Digital Imaging and Communications in Medicine (DICOM)

Supplement 213: Second Generation Radiotherapy

- Enhanced RT Image and RT Patient Position Acquisition Instruction

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149 **Open Issues for Public Comment**

#	Item
1	**Special Cone-Beam Use Cases:** Instructions for Cone-Beam do not yet cover a specification of the extent of acquisition (“stitching” use cases and alike). How should these use cases be addressed?
2	**Constraints for Bit specification Attributes:** Bits Allocated (0028,0100), Bits Stored (0028,0101) and High Bit (0028,0102) in A.86.1.a1.4.3 Image Pixel Module restrict the allowed values to 2 options: 8 and 16 for Bits Allocated (and corresponding values for Bits Stored and High Bit). Is this restriction appropriate?
3	**Inclusion of mobile X-Ray Devices:** In CID SUP213030, should a code be covering mobile X-Ray devices already? Devices using the RT Patient Position Acquisition Instruction need to understand the 2nd Generation approach to describe geometries (namely the notion of Equipment Frame of Reference), but if this is the case, this instruction can be used by such devices as well.
4	**Use of Volumetric Properties:** Are the Volumetric Properties Attributes of C.8.16.2 useful to be included for Enhanced RT Image SOP classes? RT Images are not volumetric images, but they are located in a 3D space and therefore these Attributes may have relevance.
5	**Consideration of X-Ray 3D isocenter model:** Is there anything to consider for the geometric model of the IODs in this Supplement in comparison to the X-Ray 3D isocenter model?

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Foreword

This Supplement specifies additional IODs representing projection images constructed for or acquired at Radiotherapy treatment sessions and instructions to acquire images and other artifacts for positioning the patient for Radiotherapy treatments.

This document is an extension to the following parts of the published DICOM Standard:

PS 3.2	Conformance
PS 3.3	Information Object Definitions
PS 3.4	Service Class Specifications
PS 3.6	Data Dictionary
PS 3.16	Content Mapping Resource

Scope and Field of Application

The Supplement adds three new IODs for Radiotherapy: Two IODs for projection images and one IOD for acquisition instructions for images and other artifacts for patient positioning during therapeutic treatment sessions.

Enhanced RT Image and Enhanced Continuous RT Image

The Supplement adds two new IODs to support projection images reconstructed for use during or acquired during Radiotherapy treatment sessions to support patient position verification for Radiotherapy treatment delivery sessions (“RT Images”).

One IOD covers the images with a smaller number of frames, where the per-frame functional group macros are populated for all frames.

The other IOD covers images which are continuously acquired, resulting in high number of frames due to a high frame rate. In this case it is sufficient to populate only a subset of frames to avoid a huge amount of superfluous data. E.g. an imaging device may continuously acquire image frames and store them using an MPEG Transfer syntax. A typical frame rate of 25 fps would result in 1500 frames per minute. A typical treatment may last several minutes, resulting in several thousand frames. To populate each frame with the set of required functional group macros is not necessary for most use cases of positioning and review, but will slow down processing and presentation of images. Further on it may not always be possible to populate functional groups along such frame rates when devices providing the macro content does not have the same sampling rate as the image receptor. This IOD supports to populate macros a selected subset of frames only (instead of all frames) for such cases.

Such images represent projections of the patient geometry and potentially structures in relation to the treatment device equipment. They may be used to guide the positioning of the patient on a patient support device to deliver therapeutic dose at the intended location. They may be also used to verify the position when acquired prior, during or after the delivery of the therapeutic radiation.

In the current edition of the Standard, such images are supported by the RT Image IOD. This IOD lacks various features needed for positioning in modern Radiotherapy, such as a systematic approach to reference control points of the therapeutic beam, capturing of use-case-specific data related to monitoring and tracking and technical data

related to the acquisition. In addition, some content has been added over time to address newer developments on image acquisition, but these additions lack cleanness and efficiency.

RT Patient Position Acquisition Instruction

The Supplement specifies a new IOD to convey parameters to acquire images or other artifacts for patient position verification for Radiotherapy treatment delivery sessions.

The RT Patient Position Acquisition Instruction IOD allows the definition of the devices which are to be used for patient position detection or verification. The IOD is capable of being extended later as other or newer techniques are utilized in the workflow.

In the 1st Generation DICOM RT Plan IOD it was possible to define a beam as a “setup beam” to perform a setup procedure, such as kV (planar or CBCT) or MV imaging. This concept of using beams to represent a workflow step is no longer included in the 2nd Generation RT Object definitions.

IODs as part of 2nd Generation

The IODs of this Supplement are part of the 2nd Generation RT Objects family and use the concepts developed there.

Within this family it covers the positioning imaging in close coordination with other 2nd Generation Radiotherapy Objects and makes use of the strong concepts developed there. E.g. the generalizing to diverse types of devices, the systematic description of geometries and the annotation of devices used in the beam line will significantly streamline and tighten the semantic in the new IOD. In addition, relations to other 2nd Generation Radiotherapy Objects cannot be properly expressed in the existing 1st Generation IOD.

Part 2 Addendum

Add new SOP Classes to PS3.2 Table A.1-2 UID Values:

UID Value	UID Name	Category
…		
1.2.840.10008.5.1.4.1.1.481.S213.1	Enhanced RT Image	Transfer
1.2.840.10008.5.1.4.1.1.481.S213.2	Enhanced Continuous RT Image	Transfer
1.2.840.10008.5.1.4.1.1.481.S213.3	RT Patient Position Acquisition Instruction	Transfer

Part 3 Addendum

Add the following reference to PS 3.3, Chapter 2.6

2.6 Other References

…

[MEDPHYS 23464308] Medical Physics March 2013, PMID: 23464308. Chytyk-Praznik K, VanUytven E, vanBeek TA, Greer PB, McCurdy BM. *Model-based prediction of portal dose images during patient treatment.* https://pubmed.ncbi.nlm.nih.gov/23464308/

…

Add the following columns in PS3.3 Section A.1.4, Table A.1-1 Composite Information Object Modules Overview - Images

A.1 Elements of An Information Object Definition

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A.1.4 Overview of the Composite IOD Module Content

…

IODs Modules	Enhanced RT Image	Enhanced Continuous RT Image	RT Patient Position Acquisition Instruction
Patient	M	M	M
Clinical Trial Subject	U	U	U
General Study	M	M	M
Patient Study	U	U	U
Clinical Trial Study	U	U	U

IODs Modules	Enhanced RT Image	Enhanced Continuous RT Image	RT Patient Position Acquisition Instruction
General Series	M	M	M
Clinical Trial Series	U	U	U
Enhanced RT Series	M	M	M
…			
Frame Of Reference	M	M	
Synchronization	C	C	
…			
Respiratory Synchronization	C	C	
…			
General Equipment	M	M	M
Enhanced General Equipment	M	M	M
Image Pixel	M	M	
…			
Enhanced RT Image Device	M	M	
Enhanced RT Image	M	M	
RT Patient Position Acquisition Instruction Device			M
RT Patient Position Acquisition Instruction			M
…			
Multi-frame Functional Groups	M		
Sparse Multi-frame Functional Groups		M	
Multi-frame Dimension	M	M	
…			
Contrast/Bolus	C	C	
Device	U	U	
…			
General Reference Module	M	M	M
Common Instance Reference Module	M	M	M
…			
SOP Common	M	M	M
Radiotherapy Common Instance	M	M	M
Frame Extraction	C	C	

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Add the following to PS3.3 Annex A:

A.86 RT Second Generation

…

A.86.1.a1 Enhanced RT Image Information Object Definition

A.86.1.a1.1 Enhanced RT Image IOD Description

The Enhanced RT Image IOD represents projection images related to Radiotherapy treatment sessions. The images may be acquired as projection images or may be reconstructed from volumetric data. Such images represent a projection of the patient geometry to guide or record the positioning of the patient on a patient support device to deliver therapeutic dose to an intended location.

A.86.1.a1.2 Enhanced RT Image IOD Entity-Relationship Model

See Figure A.86.1.1.1-1.

A.86.1.a1.3 Enhanced RT Image IOD Module Table

Table A.86.1.a1-5 specifies the Modules of the Enhanced RT Image IOD.

Table A.86.1.a1-1
Enhanced RT Image 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
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	C – Required if time synchronization was applied.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
RT Image	General Reference	C.12.4	M
	Image Pixel	C.7.6.3	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	M
	Respiratory Synchronization	C.7.6.18.2	C – Required if respiratory synchronization was applied.
	Enhanced Contrast/Bolus	C.7.6.4b	C - Required if contrast media was used when this image was acquired
	Device	C.7.6.12	U
	Enhanced RT Image Device	C.36.m1	M
	Enhanced RT Image	C.36.m2	M

	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
	Radiotherapy Common Instance	C.36.4	M
	Frame Extraction	C.12.3	C - Required if the SOP Instance was created in response to a Frame-Level retrieve request

A.86.1.a1.4 Enhanced RT Image IOD Content Constraints

A.86.1.a1.4.1 Modality Attribute

The value of Modality (0008,0060) shall be RTIMAGE.

A.86.1.a1.4.2 Inclusion of Modules in Standard Extended SOP Classes

The General Image Module, Overlay Plane Module, Curve Module and VOI LUT Module shall not be used in a Standard Extended SOP Class of the Enhanced RT Image IOD.

A.86.1.a1.4.3 Image Pixel Module

In the Image Pixel Module C.7.6.3, the following constraints apply:

- Samples per Pixel (0028,0002) shall be 1
- Photometric Interpretation (0028,0004) shall be MONOCHROME2
- Bits Allocated (0028,0100) shall be 8 or 16
- Bits Stored (0028,0101) shall be equal to Bits Allocated (0028,0100)
- High Bit (0028,0102) shall be one less than the value of Bits Stored (0028,0101).
- Pixel Representation (0028,0103) shall be 0

A.86.1.a1.5 Enhanced RT Image Functional Group Macros

Table A.86.1.a1-2 specifies the use of the Functional Group Macros used in the Multi-frame Functional Groups Module for the Enhanced RT Image IOD.

Table A.86.1.a1-2
ENHANCED RT IMAGE FUNCTIONAL GROUP MACROS

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M - May not be used as a Shared Functional Group.
Plane Position (Patient)	C.7.6.16.2.3	M
Plane Orientation (Patient)	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	U
Derivation Image	C.7.6.16.2.6	C - Required if the image or frame has been derived from other images.
Respiratory Synchronization	C.7.6.16.2.17	U
Cardiac Synchronization	C.7.6.16.2.7	U

Contrast/Bolus Usage	C.7.6.16.2.12	C - Required if Contrast/Bolus Agent Sequence (0018,0012) is used.
RT Image Frame General Content	C.36.2.n.X12	M
RT Image Frame Imaging Device Position	C.36.2.n.X13	M
RT Image Frame Radiation Acquisition Parameters	C.36.2.n.X14	C – Required if the image has been acquired using photon or particle radiation
RT Image Frame Context	C.36.2.n.X15	C - Required if the SOP Instance was created for the purpose of controlling the treatment position of the patient
RT Beam Limiting Device Opening	C.36.2.2.9	M
Frame VOI LUT	C.7.6.16.2.10	U
Real World Value Mapping	C.7.6.16.2.11	M

A.86.1.a1.5.1 Enhanced RT Image Functional Group Macros Content Constraints

The Dimension Index Sequence (0020,9222) shall be present, and at least one Item has the following characteristics:

- Functional Group Pointer (0020,9167) shall have the value Frame Content Sequence (0020,9111)
- Dimension Index Pointer (0020,9165) shall have the value Frame Acquisition DateTime (0018,9074)

A.86.1.a1.5.2 Pixel Spacing

See Pixel Spacing (0028,0030) in the Pixel Measures Macro C.7.6.16.2.1.

Note: The Pixel Spacing (0028,0030) is measured on the x/y plane of the Image Receptor Coordinate System at z = 0. See Section C.36.1.1.n2. Imager Pixel Spacing (0018,1164) is not used.

A.86.1.a2 Enhanced Continuous RT Image Information Object Definition

A.86.1.a2.1 Enhanced Continuous RT Image IOD Description

The Enhanced RT Image IOD represents projection images reconstructed before or during the Radiotherapy treatment sessions or acquired during Radiotherapy treatment sessions. Such images represent a projection of the patient geometry and potentially structures to guide or record the positioning of the patient on a patient support device to deliver therapeutic dose to the intended location.

This IOD allows to populate only a selected set of frames in the per-frame functional group when a high number of frames are present due to a high frame rate (e.g. 25 frames / second).

A.86.1.a2.2 Enhanced Continuous RT Image IOD Entity-Relationship Model

See Figure A.86.1.1.1-1.

