p>3D printing has become a viable option to manufacture a physical compensator for radiotherapy treatments. 3D printers typically use a triangle mesh-based representation (like STL) as the input for manufacturing. This CP introduces an alternative way of representing the Ion Range Compensator as a Surface Segmentation IOD which uses the triangle mesh-based representation. When Surface Segmentation IOD is used as the compensator representation, the compatibility with old implementations is intentionally broken.</p>
Correction Wording:	

*Update PS 3.3, chapter C.8.8.25 RT Ion Beams Module*

**Table C.8.8.25-1. RT Ion Beams Module Attributes**

>>Isocenter to Wedge Tray Distance	(300A,00D9)	1	Isocenter to downstream edge of wedge tray (mm). See Section C.8.8.25.4 and Section C.8.8.25.10
>Number of Compensators	(300A,00E0)	1	Number of compensators associated with current Beam.
>Total Compensator Tray Water-Equivalent Thickness	(300A,02E3)	3	Water-Equivalent thickness of the compensator tray (in mm) parallel to radiation beam axis.
>Ion Range Compensator Sequence	(300A,02EA)	1C	Sequence of compensators. Required if Number of Compensators (300A,00E0) is non-zero. The number of Items shall be identical to the value of Number of Compensators (300A,00E0).
>>Compensator Description	(300A,02EB)	3	User defined description for the compensator.
>>Compensator Number	(300A,00E4)	1	Identification number of the Compensator. The value of Compensator Number (300A,00E4) shall be unique within the Beam in which it is created.
>>Material ID	(300A,00E1)	2	User-supplied identifier for material used to manufacture Compensator.

>>Compensator ID	(300A,00E5)	3	User-supplied identifier for the compensator.
>>Accessory Code	(300A,00F9)	3	An accessory identifier to be read by a device such as a bar code reader.
>>Isocenter to Compensator Tray Distance	(300A,02E4)	1C	Isocenter to compensator tray attachment edge distance (in mm) for current range compensator. Required if Compensator Mounting Position (300A,02E1) is not DOUBLE_SIDED. See Section C.8.8.25.4 and Section C.8.8.25.10
>>Compensator Divergence	(300A,02E0)	1	Indicates presence or absence of geometrical divergence of the range compensator.  Enumerated Values: <b>PRESENT</b> the range compensator is shaped according to the beam geometrical divergence. <b>ABSENT</b> the range compensator is not shaped according to the beam geometrical divergence.
>>Compensator Mounting Position	(300A,02E1)	1	Indicates on which side of the Compensator Tray the compensator is mounted.  Enumerated Values: <b>PATIENT_SIDE</b> the Compensator is mounted on the side of the Compensator Tray that is towards the patient. <b>SOURCE_SIDE</b> the Compensator is mounted on the side of the Compensator Tray that is towards the radiation source. <b>DOUBLE_SIDED</b> the Compensator has a shaped (i.e., non-flat) surface on both sides of the Compensator Tray.
<u>&gt;&gt;Surface Representation Flag</u>	<u>(gggg,nnnn)</u>	<u>3</u>	<u>Indicates that the Compensator is represented using a surface.</u>  <u>Enumerated Value:</u> <u>YES</u> <u>NO</u>
<u>&gt;&gt;Referenced Surface Segmentation Sequence</u>	<u>(gggg,nnn1)</u>	<u>1C</u>	<u>Surface Segmentation containing the representation for Compensator.</u>  <u>Only a single Item shall be included in this Sequence.</u>  <u>Required if Surface Representation Flag (gggg,nnnn) is present and has value YES.</u>
<u>&gt;&gt;&gt;Include Table 10-11 "SOP Instance Reference Macro Attributes"</u>			<u>Reference to Surface Segmentation SOP Instance.</u>  <u>See Section C.8.8.25.XX.</u>
>>Compensator Rows	(300A,00E7)	1C	Number of rows in the range compensator. A row is defined to be in the X direction of the IEC Beam Limiting Device Coordinate system.  <u>Required if Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u>
>>Compensator Columns	(300A,00E8)	1C	Number of columns in the range compensator. A column is defined to be in the Y direction of the IEC Beam Limiting Device Coordinate system.