A.86.1.a2.3 Enhanced Continuous RT Image IOD Module Table

Table A.86.1.a1-5 specifies the Modules of the Enhanced RT Image IOD.

Table A.86.1.a2-1
Enhanced Continuous RT Image 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
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	C – Required if time synchronization was applied.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
RT Image	General Reference	C.12.4	M
	Image Pixel	C.7.6.3	M
	Sparse Multi-frame Functional Groups	C.36.m3	M
	Multi-frame Dimension	C.7.6.17	M
	Respiratory Synchronization	C.7.6.18.2	C – Required if respiratory synchronization was applied.
	Contrast/Bolus	C.7.6.4	C - Required if contrast media was used when this image was acquired
	Device	C.7.6.12	U
	Enhanced RT Image Device	C.36.m1	M
	Enhanced RT Image	C.36.m2	M
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
	Radiotherapy Common Instance	C.36.4	M
	Frame Extraction	C.12.3	C - Required if the SOP Instance was created in response to a Frame-Level retrieve request

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299 **A.86.1.a2.4 Enhanced Continuous RT Image IOD Content Constraints**

300 **A.86.1.a2.4.1 Modality Attribute**

301 The value of Modality (0008,0060) shall be RTIMAGE.

302 **A.86.1.a2.4.2 Inclusion of Modules in Standard Extended SOP Classes**

303 The General Image Module, Overlay Plane Module, Curve Module and VOI LUT Module shall not be used in a
304 Standard Extended SOP Class of the Enhanced RT Image IOD.

305 **A.86.1.a2.4.3 Image Pixel Module**

306 In section Image Pixel Module C.7.6.3, the constraints apply as specified in A.86.1.a1.4.3 Image Pixel Module.

A.86.1.a2.5 Enhanced Continuous RT Image Functional Group Macros

Table A.86.1.a2-2 specifies the use of the Functional Group Macros used in the Multi-frame Functional Groups Module for the Enhanced RT Image IOD.

Table A.86.1.a2-2
ENHANCED CONTINOUS RT IMAGE FUNCTIONAL GROUP MACROS

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M - May not be used as a Shared Functional Group.
Plane Position (Patient)	C.7.6.16.2.3	M
Plane Orientation (Patient)	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	U
Derivation Image	C.7.6.16.2.6	C - Required if the image has been derived from other images.
Respiratory Synchronization	C.7.6.16.2.17	U
Cardiac Synchronization	C.7.6.16.2.7	U
Contrast/Bolus Usage	C.7.6.16.2.12	C - Required if Contrast/Bolus Agent Sequence (0018,0012) is used.
RT Image Frame General Content	C.36.2.n.X12	M
RT Image Frame Imaging Device Position	C.36.2.n.X13	M
RT Image Frame Radiation Acquisition Parameters	C.36.2.n.X14	C – Required if the image has been acquired using photon or particle radiation
RT Image Frame Context	C.36.2.n.X15	C - Required if the SOP Instance was used to control the treatment position of the patient
RT Beam Limiting Device Opening	C.36.2.2.9	M
Frame VOI LUT	C.7.6.16.2.10	U
Real World Value Mapping	C.7.6.16.2.11	M

A.86.1.a2.5.1 Enhanced Continuous RT Image Functional Group Macros Content Constraints

At least one dimension shall be present which is time-related.

This dimension shall be defined as:

- Functional Group Pointer (0020,9167) shall have the value Frame Content Sequence (0020,9111)
- Dimension Index Pointer (0020,9165) shall have the value Frame Acquisition DateTime (0018,9074)

A.86.1.a2.5.2 Pixel Spacing

See Pixel Spacing (0028,0030) in the Pixel Measures Macro C.7.6.16.2.1.

Note: The Pixel Spacing (0028,0030) is measured on the x/y plane of the Image Receptor Coordinate System at z = 0. See Section C.36.1.1.n2. Imager Pixel Spacing (0018,1164) is not used.

A.86.1.a3 RT Patient Position Acquisition Instruction Information Object Definition

A.86.1.a3.1 RT Patient Position Acquisition Instruction IOD Description

The RT Patient Position Acquisition Instruction IOD contains all parameters needed to acquire the actual patient position.

A.86.1.a3.2 RT Patient Position Acquisition Instruction IOD Entity-Relationship Model

See Figure A.86.1.1.1-1.

A.86.1.a3.3 RT Patient Position Acquisition Instruction IOD Module Table

Table A.86.1.a3-1
RT Patient Position Acquisition Instruction 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
	Clinical Trial Series	C.7.3.2	U
	Enhanced RT Series	C.36.3	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Plan	General Reference	C.12.4	M
	RT Patient Position Acquisition Device	C.36.m4	M
	RT Patient Position Acquisition Instruction	C.36.m5	M
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
	Radiotherapy Common Instance	C.36.4	M

A.86.1.a3.4 RT Patient Position Acquisition Instruction IOD Constraints

A.86.1.a3.4.1 Modality Attribute

The value of Modality (0008,0060) shall be PLAN.

Add the following to PS3.3 Annex C, Section C.7.6.16.2.1 Pixel Measures Macro and C.7.6.16.2.4 Plane Orientation (Patient) Macro:

C.7.6 Common Image IE Modules

…

C.7.6.16 Multi-frame Functional Groups Module

C.7.6.16.2 Common Functional Group Macros

…

345 **C.7.6.16.2.1 Pixel Measures Macro**

346 Table C.7.6.16-2 specifies the attributes of the Pixel Measures Functional Group Macro.

347 **Table C.7.6.16-2. Pixel Measures Macro Attributes**

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Attribute Name	Tag	Type	Attribute Description
Pixel Measures Sequence	(0028,9110)	1	Identifies the physical characteristics of the pixels of this frame. Only a single Item shall be included in this Sequence.
>Pixel Spacing	(0028,0030)	1C	Physical distance in the imaging target (patient, specimen, or phantom) between the centers of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm. See Section 10.7.1.3 for further explanation of the value order. Note In the case of CT images with an Acquisition Type (0018,9302) of CONSTANT_ANGLE, the pixel spacing is that in a plane normal to the central ray of the diverging X-Ray beam as it passes through the data collection center. **In the case of Enhanced RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.1") or Enhanced Continuous RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.2") the pixel spacing is defined on the x/y plane at z = 0 of the Image Receptor Coordinate System.** Required if: Volumetric Properties (0008,9206) is other than DISTORTED or SAMPLED, or SOP Class UID is Segmentation Storage ("1.2.840.10008.5.1.4.1.1.66.4") and Frame of Reference UID (0020,0052) is present, or SOP Class UID is Ophthalmic Tomography Image Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.4") and Ophthalmic Volumetric Properties Flag (0022,1622) is YES, or SOP Class UID is Ophthalmic Optical Coherence Tomography B-scan Volume Analysis Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.8")**, or** **SOP Class UID is Enhanced RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.1"), or** **SOP Class UID is Enhanced Continuous RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.2")** May be present otherwise.
>Slice Thickness	(0018,0050)	1C	Nominal reconstructed slice thickness (for tomographic imaging) or depth of field (for optical non-tomographic imaging), in mm. See Section C.7.6.16.2.3.1 for further explanation. Note Depth of field may be an extended depth of field created by focus stacking (see Section C.8.12.4).

Attribute Name	Tag	Type	Attribute Description
			Required if: Volumetric Properties (0008,9206) is VOLUME or SAMPLED, or SOP Class UID is Segmentation Storage ("1.2.840.10008.5.1.4.1.1.66.4") and Frame of Reference UID (0020,0052) is present, or SOP Class UID is Ophthalmic Tomography Image Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.4") and Ophthalmic Volumetric Properties Flag (0022,1622) is YES, or SOP Class UID is Ophthalmic Optical Coherence Tomography B-scan Volume Analysis Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.8"). May be present otherwise**, if** **SOP Class UID is not Enhanced RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.1") or Enhanced Continuous RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.2")**.
>Spacing Between Slices	(0018,0088)	3	Spacing between adjacent slices, in mm. The spacing is measured from the center-to-center of each slice, and if present shall not be negative.

C.7.6.16.2.4 Plane Orientation (Patient) Macro

Table C.7.6.16-5 specifies the attributes of the Plane Orientation (Patient) Functional Group Macro.

Table C.7.6.16-5. Plane Orientation (Patient) Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Plane Orientation Sequence	(0020,9116)	1	Identifies orientation of the plane of this frame. Only a single Item shall be included in this Sequence.
>Image Orientation (Patient)	(0020,0037)	1C	The direction cosines of the first row and the first column with respect to the patient. See Section C.7.6.2.1.1 and Section C.7.6.16.2.3.1 for further explanation. Required if: Frame Type (0008,9007) Value 1 of this frame is ORIGINAL and Volumetric Properties (0008,9206) of this frame is other than DISTORTED, or SOP Class UID is Segmentation Storage ("1.2.840.10008.5.1.4.1.1.66.4") and Frame of Reference UID (0020,0052) is present, or SOP Class UID is Ophthalmic Tomography Image Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.4") and Ophthalmic Volumetric Properties Flag (0022,1622) is YES, or SOP Class UID is Ophthalmic Optical Coherence Tomography B-scan Volume Analysis Storage ("1.2.840.10008.5.1.4.1.1.77.1.5.8")**, or**

Attribute Name	Tag	Type	Attribute Description
			SOP Class UID is Enhanced RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.1"), or **SOP Class UID is Enhanced Continuous RT Image ("1.2.840.10008.5.1.4.1.1.481.S213.2")**. May be present otherwise.

Add the following to PS3.3 Annex C; Section 36.1:

C.36 RT Second Generation Modules

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C.36.1 RT Second Generation Concepts

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C.36.1.1 RT Second Generation Radiation Concepts

…

C.36.1.1.n1 Imaging Source Coordinate System

The Imaging Source Coordinate System describes the location of the imaging source with respect to the Equipment Frame of Reference coordinate system identified by the Equipment Frame of Reference UID (300A,0675), i.e. the Equipment Frame of Reference coordinate system is the parent system of the Imaging Source Coordinate System.

The Imaging Source to Equipment Mapping Matrix (gggg,7121) relates the two coordinate systems, and when it is identity:

- The origin of Imaging Source Coordinate System is located at the origin of the Equipment Frame of Reference coordinate system
- The axes of Imaging Source Coordinate System are aligned with the axes of the Equipment Frame of Reference coordinate system

The Imaging Source Coordinate System is aligned with the imaging source as follows:

- The origin of the Imaging Source Coordinate System is the nominal location of the imaging source.
- The z-axis is aligned with the central ray of the diverging rays
- The positive z-axis is in the direction from the image receptor to the imaging source

Beam modifying devices attached to the imaging source, such as Beam Limiting Devices, may use a Base Beam Modifier Coordinate System.

The Base Beam Modifier Coordinate System, as defined C.36.1.1.9 Beam Modifier Coordinate System, is aligned with the Image Source Coordinate System as follows:

- The parent system of the Base Beam Modifier Coordinate System is the Imaging Source Coordinate System.
- The Base Beam Modifier Plane is located at a distance specified by RT Beam Modifier Definition Distance (300A,0688) along the z-axis from the reference location specified by RT Device Distance Reference Location Code Sequence (300A,0659).
- If the radiation used for imaging is generated by a specific imaging source, the RT Device Distance Reference Location Code Sequence (300A,0659) shall have the value (S213200, 99SUP213, “Imaging Source Location”)

- If the radiation used for imaging is generated by the therapeutic source (“MV Imaging”), the RT Device Distance Reference Location Code Sequence (300A,0659) shall have the value (130358, DCM, “Nominal Radiation Source Location”)

C.36.1.1.n2 Image Receptor Coordinate System

The Image Receptor Coordinate System describes the location of the image acquisition receptor device with respect to the Equipment Frame of Reference coordinate system identified by the Equipment Frame of Reference UID (300A,0675), i.e. the Equipment Frame of Reference coordinate system is the parent system of the Image Receptor Coordinate System.

The Image Receptor Coordinate System is also used when describing the location of an acquisition plane of a virtual imaging device without presence of physical image receptor, e.g. in case of a digital reconstructed radiograph (DRR).

The Pixel Spacing (0028,0030) is measured on the x/y plane of the Image Receptor Coordinate System at z = 0.

The Image Receptor to Equipment Mapping Matrix (gggg,7122) relates the two coordinate systems, and when it is identity:

- The origin of Image Receptor Coordinate System is located at the origin of the Equipment Frame of Reference coordinate system
- The axes of Image Receptor Coordinate System are aligned with the axes of the Equipment Frame of Reference coordinate system

The Image Receptor Coordinate System is aligned with the image receptor as follows.

- The z-axis passes through the center of the image receptor
- For rectangular receptors, the x-axis and y-axis are aligned with the edges of the image receptor.

The alignment shall be documented in the Conformance Statement for the device.

Add the following Macros to PS3.3 Annex C, Section C.36.2:

C.36.2 RT Second Generation Macros

…

C.36.2.n RT Second Generation Imaging Macros

…

C.36.2.n.X2 Patient Position Acquisition Device Macro

The Patient Position Acquisition Device Macro contains all parameters that describe a device to acquire artifacts to detect the patient position.

Table C.36.2.n.X2-1
Patient Position Acquisition Device Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Number of Acquisition Devices	(gggg,7452)	1	Number of Acquisition Devices defined in the Acquisition Device Sequence (gggg,7453). For images acquired by a physical imaging device the value shall be greater than zero. For images reconstructed based on a virtual imaging device the value may be greater than zero.

Attribute Name	Tag	Type	Attribute Description
Acquisition Device Sequence	(gggg,7453)	1C	Physical Acquisition devices used during acquisition or virtual imaging devices, indicating the radiation characteristics of a physical device used during calculation of a reconstructed image. Required if the Number of Acquisition Devices (gggg,7452) has a non-zero value. The number of Items included in this Sequence shall equal the value of Number of Acquisition Devices (gggg,7452).
>Include Table C.36.2.2.3-1 "RT Accessory Device Identification Macro Attributes"			*CID is specified at invocation.*
>Device Index	(3010,0039)	1	Index of the Device in this Sequence. The value shall start at 1 and increase monotonically by 1.
>Referenced Defined Device Index	(300A,0602)	1C	Device Index value that links the device defined by this Sequence Item to the corresponding device in another SOP Radiation Instance. The description of the two devices may or may not be the same. The value is the index of a device in the Acquisition Device Sequence (gggg,7453) within the single SOP Instance referenced by a SOP Instance Sequence defined in the Macro invocation. Required if the Instance referenced in the referenced SOP Instance Sequence contains the device that corresponds to the device defined by this Sequence Item. See Section C.36.2.2.8.1.5.

C.36.2.n.X3 Acquisition Initiation Parameters Macro

The Acquisition Initiation Parameters Macro contains the parameters that describe the state of the devices and/or the patient when an acquisition is started.

Table C.36.2.n.X3-1
Acquisition Initiation Parameters Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Acquisition Initiation Sequence	(gggg,74F5)	1	Type of initiation of an acquisition and parameters describing the details of initiation. Only a single Item shall be included in this Sequence. See C.36.2.n.X3.1.1.
>Include Table 10-2 "Content Item Macro Attributes"			DTID SUP213T01 "Acquisition Initiation Parameters"

C.36.2.n.X4 RT Projection Imaging Request Geometry Macro

The RT Projection Imaging Request Geometry Macro describes the location of the imaging source and image receptor to be used for acquisition.

Table C.36.2.n.X4-1
RT Projection Imaging Request Geometry Macro Attributes

Attribute Name	Tag	Type	Description
Imaging Source Location Specification Type	(gggg,7410)	1	The method of specifying the location and orientation of the imaging source. Enumerated Values: ABSOLUTE_MATRIX: Specified using absolute values represented by matrices describing the Imaging Source Coordinate System with respect to the Equipment Frame of Reference. ABSOLUTE_PARAMS: Specified using absolute values for native parameters of a specific device. RELATIVE_PARAMS: Specified using values for native parameters relative to the values referenced in Baseline Parameters RT Radiation Sequence (gggg,7470).
Imaging Device Location Matrix Sequence	(gggg,7411)	1C	Parameters describing the location of the Imaging Source and the Image Receptor by the means of matrices. Required if Imaging Source Location Specification Type (gggg,7410) is present and has a value of ABSOLUTE_MATRIX. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X5-1 "Matrix-based RT Imaging Geometry Macro Attributes"			
Imaging Device Location Parameter Sequence	(gggg,7412)	1C	Parameters describing the location and orientation of the image receptor by the means of parameters. Required if Imaging Source Location Specification Type (gggg,7410) is present and has a value of ABSOLUTE_PARAMS or RELATIVE_PARAMS. Only a single Item shall be included in this Sequence. See C.36.2.n.X4.1.1.
>Referenced Radiation RT Control Point Index	(300A,073B)	1C	Index of the RT Control Point of the RT Radiation SOP Instance referenced in the Baseline Parameters RT Radiation Sequence (gggg,7470) which defines the values against which the relative values have to be applied. Required if Imaging Source Location Specification Type (gggg,7410) has a value of RELATIVE_PARAMS.
>Include Table C.36.2.n.X6-1 "Parameterized RT Imaging Geometry Macro Attributes"			

C.36.2.n.X4.1 RT Projection Imaging Request Geometry Macro Attribute Descriptions

C.36.2.n.X4.1.1 Imaging Device Location Parameter Sequence

If Imaging Source Location Specification Type (gggg,7410) has a value of ABSOLUTE_PARAMS the parameters have to be applied as is.

If Imaging Source Location Specification Type (gggg,7410) has a value of RELATIVE_PARAMS the parameters represent delta values between the parameters of the referenced RT Control Point in Radiation SOP Instance identified referenced in the Baseline Parameters RT Radiation Sequence (gggg,7470). Only those parameters whose value is not zero shall be included in the Imaging Device Location Parameter Sequence (gggg,7412).

C.36.2.n.X5 Matrix-based RT Imaging Geometry Macro

The Matrix-based RT Imaging Geometry Macro describes the location of the imaging source and image receptor by the means of matrices with respect to the Equipment Frame of Reference.

Table C.36.2.n.X5-1
Matrix-based RT Imaging Geometry Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Imaging Source Position Sequence	(gggg,7115)	1	The position of the imaging source. Only a single Item is permitted in this Sequence.
>Referenced Defined Device Index	(300A,0602)	1	The value of Device Index (3010,0039) from the Acquisition Device Sequence (gggg,7453) corresponding to the Acquisition Device used in this Item.
>Imaging Source to Equipment Mapping Matrix	(gggg,7121)	1	A rigid, homogeneous 4x4 transformation matrix that maps the Imaging Source Coordinate System to the Equipment Coordinate System. Matrix elements shall be listed in row-major order. See C.36.1.1.n1.
>Imaging Source Position Parameter Sequence	(gggg,7123)	2	Device-specific parameters, derived from the Image Receptor to Equipment Mapping Matrix (gggg,7122). See C.36.2.n.X5.1.1. Zero or more Items shall be included in this sequence.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID is TID SUP213T02 "Imaging Source Geometry Parameters".*
Image Receptor Position Sequence	(gggg,7116)	1	The position of the image receptor. Only a single Item is permitted in this Sequence.
>Referenced Defined Device Index	(300A,0602)	1	The value of Device Index (3010,0039) from the Acquisition Device Sequence (gggg,7453) corresponding to the Acquisition Device used in this Item.
>Image Receptor to Equipment Mapping Matrix	(gggg,7122)	1	A rigid, homogeneous 4x4 transformation matrix that maps the Image Receptor Coordinate System to the Equipment Coordinate System. Matrix elements shall be listed in row-major order. See C.36.1.1.n2.
>Image Receptor Position Parameter Sequence	(gggg,7124)	2	Device-specific parameters, derived from the Image Receptor to Equipment Mapping Matrix (gggg,7122). See C.36.2.n.X5.1.1. Zero or more Items shall be included in this sequence.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID is TID SUP213T03 "Image Receptor Geometry Parameters".*

C.36.2.n.X5.1 Matrix-based RT Imaging Geometry Macro Attribute Descriptions

C.36.2.n.X5.1.1 Imaging Source Position Parameter Sequence and the Image Receptor Position Parameter Sequence

The Imaging Source to Equipment Mapping Matrix (gggg,7121) and the Image Receptor to Equipment Mapping Matrix (gggg,7122) are the exclusive source of information to define the location of the imaging source respectively the image receptor. Imaging devices will solely derive the displacement by this matrix.

Some applications, which do not act as imaging devices and cannot de-compose these matrices into device-specific parameters, may want to informatively display device-specific parameters to the user. The purpose of the

Imaging Source Position Parameter Sequence (gggg,7123) and the Image Receptor Position Parameter Sequence (gggg,7124) is to facilitate such display. These Sequences are not a substitute for the Imaging Source to Equipment Mapping Matrix (gggg,7121) respectively the Image Receptor to Equipment Mapping Matrix (gggg,7122).

C.36.2.n.X6 Parameterized RT Imaging Geometry Macro

This macro defines positioning of the image radiation source and the image receptor by the means of device parameters.

Table C.36.2.n.X6-1
Parameterized RT Imaging Geometry Macro Attributes

Attribute Name	Tag	Type	Description
Imaging Source Position Sequence	(gggg,7115)	1	The position of the imaging source. Only a single Item is permitted in this Sequence.
>Referenced Defined Device Index	(300A,0602)	1	The value of Device Index (3010,0039) from the Acquisition Device Sequence (gggg,7453) corresponding to the Acquisition Device used in this Item.
>Imaging Source Position Parameter Sequence	(gggg,7123)	1	Parameters describing the position of the imaging source. One or more Items shall be included in this sequence.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID is TID SUP213T02 "Imaging Source Geometry Parameters".*
Image Receptor Position Sequence	(gggg,7116)	1	The position of the image receptor. Only a single Item is permitted in this Sequence.
>Referenced Defined Device Index	(300A,0602)	1	The value of Device Index (3010,0039) from the Acquisition Device Sequence (gggg,7453) corresponding to the Acquisition Device used in this Item.
>Image Receptor Position Parameter Sequence	(gggg,7124)	1	Parameters describing the position of the image receptor. One or more Items shall be included in this sequence.
>>Include Table 10-2 "Content Item Macro Attributes"			*Defined TID is TID SUP213T03 "Image Receptor Geometry Parameters".*

C.36.2.n.X7 RT Imaging Aperture Macro

The RT Imaging Aperture Macro defines the aperture of the imaging device to be applied during image acquisition.

Table C.36.2.n.X7-1
RT Imaging Aperture Macro Attributes

Attribute Name	Tag	Type	Attribute Description

Imaging Aperture Specification Type	(gggg,7425)	3	Type of specification of field aperture for imaging. Enumerated Values: OPEN: The aperture is specified to be fully opened. BEAM: The aperture is specified to be the aperture in an RT Control point of the RT Radiation SOP Instance referenced in the Baseline Parameters RT Radiation Sequence (gggg,7470). RELATIVE_TO_BEAM: The aperture is specified relative to the aperture in an RT Control point of the RT Radiation SOP Instance referenced in the Baseline Parameters RT Radiation Sequence (gggg,7470). CUSTOM: The aperture is fully specified by the provided parameter values.
Imaging Source to Beam Modifier Definition Plane Distance	(gggg,74C5)	1C	Distance in mm from the Radiation Source to the origin of the Base Beam Modifier System. Required if Imaging Aperture Specification Type (gggg,7425) does not have a value of OPEN.
Referenced Radiation RT Control Point Index	(300A,073B)	1C	Index of the RT Control Point of the RT Radiation SOP Instance referenced in the Baseline Parameters RT Radiation Sequence (gggg,7470) which provides the basis for the aperture definition of the imaging source. Required if Imaging Aperture Specification Type (gggg,7425) has a value of BEAM or RELATIVE_TO_BEAM.
Imaging Aperture Sequence	(gggg,7413)	1C	Parameters describing the aperture of the imaging source. If Imaging Aperture Specification Type (gggg,7425) has a value of CUSTOM, the provided parameter values fully specify the aperture. If Imaging Aperture Specification Type (gggg,7425) has a value of RELATIVE_TO_BEAM, the provided parameter values represent delta values with respect to the values in the referenced RT Control Point in the Radiation SOP Instance. Required if Imaging Aperture Specification Type (gggg,7425) has a value of CUSTOM or RELATIVE_TO_BEAM. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.2.9-1 "RT Beam Limiting Device Opening Macro Attributes"			*No Baseline CID is defined.*

471

472 **C.36.2.n.X8 3D RT Cone-Beam Imaging Geometry Macro**

473 The 3D RT Cone-Beam Imaging Geometry Macro describes the parameters to be applied for a Cone-Beam
474 acquisition to construct a volumetric image in a Radiotherapy context.