			<b><u>Required if Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>
>>Compensator Pixel Spacing	(300A,00E9)	1C	Physical distance (in mm) between the center of each pixel projected onto machine isocentric plane. Specified by a numeric pair - adjacent row spacing followed by adjacent column spacing. See Section 10.7.1.3 for further explanation of the value order.  <b><u>Required if Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>
>>Compensator Position	(300A,00EA)	1C	The x and y coordinates of the upper left hand corner (first pixel transmitted) of the range compensator, projected onto the machine isocentric plane in the IEC BEAM LIMITING DEVICE coordinate system (mm).  <b><u>Required if Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>
>>Compensator Column Offset	(300A,02E5)	1C	The offset distance (in mm) applied to the x coordinate of Compensator Position (300A,00EA) for even numbered rows. Required if the compensator pattern is hexagonal <b><u>and Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>
>>Compensator Thickness Data	(300A,00EC)	1C	A data stream of the pixel samples that comprise the range compensator, expressed as physical thickness (in mm), either parallel to radiation beam axis if Compensator Divergence (300A,02E0) equals ABSENT, or divergent according to the beam geometrical divergence if Compensator Divergence (300A,02E0) equals PRESENT. The order of pixels encoded is left to right, top to bottom (upper left pixel, followed by the remainder of row 1, followed by the remainder of the rows).  <b><u>Required if Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>
>>Isocenter to Compensator Distances	(300A,02E6)	1C	A data stream of the pixel samples that comprise the distance from the isocenter to the compensator surface closest to the radiation source (in mm). The order of pixels encoded is left to right, top to bottom (upper left pixel, followed by the remainder of row 1, followed by the remainder of the rows).  Required if Material ID (300A,00E1) is non-zero length, and Compensator Mounting Position (300A,02E1) is DOUBLE_SIDED <b><u>and Surface Representation Flag (gggg,nnnn) is absent or has value NO.</u></b>  See Section C.8.8.14.9, Section C.8.8.25.4, Section C.8.8.25.10 and Section C.8.8.25.11.
>>Compensator Relative Stopping Power Ratio	(300A,02E7)	3	Compensator Linear Stopping Power Ratio, relative to water, at the beam energy specified by the Nominal Beam Energy (300A,0114) of the first Control Point of the Ion Control Point Sequence (300A,03A8).
>>Compensator Milling Tool Diameter	(300A,02E8)	3	The diameter (in mm) of the milling tool to be used to create the compensator. The diameter is expressed as the actual physical size and not a projected size at isocenter.

### C.8.8.25.XX Compensator as a Surface Segmentation IOD

Following restrictions apply when a Compensator is represented as a Surface Segmentation IOD:

- Segment Sequence (0062,0002) shall contain only one item.
- Segmented Property Category Code (0062,0003) shall be (260787004, SCT, “Physical object”)
- Segmented Property Type Code (0062,000F) shall be (130340, DCM, “Physical Compensator”)
- Finite Volume (0066,000E) shall be YES
- Manifold (0066,0010) shall be YES
- Point Coordinates Data (0066,0016) shall be defined in mm in the IEC GANTRY coordinate system where the origin (0,0,0) is at the isocenter. This means that for a single sided compensator, the z-coordinate for the vertices at the base of the compensator has the value of Isocenter to Compensator Tray Distance (300A,02E4).

Update section 6 in PS3.6

Tag	Name	Keyword	VR	VM	
<u>(ggggg.nnnn)</u>	<u>Surface Representation Flag</u>	<u>SurfaceRepresentationFlag</u>	<u>CS</u>	<u>1</u>	
<u>(ggggg.nnn1)</u>	<u>Referenced Surface Segmentation Sequence</u>	<u>ReferencedSurfaceSegmentationSequence</u>	<u>SQ</u>	<u>1</u>	

Update B.1 in PS3.16

## CID 7157 Device Segmentation Type

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML  
Keyword: DeviceSegmentationType  
FHIR Keyword: dicom-cid-7157-DeviceSegmentationType  
Type: Extensible  
Version: 20130617  
UID: 1.2.840.10008.6.1.503

Table CID 7157. Device Segmentation Type

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
Include CID 9505 “Fixation or Positioning Device”				
Include CID 9506 “Brachytherapy Device”				
SCT	77444004	Bone Pin	A-12024	C0175718
SCT	68183006	Bone Screw	A-12030	C0005975
SCT	14106009	Cardiac Pacemaker	A-11100	C0030163
SCT	72506001	Defibrillator	A-11206	C0162589
SCT	27606000	Dental Prosthesis	A-04200	C0162686

<b>Coding Scheme Designator</b>	<b>Code Value</b>	<b>Code Meaning</b>	<b>SNOMED-RT ID</b>	<b>UMLS Concept Unique ID</b>
SCT	272287005	Inlay Dental Restoration	A-04036	C0441351
SCT	360066001	Left ventricular assist device	A-11FCD	C0181598
SCT	79068005	Needle	A-30360	C0027551
SCT	19443004	Radioactive implant	A-04034	C0521196
SCT	65818007	Stent	A-25500	C0038257
<b><u>DCM</u></b>	<b><u>130340</u></b>	<b><u>Physical Compensator</u></b>		