475 **Table C.36.2.n.X8-1**
476 **3D RT Cone-Beam Imaging Geometry Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Scan Arc Type	(gggg,74D1)	3	Categorization of the amount of rotation of the scan. Enumerated Values:

Attribute Name	Tag	Type	Attribute Description
			FULL_ARC = 360 deg HALF_ARC = 180 deg CUSTOM_ARC = user defined scan range
Scan Start Position Sequence	(gggg,74C2)	1C	Start Position of the 3D RT Cone Beam Radiation Imaging Acquisition. Required if Scan Arc Type (gggg,74D1) equals HALF_ARC and CUSTOM. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X6-1 "Parameterized RT Imaging Geometry Macro Attributes"			
Scan Rotation Direction	(gggg,74C4)	1C	Direction of rotation. Required if Scan Arc Type (gggg,74D1) equals FULL_ARC and HALF_ARC.
Scan Stop Position Sequence	(gggg,74C3)	1C	Stop Position of the 3D RT Cone Beam Radiation Imaging Acquisition. Required if Scan Arc Type (gggg,74D1) equals CUSTOM. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X6-1 "Parameterized RT Imaging Geometry Macro Attributes"			
Detector Positioning Type	(gggg,74D2)	3	Fan type of acquisition. Enumerated Values: CENTERED = full fan, detector is centered, resulting in a normal field of view SHIFTED = half fan, detector is laterally shifted to increase the field of view.
Parameters Specification Sequence	(0018,9913)	3	Acquisition parameters. One or more Items are permitted in this Sequence.
>Include Table 10.25-1 "Attribute Value Constraint Macro Attributes"			*Only Attributes defined in Table C.34.10-1 (i.e., in the Acquisition Protocol Element Sequence (0018,9920) in the Performed CT Acquisition Module) and Private Data Elements associated with this acquisition protocol element may be specified as Selector Attributes.* *The semantics of values of Constraint Violation Significance (0082,0036) in the Macro are assigned in Section C.34.9.3.* *The same Attribute shall not appear in more than one Item in the Sequence with the same values for Selector Sequence Pointer (0072,0052) and Selector Sequence Pointer Items (0074,1057).*

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479 **C.36.2.n.X10 kV Radiation Image Acquisition Parameters Macro**

480 The kV Radiation Image Acquisition Parameters Macro contains parameters specifying details of X-Ray generation
481 for image acquisition using kV-level radiation.

Table C.36.2.n.X10-1
kV Radiation Image Acquisition Parameters Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Imaging Energy Category Code Sequence	(gggg,74F0)	1C	Categorical specification of the imaging energy. Required if KVP (0018,0060) is not present. Only a single Item shall be included in this Sequence. See C.36.2.n.X10.1.1.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Baseline CID SUP213007 "Imaging Energy Categories"*
KVP	(0018,0060)	2C	Peak kilo voltage of the X-Ray generator used to acquire image. Required if Imaging Energy Category Code Sequence (gggg,74F0) is not present.
X-Ray Tube Current in μA	(0018,8151)	3	X-Ray Tube Current in μA.
Exposure Time in μS	(0018,8150)	3	Duration of X-Ray exposure in μsec.
Average Pulse Width	(0018,1154)	3	Average width of X-Ray pulse in msec.
Radiation Mode	(0018,115A)	3	Specifies X-Ray radiation mode. Enumerated Values: CONTINUOUS PULSED
X-Ray Filter Sequence	(0018,9556)	3	Image filter to be inserted into the X-Ray beam. One or more Items are permitted in this Sequence.
>Include Table 10.36-1 "Device Identification Macro Attributes"			*Baseline CID 10007 "X-Ray Filter Types".*

C.36.2.n.X10.1 kV Radiation Image Acquisition Parameters Macro Attribute Descriptions

C.36.2.n.X10.1.1 Imaging Energy Category Code Sequence

The Imaging Energy can be described in either Imaging Energy Category Code Sequence (gggg,74F0) or KVP (0018,0060).

When KVP (0018,0060) is present and has no value, no Imaging Energy is described.

C.36.2.n.X11 MV Radiation Image Acquisition Parameters Macro

The MV Radiation Image Acquisition Parameters Macro contains parameters specifying details of X-Ray generation for image acquisition using MV-level radiation.

Table C.36.2.n.X11-1
MV Radiation Image Acquisition Parameters Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Imaging Energy Category Code Sequence	(gggg,74F0)	1C	Categorical specification of the imaging energy. Required if Radiation Generation Mode Sequence (300A,067B) is not present. Only a single Item shall be included in this Sequence. See C.36.2.n.X11.1.1.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Baseline CID SUP213007 "Imaging Energy Categories"*

Attribute Name	Tag	Type	Attribute Description
Radiation Generation Mode Sequence	(300A,067B)	2C	The beam parameters of the imaging energy. Required if Imaging Energy Category Code Sequence (gggg,74F0) is not present. Zero or one Items shall be included in this Sequence. See C.36.2.n.X11.1.1.
>Include Table C.36.2.2.7-1 "Radiation Generation Mode Macro Attributes"			*Defined CID for Radiation Type Code Sequence (300A,067F) is CID 9525 "Radiation Therapy Particle".* *Defined CID for Energy Unit Code Sequence (300A,0684) is CID 9521 "Radiotherapy Treatment Energy Unit".* *Defined CID for Radiation Fluence Modifier Code Sequence (300A,0683) is CID 9549 "Radiation Generation Mode Types".* *The Number of Radiation Generation Modes (300A,0685) shall have the value one.*
Maximum Cumulative Meterset Range	(gggg,74F2)	3	The maximum allowed range of Meterset values between start and stop of acquisition. The unit is defined in the Radiation Dosimeter Unit Sequence (300A,0658).
Radiation Dosimeter Unit Sequence	(300A,0658)	1C	Measurement unit of the machine dosimeter. Required if Maximum Cumulative Meterset Range (gggg,74F2) is present. Only a single Item shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP213031 "RT Radiation Meterset Units"*
Delivery Rate	(300A,063D)	3	The nominal rate of delivery of the Meterset during acquisition. The unit is defined in the Delivery Rate Unit Sequence (300A,063E).
Delivery Rate Unit Sequence	(300A,063E)	1C	The unit of a delivery rate value. Required if Delivery Rate (300A,063D) is present. Only a single Item shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*CID is defined by invocation.*

C.36.2.n.X11.1 MV Radiation Image Acquisition Request Parameters Macro Attribute Description

C.36.2.n.X11.1.1 Energy-related Attributes

The Imaging Energy can be described in either Imaging Energy Category Code Sequence (gggg,74F0) or Radiation Generation Mode Sequence (300A,067B).

When the Radiation Generation Mode Sequence (300A,067B) is present with zero Items, the imaging energy may be defined as follows:

- When the acquisition occurs before or after the therapeutic radiation delivery, the energy may be defined by the imaging protocol or set by the user.
- When the acquisition occurs during the therapeutic radiation delivery, the energy is defined by parameters set for the therapeutic beam.

C.36.2.n.X12 RT Image Frame General Content Macro

The RT Image Frame General Content Macro contains information about the geometric and dosimetric context of a frame reconstructed for use in or acquired during Radiotherapy treatment sessions.

Table C.36.2.n.X12-1
RT Image Frame General Content Macro Attributes

Attribute Name	Tag	Type	Attribute Description
RT Image Frame General Content Sequence	(gggg,7020)	1	Identifies RT-specific characteristics of the frame. Only a single Item shall be included in this Sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued Attribute analogous to Image Type (0008,0008). See C.36.2.n.X12.1.1
>Referenced Treatment Position Index	(300A,060B)	1	The value of Treatment Position Index (300A,0606) from the Treatment Position Sequence (300A,063F) within this IOD describing the position when the frame was taken.
>Start Cumulative Meterset	(gggg,7030)	2C	The value of the Cumulative Meterset when the acquisition of the current frame started. Required if the image was acquired while therapeutic radiation was applied.

C.36.2.n.X12.1 RT Image Frame General Content Macro Attribute Descriptions

C.36.2.n.X12.1.1 Frame Type

Image Type (0008,0008) Value 1 and Value 2 shall identify the Pixel Data Characteristics in accordance with Section C.7.6.1.1.2.

Vaues 3 and 4 are required to be present.

Defined Terms for Value 3:

PLANNED: Image representing planned treatment position

TREATMENT: Image acquired or reconstructed at the actual treatment position

SIMULATION: Image acquired at a treatment device to simulate a potential treatment of a conventional simulator image

Defined Terms for Value 4:

IMAGE: Image

PORTFILM: Digitized Portimage

DOSE: Integrated dose at the imaging device plane [MEDPHYS 23464308]

FLUENCE: Fluence map

Defined Terms for Value 5:

ACQUIRED: Image or dose as acquired by image receptor

REF_MATCHING: Image reconstructed to match an image acquired at treatment position

PREDICTED: Values of dose expected after an integrated acquisition

C.36.2.n.X13 RT Image Frame Imaging Device Position Macro

The RT Image Frame Imaging Device Position Macro contains the specification of the >position of the imaging source and the imaging device.

Table C.36.2.n.X13-1
RT Image Frame Imaging Device Position Macro Attributes

Attribute Name	Tag	Type	Attribute Description
RT Image Frame Imaging Device Position Sequence	(gggg,7040)	1	Identifies the position of the imaging source and the imaging device for this frame. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X5-1 "Matrix-based RT Imaging Geometry Macro Attributes"			

C.36.2.n.X14 RT Image Frame Radiation Acquisition Parameters Macro

The Radiation Image Acquisition Parameters Macro contains parameters specifying details of generation of the radiation used for image acquisition.

Table C.36.2.n.X14-1
RT Image Frame Radiation Acquisition Parameters Macro Attributes

Attribute Name	Tag	Type	Attribute Description
RT Image Frame kV Radiation Acquisition Sequence	(gggg,7041)	1C	Identifies the kV acquisition parameters of the frame. Required if RT Image Frame MV Radiation Acquisition Sequence (gggg,7042) is not present. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X10-1 "kV Radiation Image Acquisition Parameters Macro Attributes"			
RT Image Frame MV Radiation Acquisition Sequence	(gggg,7042)	1C	Identifies the MV photon or particle acquisition parameters of the frame. Required if RT Image Frame kV Radiation Acquisition Sequence (gggg,7041) is not present. Only a single Item shall be included in this Sequence.
>Include Table C.36.2.n.X11-1 "MV Radiation Image Acquisition Parameters Macro Attributes"			

C.36.2.n.X15 RT Image Frame Context Macro

The RT Image Frame Context Macro contains information about the context of a frame constructed for use in or acquired during Radiotherapy treatment sessions.

Table C.36.2.n.X12-1
RT Image Frame General Content Macro Attributes

Attribute Name	Tag	Type	Attribute Description
RT Image Frame Context Sequence	(gggg,7021)	1	Identifies contextual information of the frame. Only a single Item shall be included in this Sequence.
>RT Image Scope Sequence	(gggg,7022)	1	The RT Radiation Instances or the Treatment Position Groups for which the Frame is reconstructed or acquired.

Attribute Name	Tag	Type	Attribute Description
>>Include Table [Sup160]C.36.2.2.X3 "RT Radiation Instance and Treatment Position Group Reference"			
>RT Radiation Set Delivery Number	(300A,0704)	1C	The RT Radiation Set Delivery Number that indicates the RT Treatment Fraction of the referenced RT Radiation Set Instance that this frame refers to. Required if the Frame is related to a specific Fraction. See C.36.20.1.2.
>Clinical Fraction Number	(300A,0705)	1C	The Clinical Fraction Number that indicates the RT Treatment Fraction of the referenced RT Radiation Set Instance that this frame refers to. Required if the Frame is related to a specific Fraction. See C.36.20.1.2.

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Add the following Modules to PS3.3 Annex C, section C.36

C.36.m1 Enhanced RT Image Device Module

The Enhanced RT Image Module contains information about the overall content of the image.

Table C.36.m1-1
Enhanced RT Image Device Module Attributes

Attribute Name	Tag	Type	Description
Equipment Frame of Reference UID	(300A,0675)	1	Frame of Reference identifier identifying the Equipment Frame of Reference coordinate system which is the parent for Imaging Source Coordinate System and/or the Image Receptor Coordinate System. See 10.39.1.1 and C.36.1.1.n1 and C.36.1.1.n2
Beam Modifier Coordinates Presence Flag	(gggg,7025)	1	Whether Beam Modifiers are present in the current SOP Instance which contain coordinates referring to the Beam Modifier Coordinate System. YES: Beam Modifiers containing such coordinates are present. NO: Beam Modifiers containing such coordinates are not present.
RT Device Distance Reference Location Code Sequence	(300A,0659)	1C	Point of reference used for measuring the distance to various devices. Required if Beam Modifier Coordinates Presence Flag (gggg,7025) equals YES. Only a single item shall be included in this Sequence.
>Include Table 8.8-1 "Code Sequence Macro Attributes".			*DCID SUP213006 "Patient Position Acquisition Radiation Source Locations".*
RT Beam Modifier Definition Distance	(300A,0688)	1C	Absolute distance in mm along the z-axis of the Base Beam Modifier Coordinate System from the reference location as specified by RT Device Distance Reference Location Code Sequence (300A,0659) to the Beam Modifier Definition Plane. The value shall be greater than or equal to zero. Required if Beam Modifier Coordinates Presence Flag (gggg,7025) equals YES. See Section C.36.1.1.9.
Include Table C.36.2.2.2-1 "RT Patient Support Devices Macro Attributes"			
Include Table C.36.2.2.14-1 "RT Accessory Holders Definition Macro Attributes"			
Include Table C.36.2.2.15-1 "General Accessories Definition Macro Attributes"			
Include Table C.36.2.2.8-1 "RT Beam Limiting Devices Definition Macro Attributes"			

Attribute Name	Tag	Type	Description
Include Table C.36.2.n.X2-1 "Patient Position Acquisition Device Macro Attributes"			*Defined CID SUP213033 "RT Image Patient Position Acquisition Devices".* *The SOP Instance Sequence referred to by the Referenced Defined Device Index (300A,0602) is not declared.*
Include Table C.36.2.2.4-1 "RT Treatment Position Macro Attributes"			

557

558 **C.36.m2 Enhanced RT Image Module**

559 This section described the Enhanced RT Image Module. Table C.36.m2-1 contains IOD Attributes that describe a
560 Enhanced RT Image by specializing Attributes of the General Image Module and Image Pixel Module, and adding
561 additional Attributes.

562 **Table C.36.m2-1**
563 **Enhanced RT Image Module Attributes**

Attribute Name	Tag	Type	Description
Include Table 10.32-1 "Entity Long Labeling Macro Attributes"			
Start Cumulative Meterset	(gggg,7030)	2C	The value of the Cumulative Meterset when the acquisition of the first frame started. Required if the image was acquired while therapeutic radiation was applied. May be present otherwise.
End Cumulative Meterset	(gggg,7031)	2C	The value of the Cumulative Meterset when the acquisition of the last frame was finished. Required if the image was acquired while therapeutic radiation was applied. May be present otherwise.
Exposure Time in μS	(0018,8150)	2C	Cumulative X-Ray exposure time in μsec summed across all frames for this SOP Instance. Required if the image was acquired while therapeutic radiation was applied. May be present otherwise.

564

565 **C.36.m3 Sparse Multi-frame Functional Groups Module**

566 Table C.36.m3-1 specifies the Attributes of the Enhanced RT Image Multi-frame Functional Groups Module. This
567 Module is included in SOP Instances which contain pixel acquired continuously with a high frame rate, resulting in a
568 high number of frames.

569 Unlike the Per-frame Functional Groups Sequence (5200,9230) where functional groups that are not shared must
570 be populated on every frame, the Selected Frame Functional Groups Sequence (gggg,7011) allows a selected
571 subset of frames to be populated, i.e. for frames that are not selected, the functional groups that are not shared are
572 not present. The Selected Frame Functional Groups Sequence (gggg,7011) allows frames to be omitted, but does
573 not allow required Attributes within the selected frames to be omitted.

574 The Per-frame Functional Group Macros of a frame shall be populated if any value of the required Attributes of the
575 per-frame Functional Group Macro changes; the definition of the change is up to the discretion to the implementer
576 and shall be documented in the Conformance Statement.

577 Per-frame Functional Group Macros for Frames may also be populated even if all required Attribute values do not
578 change, e.g. when frames are populated with a constant sampling rate.

579

580 The rest of the semantics of C.7.6.16 Multi-frame Functional Groups Module apply to this Module.

581

582 **Table C.36.m3-1. Sparse Multi-frame Functional Groups Module Attributes**

583

Attribute Name	Tag	Type	Attribute Description
Shared Functional Groups Sequence	(5200,9229)	1	Sequence that contains the Functional Group Macros that are shared for all frames in this SOP Instance and Concatenation. Note The contents of this Sequence are the same in all SOP Instances that comprise a Concatenation. Only a single Item shall be included in this Sequence. See Section C.7.6.16.1.1 for further explanation.
>Include one or more Functional Group Macros that are shared by all frames. The selected Functional Group Macros shall not be present in the Per-frame Functional Groups Sequence (5200,9230).			*For each IOD that includes this Module, a table is defined in which the permitted Functional Group Macros and their usage is specified.* *The Item may be empty if the requirements for inclusion of the Functional Groups are not satisfied.*
Selected Frame Functional Groups Sequence	(gggg,7011)	1C	Sequence that contains the Functional Group Sequence Attributes corresponding to selected frames of the Multi-frame Image. One or more Items shall be included in this Sequence. The number of Items shall be greater than zero and the less as the number of frames in the Multi-frame image. See Section C.36.m3.1.1 for further explanation. Required if for any referenced frame, there are Per-Frame Functional Groups that are not empty.
>Selected Frame Number	(gggg,7010)	1	Identifies the frame number. The first frame shall be denoted as frame number 1.
>Include one or more Functional Group Macros.			*For each IOD that includes this Module, a table is defined in which the permitted Functional Group Macros and their usage is specified.*
Instance Number	(0020,0013)	1	A number that identifies this Instance. The value shall be the same for all SOP Instances of a Concatenation, and different for each separate Concatenation and for each SOP Instance not within a Concatenation in a Series.
Content Date	(0008,0023)	1	The date the data creation was started. Note For Instance, this is the date the pixel data is created, not the date the data is acquired.
Content Time	(0008,0033)	1	The time the data creation was started. Note

Attribute Name	Tag	Type	Attribute Description
			For Instance, this is the time the pixel data is created, not the time the data is acquired.
Number of Frames	(0028,0008)	1	Number of frames in a multi-frame image. See Section C.7.6.6.1.1 for further explanation.
Stereo Pairs Present	(0022,0028)	3	The multi-frame pixel data consists of left and right stereoscopic pairs. See Section C.7.6.6.1.3 for further explanation. Enumerated Values: YES NO
Concatenation Frame Offset Number	(0020,9228)	1C	Offset of the first frame in a multi-frame image of a concatenation. Logical frame numbers in a concatenation can be used across all its SOP Instances. This offset can be applied to the implicit frame number to find the logical frame number in a concatenation. The offset is numbered from zero; i.e., the instance of a concatenation that begins with the first frame of the concatenation has a Concatenation Frame Offset Number (0020,9228) of zero. Required if Concatenation UID (0020,9161) is present.
Representative Frame Number	(0028,6010)	3	The frame number selected for use as a pictorial representation (e.g., icon) of the multi-frame Image.
Concatenation UID	(0020,9161)	1C	Identifier of all SOP Instances that belong to the same concatenation. Required if a group of multi-frame image SOP Instances within a Series are part of a Concatenation.
SOP Instance UID of Concatenation Source	(0020,0242)	1C	The SOP Instance UID of the single composite SOP Instance of which the Concatenation is a part. All SOP Instances of a concatenation shall use the same value for this Attribute, see Section C.7.6.16.1.3. Note May be used to reference the entire Instance rather than individual Instances of the concatenation, which may be transient (e.g., from a presentation state). Required if Concatenation UID (0020,9161) is present.
In-concatenation Number	(0020,9162)	1C	Identifier for one SOP Instance belonging to a concatenation. See Section C.7.6.16.2.2.4 for further specification. The first Instance in a concatenation (that with the lowest Concatenation Frame Offset Number (0020,9228) value) shall have an In-concatenation Number (0020,9162) value of 1, and subsequent Instances shall have values monotonically increasing by 1.

Attribute Name	Tag	Type	Attribute Description
			Required if Concatenation UID (0020,9161) is present.
In-concatenation Total Number	(0020,9163)	3	The number of SOP Instances sharing the same Concatenation UID. If present, shall have a value greater than one, unless an IOD overrides this constraint to enumerate a value of 1 to prevent the use of Concatenations (e.g., see Section C.8.17.7 and Section C.8.17.16).

C.36.m3.1 Sparse Multi-frame Functional Groups Module Attribute Descriptions

C.36.m3.1.1 Per-frame Functional Groups Sequence

The Per-frame Functional Groups Sequence Attribute (5200,9230) consists of a Sequence of Items. Each Item describes a frame in the multi-frame pixel data, identified by Selected Frame Number (gggg,7010). Frames are implicitly numbered starting from 1. See Figure C.36.m3-1.

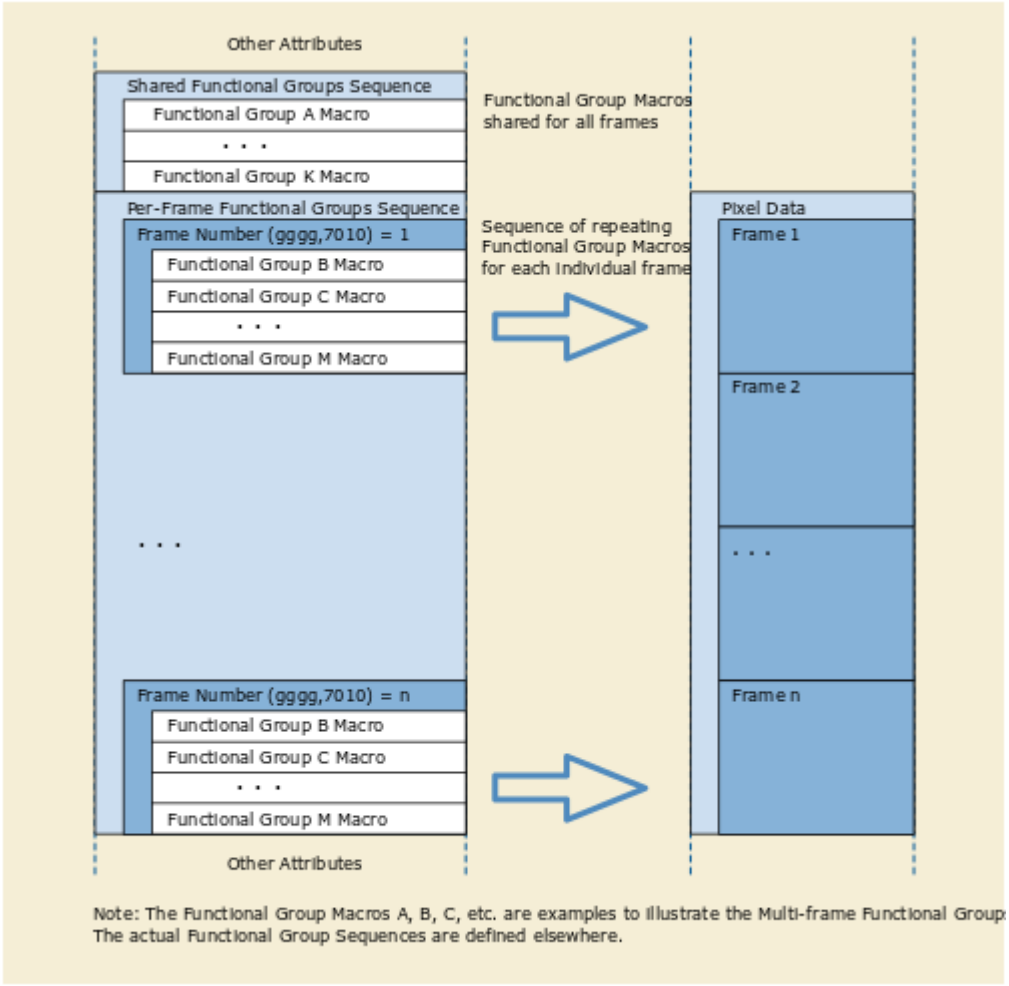

Figure C.36.m3-1. A Graphical Presentation of the Multi-frame Functional Groups Structure for Sparse Multi-frame Functional Groups

C.36.m4 RT Patient Position Acquisition Device Module

The RT Patient Position Acquisition Instruction Device Module contains information about the devices specified to be used during acquiring artifacts to detect the patient position before, during or after delivering of a Radiation.

More devices as listed in this macro may be used during acquisition. Only devices for which parameters are prescribed in the current SOP Instance may be present. The use of other devices may be implied by other information such as the identification of acquisition protocols as defined by Position Acquisition Template Identification Name (gggg,7475).

Table C.36.m4-1
RT Patient Position Acquisition Device Module Attributes

Attribute Name	Tag	Type	Description
Equipment Frame of Reference UID	(300A,0675)	1C	Frame of Reference identifier for the Treatment Delivery Device defining the coordinate system in which the geometric parameters are defined. Required if Image to Equipment Mapping Matrix (0028,9520), Imaging Source to Equipment Mapping Matrix (gggg,7121) or Image Receptor to Equipment Mapping Matrix (gggg,7122) is present in the current SOP Instance. See C.36.12.1.1.
Include Table C.36.2.2.2-1 "RT Patient Support Devices Macro Attributes"			
Include Table C.36.2.2.14-1 "RT Accessory Holders Definition Macro Attributes"			
Include Table C.36.2.2.15-1 "General Accessories Definition Macro Attributes"			
Include Table C.36.2.2.8-1 "RT Beam Limiting Devices Definition Macro Attributes"			*Defined CID for Device Type Code Sequence (3010,002E) within "RT Accessory Device Identification Macro" is CID 9541 "Beam Limiting Device Types".*
Include Table C.36.2.n.X2-1 "Patient Position Acquisition Device Macro Attributes"			*Defined CID SUP213030 "Patient Position Acquisition Devices".* *The SOP Instance Sequence referred to by the Referenced Defined Device Index (300A,0602) is not declared.*
Include Table C.36.2.2.4-1 "RT Treatment Position Macro Attributes"			

C.36.m5 RT Patient Position Acquisition Instruction Module

The RT Patient Position Acquisition Instruction Module contains information required by a Patient Position Acquisition System (PPAS) when specifying acquisition of data to detect the patient position before, during or after the delivery specified by an RT Radiation SOP Instance.

The RT Patient Position Acquisition Instruction Module consists of a sequence of one or more acquisition tasks. Every acquisition task consists of one or more acquisition subtasks (e.g. two subtasks are required in case of a dual plane acquisition task).

610 **Table C.36.m5-1**
611 **RT Patient Position Acquisition Instruction Module Attributes**

Attribute Name	Tag	Type	Description
Include Table 10.32-1 "Entity Long Labeling Macro Attributes"			
Acquisition Task Sequence	(gggg,7463)	1	Sequence of acquisition tasks. One or more Items shall be included in this Sequence.
>Acquisition Task Index	(gggg,7468)	1	Index of this acquisition task in this Sequence. The value shall start at 1 and increase monotonically by 1.
>RT Acquisition Workitem Code Sequence	(gggg,7464)	1	The Workitem code of the acquisition task. Only a single Item shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID 9242 "Radiotherapy Acquisition Workitem Definition"*
>Acquisition Task Applicability Sequence	(gggg,7478)	1C	The RT Radiation Instances or the Treatment Position Groups to which the acquisition task is applicable. Required if RT Radiation Instances or Treatment Position Groups exist whose treatment position is guided by this acquisition task. Note: In urgent treatment scenarios, acquisition may be performed prior to the completion of RT Radiation Instances or Treatment Position Groups.
>>Include [sup160]Table C.36.2.2.X3-1 "RT Radiation Instance and Treatment Position Group Reference Macro Attributes"			
>Include [sup160]Table C.36.2.2.X4-1 "RT Treatment Setup Position Macro Attributes"			
>Acquisition Subtask Sequence	(gggg,7465)	1	Sequence of acquisition subtasks. One or more Items shall be included in this Sequence. The number of Items depends on the code in the RT Acquisition Workitem Code Sequence (gggg,7464) as defined in C.36.m5.1.
>>Acquisition Subtask Index	(gggg,7469)	1	Index of this acquisition subtask in this Sequence. The value shall start at 1 and increase monotonically by 1.
>>Position Acquisition Template Identification Sequence	(gggg,7472)	1C	Identification of an Acquisition template containing a set of parameters to be used when acquiring data for patient position detection. Parameter values which are explicitly included in this module have precedence over values implied by the specified protocol. Required if acquisition technique parameters are identified by a protocol. Only a single Item shall be included in this Sequence.
>>>Position Acquisition Template Identification Name	(gggg,7475)	1	User defined name of the position acquisition template to be used to acquire this data.

Attribute Name	Tag	Type	Description
>>> Position Acquisition Template Identification Code Sequence	(gggg,7476)	1C	Code identifying the position acquisition template to be used to acquire this data. Required if Position Acquisition Template Identification ID (gggg,7474) not present. Only a single Item shall be included in this Sequence.
>>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*No Baseline CID defined.*
>>> Position Acquisition Template Identification ID	(gggg,7474)	1C	Identifier of the position acquisition template. Required if Position Acquisition Template Identification Code Sequence (gggg,7476) is not present. May be present otherwise.
>>>Position Acquisition Template Identification Description	(gggg,7477)	2	User-defined description of the position acquisition template to be used to acquire this data.
>>RT Acquisition Workitem Code Sequence	(gggg,7466)	1	The Workitem code of the acquisition subtask. Only a single Item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*Defined CID SUP213005 "Radiotherapy Acquisition WorkItem Subtask Codes"*
>>Baseline Parameters RT Radiation Sequence	(gggg,7470)	1C	RT Radiation SOP Instance defining the baseline parameters for reference acquisition. Required if one or more parameters for the reference acquisition are based upon the parameters of an RT Radiation SOP Instance. Required if Imaging Source Location Specification Type (gggg,7410) has the value RELATIVE_PARAMS or Imaging Aperture Specification Type (gggg,7425) has the value the BEAM or RELATIVE_TO_BEAM. Only a single Item shall be included in this Sequence.
>>>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
>>Referenced Device Index	(300A,0607)	1C	The value of device of Device Index (3010,0039) from the Acquisition Device Sequence (gggg,7453) corresponding to the device to be used for acquisition. Required if Number of Acquisition Devices (gggg,7452) is greater than one.
>>RT Device Distance Reference Location Code Sequence	(300A,0659)	1C	Point of reference used for measuring the distance to various devices. Note: When multiple reference locations with the same code values are present in this Instance, the specific location is distinguished by the Referenced Device Index (300A,0607). Required if the current Item contains any Attributes which refer to the Base Beam Modifier Coordinate System. Only a single item shall be included in this Sequence.
>>>Include Table 8.8-1 "Code Sequence Macro Attributes".			*DCID SUP213006 "Patient Position Acquisition Radiation Source Locations".*

Attribute Name	Tag	Type	Description
>>RT Beam Modifier Definition Distance	(300A,0688)	1C	Absolute distance in mm along the z-axis of the Base Beam Modifier Coordinate System from the reference location specified by RT Device Distance Reference Location Code Sequence (300A,0659) to the Beam Modifier Definition Plane. The value shall be greater than or equal to zero. Required if RT Device Distance Reference Location Code Sequence(300A,0659) is present. See Section C.36.1.1.9.
>>Acquisition Initiation Sequence	(gggg,74F5)	3	Sequence describing how to trigger the acquisition. Only a single Item shall be included in this Sequence.
>>>Include Table C.36.2.n.X3-1 "Acquisition Initiation Parameters Macro Attributes"			
>>kV Generation Imaging Parameters Sequence	(gggg,7490)	1C	Parameters for kV Imaging Acquisitions. Required if the code in RT Acquisition Specialization Workitem Code Sequence (gggg,7466) is part of CID SUP213008 "kV Imaging Acquisition Techniques". Only a single Item shall be included in this Sequence.
>>>Include Table C.36.2.n.X10-1 "kV Radiation Image Acquisition Parameters Macro Attributes"			
>>MV Generation Imaging Parameters Sequence	(gggg,7491)	1C	Parameters for MV Imaging Acquisitions. Required if the code in RT Acquisition Specialization Workitem Code Sequence (gggg,7466) is part of CID SUP213009 "MV Imaging Acquisition Techniques". Only a single Item shall be included in this Sequence.
>>>Include Table C.36.2.n.X11-1 "MV Radiation Image Acquisition Parameters Macro Attributes"			
>>Referenced Treatment Position Index	(300A,060B)	2	The value of Treatment Position Index (300A,0606) from the Treatment Position Sequence (300A,063F) within this IOD that this acquisition subtask applies to.
>>Projection Imaging Acquisition Parameter Sequence	(gggg,7480)	1C	Parameters for Projection Image Acquisitions. Required if the code in RT Acquisition Specialization Workitem Code Sequence (gggg,7466) is part of CID SUP213010 "Patient Position Acquisition - Projection Techniques". May be present otherwise. Only a single Item shall be included in this Sequence.
>>>Include Table C.36.2.n.X4-1 "RT Projection Imaging Request Geometry Macro"			
>>>Include Table C.36.2.n.X7-1 "RT Imaging Aperture Macro Attributes"			

Attribute Name	Tag	Type	Description
>>CT Imaging Acquisition Parameter Sequence	(gggg,7481)	1C	Parameters for CT Image Acquisitions. Required if the code in RT Acquisition Specialization Workitem Code Sequence (gggg,7466) is part of CID SUP213011 “Patient Position Acquisition – CT Techniques”. May be present otherwise. Only a single Item shall be included in this Sequence.
>>>Include Table C.36.2.n.X8-1 “3D RT Cone-Beam Imaging Geometry Macro Attributes”			
>>Device-Specific Acquisition Parameter Sequence	(gggg,74E2)	3	User-specified device-specific acquisition parameters applicable to the device executing this Acquisition Subtask.
>>>Include Table 10-2 “Content Item Macro Attributes”			*No Baseline CID defined.*
>>Additional RT Accessory Device Sequence	(gggg,74E1)	1C	Additional devices used during the acquisition of the reference position artifacts. Required if additional RT Accessory Devices are to be used during patient position acquisition. One or more Items shall be included in this Sequence.
>>>Referenced Device Index	(300A,0607)	1	Reference to the General Accessory Definition Sequence (300A,0671).
>>>Device-Specific Acquisition Parameter Sequence	(gggg,74E2)	3	User-specified device-specific acquisition parameters applicable to the device of the current Item.
>>>>Include Table 10-2 “Content Item Macro Attributes”			*No Baseline CID defined.*
>>Referenced Position Reference Instance Sequence	(gggg,74E3)	3	SOP Instances which may be used for verification of patient position in the current acquisition subtask. One or more Items are permitted in this Sequence.
>>Include Table 10.37-1 “Related Information Entities Macro Attributes”			*Defined CID SUP213012 “Patient Positioning Related Object Purposes”*

C.36.m5.1 Patient Position Reference Acquisition Subtask Sequence Multiplicity

For the codes defined in Table C.36.m5.1-2 the number of items in the Acquisition Subtask Sequence (gggg,7465) shall be determined by the code in the RT Acquisition Workitem Code Sequence (gggg,7464) as follows:

Table C.36.m5.1-1
Workitem Codes and Subtask Multiplicity

Code Value (0008,0100)	Code Meaning (0008,0104)	Number of Sequence Items
121702	RT Patient Position Acquisition, single plane MV	1
121703	RT Patient Position Acquisition, dual plane MV	2
121704	RT Patient Position Acquisition, single plane kV	1
121705	RT Patient Position Acquisition, dual plane kV	2
121706	RT Patient Position Acquisition, dual plane kV/MV	2
121707	RT Patient Position Acquisition, CT kV	1

121708	RT Patient Position Acquisition, CT MV	1

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620 **Part 4 Addendum**

621 **Add the following to PS3.4, Appendix B.5, Table B.5-1**

SOP Class Name	SOP Class UID	IOD Spec (defined in PS 3.3)
Enhanced RT Image Storage	**1.2.840.10008.5.1.4.1.1.481.S213.1**	**Enhanced RT Image IOD**
Enhanced Continuous RT Image Storage	**1.2.840.10008.5.1.4.1.1.481.S213.2**	**Enhanced Continuous RT Image IOD**
RT Patient Treatment Setup Reference Acquisition Instruction Storage	**1.2.840.10008.5.1.4.1.1.481.S213.3**	**RT Patient Treatment Setup Reference Acquisition Instruction IOD**

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Part 6 Addendum

Add the following data elements to PS3.6:

6 Registry of DICOM Data Elements

Editorial Note:

Use Range (gggg,7000) – (gggg,74FF).

(gggg,7010)	Selected Frame Number	SelectedFrameNumber	IS	1
(gggg,7011)	Selected Frame Functional Groups Sequence	SelectedFrameFunctionalGroupsSequence	SQ	1
(gggg,7020)	RT Image Frame General Content Sequence	RTImageFrameGeneralContentSequence	SQ	1
(gggg,7021)	RT Image Frame Context Sequence	RTImageFrameContextSequence	SQ	1
(gggg,7022)	RT Image Scope Sequence	RTImageScopeSequence	SQ	1
(gggg,7025)	Beam Modifier Coordinates Presence Flag	BeamModifierCoordinatesPresenceFlag	CS	1
(gggg,7030)	Start Cumulative Meterset	StartCumulativeMeterset	FD	1
(gggg,7031)	Stop Cumulative Meterset	StopCumulativeMeterset	FD	1
(gggg,7040)	RT Image Frame Imaging Device Position Sequence	RTImageFrameImagingDevicePositionSequence	SQ	1
(gggg,7041)	RT Image Frame kV Radiation Acquisition Sequence	RTImageFramekVRadiationAcquisitionSequence	SQ	1
(gggg,7042)	RT Image Frame MV Radiation Acquisition Sequence	RTImageFrameMVRadiationAcquisitionSequence	SQ	1
(gggg,7115)	Imaging Source Position Sequence	ImagingSourcePositionSequence	SQ	1
(gggg,7116)	Image Receptor Position Sequence	ImageReceptorPositionSequence	SQ	1
(gggg,7121)	Imaging Source to Equipment Mapping Matrix	ImagingSourcetoEquipmentMappingMatrix	FD	16
(gggg,7122)	Image Receptor to Equipment Mapping Matrix	ImageReceptortoEquipmentMappingMatrix	FD	16
(gggg,7123)	Imaging Source Position Parameter Sequence	ImagingSourcePositionParameterSequence	SQ	1
(gggg,7124)	Image Receptor Position Parameter Sequence	ImageReceptorPositionParameterSequence	SQ	1
(gggg,7410)	Imaging Source Location Specification Type	ImagingSourceLocationSpecificationType	CS	1
(gggg,7411)	Imaging Device Location Matrix Sequence	ImagingDeviceLocationMatrixSequence	SQ	1

(gggg,7412)	Imaging Device Location Parameter Sequence	ImagingDeviceLocationParameterSequence	SQ	1
(gggg,7413)	Imaging Aperture Sequence	ImagingApertureSequence	SQ	1
(gggg,7425)	Imaging Aperture Specification Type	ImagingApertureSpecificationType	CS	1
(gggg,7452)	Number of Acquisition Devices	NumberofAcquisitionDevices	US	1
(gggg,7453)	Acquisition Device Sequence	AcquisitionDeviceSequence	SQ	1
(gggg,7463)	Acquisition Task Sequence	AcquisitionTaskSequence	SQ	1
(gggg,7464)	RT Acquisition Workitem Code Sequence	RTAcquisitionWorkitemCodeSequence	SQ	1
(gggg,7465)	Acquisition Subtask Sequence	AcquisitionSubtaskSequence	SQ	1
(gggg,7466)	RT Acquisition Specialization Workitem Code Sequence	RTAcquisitionSpecializationWorkitemCodeSequence	SQ	1
(gggg,7468)	Acquisition Task Index	AcquisitionTaskIndex	US	1
(gggg,7469)	Acquisition Subtask Index	AcquisitionSubtaskIndex	US	1
(gggg,7470)	Baseline Parameters RT Radiation Sequence	BaselineParametersRTRadiationSequence	SQ	1
(gggg,7472)	Position Acquisition Template Identification Sequence	PositionAcquisitionTemplateIdentificationSequence	SQ	1
(gggg,7474)	Position Acquisition Template Identification ID	PositionAcquisitionTemplateIdentificationID	ST	1
(gggg,7475)	Position Acquisition Template Identification Name	PositionAcquisitionTemplateIdentificationName	LO	1
(gggg,7476)	Position Acquisition Template Identification Code Sequence	PositionAcquisitionTemplateIdentificationCodeSequence	SQ	1
(gggg,7477)	Position Acquisition Template Identification Description	PositionAcquisitionTemplateIdentificationDescription	LT	1
(gggg,7478)	Acquisition Task Applicability Sequence	AcquisitionTaskApplicabilitySequence	SQ	1
(gggg,7480)	Projection Imaging Acquisition Parameter Sequence	ProjectionImagingAcquisitionParameterSequence	SQ	1
(gggg,7481)	CT Imaging Acquisition Parameter Sequence	CTImagingAcquisitionParameterSequence	SQ	1
(gggg,7490)	kV Generation Imaging Parameter Sequence	kVGenerationImagingParameterSequence	SQ	1
(gggg,7491)	MV Generation Imaging Parameter Sequence	MVGenerationImagingParameterSequence	SQ	1
(gggg,74C2)	Scan Start Position Sequence	ScanStartPositionSequence	SQ	1
(gggg,74C3)	Scan Stop Position Sequence	ScanStopPositionSequence	SQ	1
(gggg,74C4)	Scan Rotation Direction	ScanRotationDirection	FD	1
(gggg,74C5)	Imaging Source to Beam Modifier Definition Plane Distance	ImagingSourceToBeamModifierDefinitionPlaneDistance	FD	1
(gggg,74D1)	Scan Arc Type	ScanArcType	CS	1
(gggg,74D2)	Detector Positioning Type	DetectorPositioningType	CS	1
(gggg,74E1)	Additional RT Accessory Device Sequence	AdditionalRTAccessoryDeviceSequence	SQ	1

(gggg,74E2)	Device-Specific Acquisition Parameter Sequence	DeviceSpecificAcquisitionParameterSequence	SQ	1
(gggg,74E3)	Referenced Position Reference Instance Sequence	ReferencedPositionReferenceInstanceSequence	SQ	1
(gggg,74F0)	Imaging Energy Category Code Sequence	ImagingEnergyCategoryCodeSequence	SQ	1
(gggg,74F2)	Maximum Cumulative Meterset Range	MaximumCumulativeMetersetRange	FD	1
(gggg,74F5)	Acquisition Initiation Sequence	AcquisitionInitiationSequence	SQ	1

Add the following to PS3.6 Annex A:

Annex A Registry of DICOM unique identifiers (UIDs) (Normative)

Table A-1 UID Values

UID Value	UID Name	UID Type	Part
1.2.840.10008.5.1.4.1.1.481.S213.1	Enhanced RT Image Storage	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.481.S213.2	Enhanced Continuous RT Image Storage	SOP Class	PS3.4
1.2.840.10008.5.1.4.1.1.481.S213.3	RT Patient Treatment Setup Reference Acquisition Storage	SOP Class	PS 3.4

Table A-3 Context Group UID Values

Context UID	Context Identifier	Context Group Name
1.2.840.10008.6.1.S213.5	SUP213005	Radiotherapy Acquisition WorkItem Subtask Codes
1.2.840.10008.6.1.S213.6	SUP213006	Patient Position Acquisition Radiation Source Locations
1.2.840.10008.6.1.S213.7	SUP213007	Imaging Energy Categories
1.2.840.10008.6.1.S213.8	SUP213008	kV Imaging Acquisition Techniques
1.2.840.10008.6.1.S213.9	SUP213009	MV Imaging Acquisition Techniques
1.2.840.10008.6.1.S213.10	SUP213010	Patient Position Acquisition - Projection Techniques
1.2.840.10008.6.1.S213.11	SUP213011	Patient Position Acquisition - CT Techniques
1.2.840.10008.6.1.S213.12	SUP213012	Patient Positioning Related Object Purposes
1.2.840.10008.6.1.S213.30	SUP213030	Patient Position Acquisition Devices
1.2.840.10008.6.1.S213.31	SUP213031	RT Radiation Meterset Units
1.2.840.10008.6.1.S213.32	SUP213032	Acquisition Initiation Types

1.2.840.10008.6.1.S213.33	**SUP213033**	**RT Image Patient Position Acquisition Devices**

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644 **Part 15 Addendum**

645 **Add the following definitions PS3.15, Annex E:**

646

647 *Extensions for Table E.1-1. will be defined in the Letter Ballot document.*

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

Attribute Name	Tag	Retired (from PS3.6)	In Std. Comp. IOD (from PS3.3)	Basic Profile	Retain Safe Private Option	Retain UIDs Option	Retain Device Ident. Option	Retain Inst. Ident. Option	Retain Patient Chars. Option	Retain Long. Full Dates Option	Retain Long. Modif. Dates Option	Clean Desc. Option	Clean Struct. Cont. Option	Clean Graph. Option

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651 **Part 16 Addendum**

652 **Modify the following CIDs to PS3.16, Annex B:**

653 **Annex B DCMR Context Groups (Normative)**

654

655 **CID 9242 Radiotherapy Acquisition Workitem Definition**

656 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**

657 **Type: Extensible**

658 **Version: yyyymmdd**

659 **UID: 1.2.840.10008.6.1.932**

660

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID SUP213010 "Patient Position Acquisition - Projection Techniques"		
Include CID SUP213011 "Patient Position Acquisition - CT Techniques"		
~~DCM~~	~~121702~~	~~RT Patient Position Acquisition, single plane MV~~
~~DCM~~	~~121703~~	~~RT Patient Position Acquisition, dual plane MV~~
~~DCM~~	~~121704~~	~~RT Patient Position Acquisition, single plane kV~~
~~DCM~~	~~121705~~	~~RT Patient Position Acquisition, dual plane kV~~
~~DCM~~	~~121706~~	~~RT Patient Position Acquisition, dual plane kV/MV~~
~~DCM~~	~~121707~~	~~RT Patient Position Acquisition, CT kV~~
~~DCM~~	~~121708~~	~~RT Patient Position Acquisition, CT MV~~

~~DCM~~	~~121709~~	~~RT Patient Position Acquisition, Optical~~
~~DCM~~	~~121710~~	~~RT Patient Position Acquisition, Ultrasound~~
~~DCM~~	~~121711~~	~~RT Patient Position Acquisition, Spatial Fiducials~~

Add the following new CIDs to PS3.16, Annex B:

CID SUP213005 Radiotherapy Acquisition WorkItem Subtask Codes

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: yyyymmdd

UID: 1.2.840.10008.6.1.S213.5

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121702	RT Patient Position Acquisition, single plane MV
DCM	121703	RT Patient Position Acquisition, dual plane MV
DCM	121704	RT Patient Position Acquisition, single plane kV
DCM	121705	RT Patient Position Acquisition, dual plane kV
DCM	S213160	RT Patient Position Acquisition, integrated dose MV
DCM	S213161	RT Patient Position Acquisition, Film Cassette MV
DCM	S213162	RT Patient Position Acquisition, Film Cassette kV
DCM	121707	RT Patient Position Acquisition, CT kV
DCM	121708	RT Patient Position Acquisition, CT MV
DCM	S213163	RT Patient Position Acquisition, Cone-Beam kV
DCM	S213164	RT Patient Position Acquisition, Conventional CT kV
DCM	S213165	RT Patient Position Acquisition, Cone-Beam MV
DCM	S213166	RT Patient Position Acquisition, Conventional CT MV

CID SUP213006 Patient Position Acquisition Radiation SOurce Locations

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: yyyymmdd

UID: 1.2.840.10008.6.1.S213.6

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	130358	Nominal Radiation Source Location
99SUP213	S213200	Nominal Imaging Source Location

678 **CID SUP213007 Imaging Energy Categories**

679 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**

680 **Type: Extensible**

681 **Version: yyyymmdd**

682 **UID: 1.2.840.10008.6.1.S213.7**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP213	S213700	Configured Lowest Imaging Energy
99SUP213	S213701	Configured Default Imaging Energy

683

684 **CID SUP213008 kV Imaging Acquisition Techniques**

685 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**

686 **Type: Extensible**

687 **Version: yyyymmdd**

688 **UID: 1.2.840.10008.6.1.S213.8**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121704	RT Patient Position Acquisition, single plane kV
DCM	121705	RT Patient Position Acquisition, dual plane kV
DCM	121707	RT Patient Position Acquisition, CT kV
DCM	S213163	RT Patient Position Acquisition, Cone-Beam CT kV
DCM	S213164	RT Patient Position Acquisition, Conventional CT kV
DCM	S213162	RT Patient Position Acquisition, Film Cassette kV

689

690 **CID SUP213009 MV Imaging Acquisition Techniques**

691 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**

692 **Type: Extensible**

693 **Version: yyyymmdd**

694 **UID: 1.2.840.10008.6.1.S213.9**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121702	RT Patient Position Acquisition, single plane MV
DCM	121703	RT Patient Position Acquisition, dual plane MV
DCM	121708	RT Patient Position Acquisition, CT MV
DCM	S213165	RT Patient Position Acquisition, Cone-Beam CT MV
DCM	S213166	RT Patient Position Acquisition, Conventional CT MV
DCM	S213160	RT Patient Position Acquisition, integrated dose MV
DCM	S213161	RT Patient Position Acquisition, Film Cassette MV

695

CID SUP213010 Patient Position Acquisition - Projection Techniques

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: yyyymmdd

UID: 1.2.840.10008.6.1.S213.10

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121702	RT Patient Position Acquisition, single plane MV
DCM	121703	RT Patient Position Acquisition, dual plane MV
DCM	121704	RT Patient Position Acquisition, single plane kV
DCM	121705	RT Patient Position Acquisition, dual plane kV
DCM	121706	RT Patient Position Acquisition, dual plane kV/MV
DCM	S213160	RT Patient Position Acquisition, integrated dose MV
DCM	S213161	RT Patient Position Acquisition, Film Cassette MV
DCM	S213162	RT Patient Position Acquisition, Film Cassette kV

CID SUP213011 Patient Position Acquisition – CT Techniques

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: yyyymmdd

UID: 1.2.840.10008.6.1.S213.11

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121707	RT Patient Position Acquisition, CT kV
DCM	S213163	RT Patient Position Acquisition, Cone-Beam CT kV
DCM	S213164	RT Patient Position Acquisition, Conventional CT kV
DCM	121708	RT Patient Position Acquisition, CT MV
DCM	S213165	RT Patient Position Acquisition, Cone-Beam CT MV
DCM	S213166	RT Patient Position Acquisition, Conventional CT MV

CID SUP213012 Patient Positioning Related Object Purposes

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: yyyymmdd

UID: 1.2.840.10008.6.1.S213.12

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)

DCM	S213300	RT Patient Positioning Reference Image

715
716
717 **CID SUP213030 Patient Position Acquisition Devices**

718 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**
719 **Type: Extensible**
720 **Version: yyyymmdd**
721 **UID: 1.2.840.10008.6.1.S213.30**
722

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SCT	468886001	Digital imaging scanner, computed radiography
SCT	468440006	Digital imager, radiation therapy
SCT	466556008	X-ray film cassette, manual

723
724 **CID SUP213031 RT Radiation Meterset Units**

725 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**
726 **Type: Extensible**
727 **Version: yyyymmdd**
728 **UID: 1.2.840.10008.6.1.S213.31**
729

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
Include CID 9552 "C-Arm Photon-Electron Dosimeter Units"		
Include CID 9557 "Tomotherapeutic Dosimeter Units"		
Include CID 9559 "Robotic Delivery Device Dosimeter Units"		

730
731 **CID SUP213032 Acquisition Initiation Types**

732 **Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML**
733 **Type: Extensible**
734 **Version: yyyymmdd**
735 **UID: 1.2.840.10008.6.1.S213.32**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
99SUP213	S213501	Acquisition Initiation not defined
99SUP213	S213502	Acquisition Initiation before start of Radiation
99SUP213	S213503	Acquisition Initiation after end of Radiation
99SUP213	S213504	Acquisition Initiation at specified value

736

737 **CID SUP213033 RT Image Patient Position Acquisition Devices**

738 **Resources: HTML I FHIR JSON I FHIR XML I IHE SVS XML**

739 **Type: Extensible**

740 **Version: yyyymmdd**

741 **UID: 1.2.840.10008.6.1.S213.33**

742

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SCT	468440006	Digital imager, radiation therapy
SCT	468440006	Digital imager, radiation therapy

743

744

745 **Add the following template to PS3.16, Annex C:**

746 **Annex C Acquisition and Protocol Context Templates (Normative)**

747

748

749 **TID SUP213T01 Acquisition Initiation Parameters**

750 **Type: Extensible**

751 **Order: Non-Significant**

752 **Root: No**

753

	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	CODE	EV (S213500, DCM, “Acquisition Initiation Type”)	1	M		BCID SUP213032 “Acquisition Initiation Types”
2	CODE	EV (S213510, DCM, “Acquisition Repetition”)	1	MC	IFF value of Row 1 is (S213504, DCM, “Acquisition Initiation by triggering parameter”)	DCID 231 “Yes-No Only”
3	NUMERIC	EV (S213520, DCM, "Meterset")	1-n	MC	IFF value of Row 1 is (S213504, DCM, "Acquisition Initiation at specified value") XOR Rows 4, 5, 6	UNITS = DCID SUP213031 “RT Radiation Meterset Units”.
4	NUMERIC	EV (S213521, DCM, "Source Continuous Roll Angle")	1-n	MC	IFF value of Row 1 is (S213504, DCM, "Acquisition Initiation at specified value") XOR Rows 3, 5, 6	UNITS = EV (deg, UCUM, "deg")
5	NUMERIC	EV (S213522, DCM, "Time after start of Radiation")	1-n	MC	IFF value of Row 1 is (S213504, DCM, "Acquisition Initiation at specified value") XOR Rows 3, 4, 8	UNITS = EV (s, UCUM, "s")

6	NUMERIC	EV (S213523, DCM, “Percentage of expected beam-on time of Radiation")	1-n	MC	IFF value of Row 1 is (S213504, DCM, "Acquisition Initiation at specified value") XOR Rows 3, 4, 5	UNITS = EV (%, UCUM, "%")

754

755 **Content Item Descriptions**

Row 3 - 6	These rows provide the value(s) of a triggering parameter associated with acquisition initiation. If Row 2 has the value of (373066001, SCT, "Yes") these rows contain 2 or 3 values. Value 1 represents the start value at which the repeated acquisition starts and value 2 contains the interval value by which the start value is repeatedly incremented to trigger subsequent acquisitions. Value 3 if present contains the stop value at which, when exceeded, no further acquisitions are started. If the stop value is not provided, the acquisition is triggered until the end of the therapeutic radiation. If Row 2 has the value of (373066001, SCT, "No") these rows shall contain a distinct value for the start of each acquisition. If more than one value is present, the values shall be specified in increasing order.

756

757

758 **TID SUP213T02 Imaging Source Geometry Parameters**

759 **Type: Extensible**

760 **Order: Non-Significant**

761 **Root: No**

762

	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	NUMERIC	EV (126809, DCM, "IEC61217 Gantry Continuous Roll Angle")	1	U		Units = EV (deg, UCUM, "deg")
2	NUMERIC	EV (126810, DCM, "IEC61217 Gantry Continuous Pitch Angle")	1	U		Units = EV (deg, UCUM, "deg")
3	NUMERIC	EV (126811, DCM, "IEC61217 Gantry Continuous Yaw Angle")	1	U		Units = EV (deg, UCUM, "deg")
4	NUMERIC	EV (S213600, 99SUP213, "IEC61217 Imaging Source to Axis Distance")	1	U		Units = EV (mm, UCUM, "mm")

763

764 **TID SUP213T03 Image Receptor Geometry Parameters**

765 **Type: Extensible**

766 **Order: Non-Significant**

767 **Root: No**

768

	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	NUMERIC	EV (126809, DCM, "IEC61217 Gantry Continuous Roll Angle")	1	U		Units = EV (deg, UCUM, "deg")
2	NUMERIC	EV (126810, DCM, "IEC61217 Gantry	1	U		Units = EV (deg, UCUM, "deg")

		Continuous Pitch Angle")				
3	NUMERIC	EV (126811, DCM, "IEC61217 Gantry Continuous Yaw Angle")	1	U		Units = EV (deg, UCUM, "deg")
4	NUMERIC	EV (S213620, 99SUP213, "IEC61217 X-Ray image receptor radial displacement from Isocenter")	1	U		Units = EV (mm, UCUM, "mm")
5	NUMERIC	EV (S213621, 99SUP213, "IEC61217 X-Ray Image Receptor longitudinal displacement")	1	U		Units = EV (mm, UCUM, "mm")
6	NUMERIC	EV (S213622, 99SUP213, "IEC61217 X-Ray Image Receptor lateral displacement")	1	U		Units = EV (mm, UCUM, "mm")
7	NUMERIC	EV (S213623, 99SUP213, "IEC61217 X-Ray Image Receptor Rotation")	1	U		Units = EV (deg, UCUM, "deg")

Note: The Z-axis of the IEC 61217 GANTRY coordinate system passes through and is directed towards the radiation source, which in this context is the imaging source.

Change the following codes to the table in PS3.16, Annex D:

Code Value	Code Meaning	Definition	Notes
121702	RT Patient Position Acquisition, single plane MV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using single-plane megavoltage imaging.	
121703	RT Patient Position Acquisition, dual plane MV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using dual-plane megavoltage imaging.	
121704	RT Patient Position Acquisition, single plane kV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using single-plane kilovoltage imaging.	
121705	RT Patient Position Acquisition, dual plane kV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using dual-plane kilovoltage imaging.	
121706	RT Patient Position Acquisition, dual plane kV/MV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using dual-plane combination kilovoltage and megavoltage imaging.	
121707	RT Patient Position Acquisition, CT kV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using kilovoltage CT imaging. **Note: This code encompasses both Cone-Beam CT and conventional CT**	
121708	RT Patient Position Acquisition, CT MV	Acquisition of patient positioning information ~~**prior to treatment delivery**~~, using megavoltage CT imaging. **Note: This code encompasses both Cone-Beam CT and conventional CT**.	

Code Value	Code Meaning	Definition	Notes
121709	RT Patient Position Acquisition, Optical	Acquisition of patient positioning information ~~prior to treatment delivery~~, using optical imaging.	
121710	RT Patient Position Acquisition, Ultrasound	Acquisition of patient positioning information ~~prior to treatment delivery~~, using ultrasound imaging.	
121711	RT Patient Position Acquisition, Spatial Fiducials	Acquisition of patient positioning information ~~prior to treatment delivery~~, using spatial fiducials.	

Add the following codes to the table in PS3.16, Annex D:

Annex D Dicom controlled terminology definitions (normative)

Code Value	Code Meaning	Definition	Notes
S213160	RT Patient Position Acquisition, integrated dose MV	Acquisition of patient positioning information using continuous megavoltage acquisition during treatment delivery. Note, this creates an integrated dose image.	
S213161	RT Patient Position Acquisition, Film Cassette MV	Acquisition of patient positioning information using a radiation-sensitive film suited for megavoltage radiation.	
S213162	RT Patient Position Acquisition, Film Cassette kV	Acquisition of patient positioning information using a radiation-sensitive film suited for photon radiation.	
S213163	RT Patient Position Acquisition, Cone-Beam CT kV	Acquisition of patient positioning information using kilovoltage Cone-Beam CT imaging.	
S213164	RT Patient Position Acquisition, Conventional CT kV	Acquisition of patient positioning information using kilovoltage conventional CT imaging.	
S213165	RT Patient Position Acquisition, Cone-Beam CT MV	Acquisition of patient positioning information using megavoltage Cone-Beam CT imaging.	
S213166	RT Patient Position Acquisition, Conventional CT MV	Acquisition of patient positioning information using megavoltage conventional CT imaging.	
S213200	Nominal Imaging Source Location	The point location defined as the nominal source of radiation used for imaging.	
S213300	RT Patient Positioning Reference Image	Image(s) used to provide a reference for the planned treatment position.	
S213500	Acquisition Initiation Type	The type of the initiation to be used to start the acquisition.	
S213501	Acquisition Initiation not defined	The acquisition trigger is not specified. Acquisition may be initiated manually by the device operator.	
S213502	Acquisition Initiation before start of Radiation	The acquisition is started before delivering the therapeutic radiation.	
S213503	Acquisition Initiation after end of Radiation	The acquisition is started after delivering the therapeutic radiation.	
S213504	Acquisition Initiation by triggering parameter	The acquisition is started when the triggering parameter reaches specific value(s).	

Code Value	Code Meaning	Definition	Notes
S213510	Acquisition Repetition	Flag denoting whether the acquisition is to be repeated in regular intervals.	
S213520	Meterset	Meterset of an RT Radiation delivery.	
S213521	Source Continuous Roll Angle	Angle in degrees about the Y-axis of the Equipment Coordinate System by which the source is rotated. A Continuous Rotation Angle is an angle in the range (-∞,+∞). Continuous Rotation Angle represent a rotation direction and magnitude. The magnitude is not limited to be between 0 and 360 degrees.	
S213522	Time after start of Radiation	Time elapsed after the start of the delivery of an RT Radiation.	
S213523	Percentage of expected beam-on time of Radiation	Percentage of the duration of a Radiation. Duration is the expected time between the start and the end of the delivery of an RT Radiation, excluding periods where the radiation is interrupted (“beam-off periods”).	
S213600	IEC61217 Imaging Source to Axis Distance	The distance from the imaging source to the rotation axis of a C-Arm Device [IEC61217].	
S213620	IEC61217 X-Ray Image Receptor radial displacement from Isocenter	IEC X-RAY Image Receptor radial displacement in the direction of the z-Axis of the IEC GANTRY Coordinate System [IEC 61217].	
S213621	IEC61217 X-Ray Image Receptor longitudinal displacement	IEC X-RAY Image Receptor longitudinal displacement in the direction of the y-Axis of the IEC GANTRY Coordinate System [IEC 61217].	
S213622	IEC61217 X-Ray Image Receptor lateral displacement	IEC X-RAY Image Receptor lateral displacement in the direction of the x-Axis of the IEC GANTRY Coordinate System [IEC 61217].	
S213623	IEC61217 X-Ray Image Receptor Rotation	IEC X-RAY Image Receptor rotation around the z-axis of the X-RAY Image Receptor Coordinate System [IEC61217].	
S213700	Configured Lowest Imaging Energy	Lowest energy for acquiring an image as configured on the device.	
S213701	Configured Default Imaging Energy	Default energy for acquiring an image as configured on the device.	

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