



Customer Technical Reference

DICOM Conformance Statement: Proton Therapy Imaging



Abstract	This document contains important information on the handling and use of the product as well as on the safety measures to be observed.
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1 Introduction

1.1 Overview

The Proton Therapy Imaging (PTI) application, part of Varian's ProBeam proton therapy system, is used to set up a patient for treatment purposes. To support this function, DICOM® services are used for receiving and sending data from/to diagnostic imaging modalities. This document describes PTI compliance to DICOM conformance requirements.

The table below lists the network services supported by the PTI application.

Tab. 1: Network Services Used by ProBeam Imaging

Service	SOP Class	User of Service (SCU)	Provider of Service (SCP)
Transfer	CT Image Storage	Yes	Yes
Transfer	Spatial Registration Storage	Yes	No
Transfer	RT Structure Set Storage	Yes	Yes
Transfer	RT Image Storage	Yes	Yes
Transfer	RT Ion Plan Storage	No	Yes
Transfer	Storage Commitment Push Model	No	Yes
Query/Retrieve	Study Root Query/Retrieve Information Model – FIND	No	No
Query/Retrieve	Study Root Query/Retrieve Information Model – MOVE	Yes	No

The table below lists the media file SOP classes supported for file-based export and import. These SOP classes are supported only when the PTI is operating in file mode.

Tab. 2: Media File SOP Classes Supported by ProBeam Imaging

SOP Classes	DICOM Media File Export	DICOM Media File Import
CT Image Storage	Yes	Yes
Spatial Registration Storage	Yes	No
RT Structure Set Storage	Yes	Yes
RT Image Storage	Yes	Yes
RT Ion Plan Storage	No	Yes

1.2 Audience

This document is written for the people who need to understand how Varian's ProBeam system can be integrated into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product.

This document contains some basic DICOM definitions so the reader can understand how this product implements the DICOM features. It is assumed that integrators are well-versed in DICOM, and that they fully understand DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

1.3 Remarks

This Conformance Statement should be read and understood in conjunction with the DICOM Standard, 2017. DICOM by itself does not guarantee interoperability; the Conformance Statement, however, facilitates a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

Because the DICOM standard is subject to ongoing changes, enhancements and improvements, Varian Medical Systems reserves the right to advance their products by making use of upcoming DICOM features.

This document contains definitions which are specific to the Proton Therapy Imaging application (PTI). For definitions that are specific to the Proton Treatment Console (PTC), see *Proton Treatment Console DICOM Conformance Statement*. Otherwise, all definitions of the Varian System Server DICOM conformance statement apply as applicable; see *Varian System Server DICOM Conformance Statement*.

See also

 [References \[▶ 9\]](#)

1.4 Terms and Definitions

The table below contains informal definitions of terms used in ProBeam DICOM Conformance Statements. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax

The information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE)

An end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title (AET)	The externally known name of an <i>Application Entity</i> , used to identify a DICOM application to other DICOM applications on the network.
Application Context	The specification of the type of communication used between <i>Application Entities</i> . Example: DICOM network protocol.
Association	A network communication channel set up between <i>Application Entities</i> .
Attribute	A unit of information in an object definition; a data element identified by a <i>tag</i> . The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).
Information Object Definition (IOD)	The specified set of <i>Attributes</i> that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The <i>Attributes</i> may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.
Media Application Profile	The specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs).
Module	A set of <i>Attributes</i> within an <i>Information Object Definition</i> that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.
Negotiation	First phase of <i>Association</i> establishment that allows <i>Application Entities</i> to agree on the types of data to be exchanged and how that data will be encoded.
Presentation Context	The set of DICOM network services used over an <i>Association</i> , as negotiated between <i>Application Entities</i> ; includes <i>Abstract Syntaxes</i> and <i>Transfer Syntaxes</i> .
ProBeam	Varian's ProBeam System is a proton therapy system used to treat various forms of cancer and related conditions.
Protocol Data Unit (PDU)	A packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.
Security Profile	A set of mechanisms, such as encryption, user authentication, or digital signatures, used by an <i>Application Entity</i> to ensure confidentiality, integrity, and/or availability of exchanged DICOM data.

Service Class Provider (SCP)	Role of an <i>Application Entity</i> that provides a DICOM network service; typically, a server that performs operations requested by another <i>Application Entity</i> (<i>Service Class User</i>). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).
Service Class User (SCU)	Role of an <i>Application Entity</i> that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU).
Service/Object Pair Class (SOP Class)	The specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.
Service/Object Pair Instance (SOP Instance)	An information object; a specific occurrence of information exchanged in a <i>SOP Class</i> . Examples: a specific x-ray image.
Tag	A 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element].
Transfer Syntax	The encoding used for exchange of DICOM information objects and messages. Examples: <i>JPEG</i> compressed (images), little endian explicit value representation.
Transmission Control Protocol/Internet Protocol (TCP/IP)	A widely used computer networking protocol.
Treatment Management System	DICOM entity from which the ProBeam Imaging application retrieves structure set data.
Unique Identifier (UID)	A globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.
Value Representation (VR)	The format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

1.5 Abbreviations

AE Application Entity

AET	Application Entity Title
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
FOR	Frame of Reference
HIS	Hospital Information System
HL7	Health Level 7 standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Organization for Standards
JPEG	Joint Photographic Experts Group
MPEG	Moving Picture Experts Group
NEMA	National Electrical Manufacturers Association
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
PET	Positron Emission Tomography
PTC	Proton Treatment Console treatment application for ProBeam
SAD	Source to Axis Distance
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
SR	Structured Reporting
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
UID	Unique Identifier
UL	Upper Layer
VR	Value Representation

1.6 References

[1] Digital Imaging and Communications in Medicine (DICOM), Parts 1-18 (2017), National Electrical Manufacturers Association (NEMA)
 Rosslyn, VA, USA
 available free at <http://medical.nema.org/>

[2] Proton Treatment Console DICOM Conformance Statement
 PB-CTR-00009
 Varian Medical Systems Inc
 Palo Alto, CA, USA

[3] Varian System Server DICOM Conformance Statement
 B VA1302D3CS (System Server version 13)

Varian Medical Systems International AG
Baden, Switzerland

[4] IHE Radiation Oncology
Technical Framework Supplement
Multimodality Image Registration for Radiation Oncology 2012
(MMRO-II)
ftp://ftp.ihe.net/RadiationOncology/Supplements/MMRO-II/IHE-RO_MMRO-II_Supplement_V1-0_2012-02-29.docx

2 Networking

2.1 Implementation Model

2.1.1 Application Data Flow

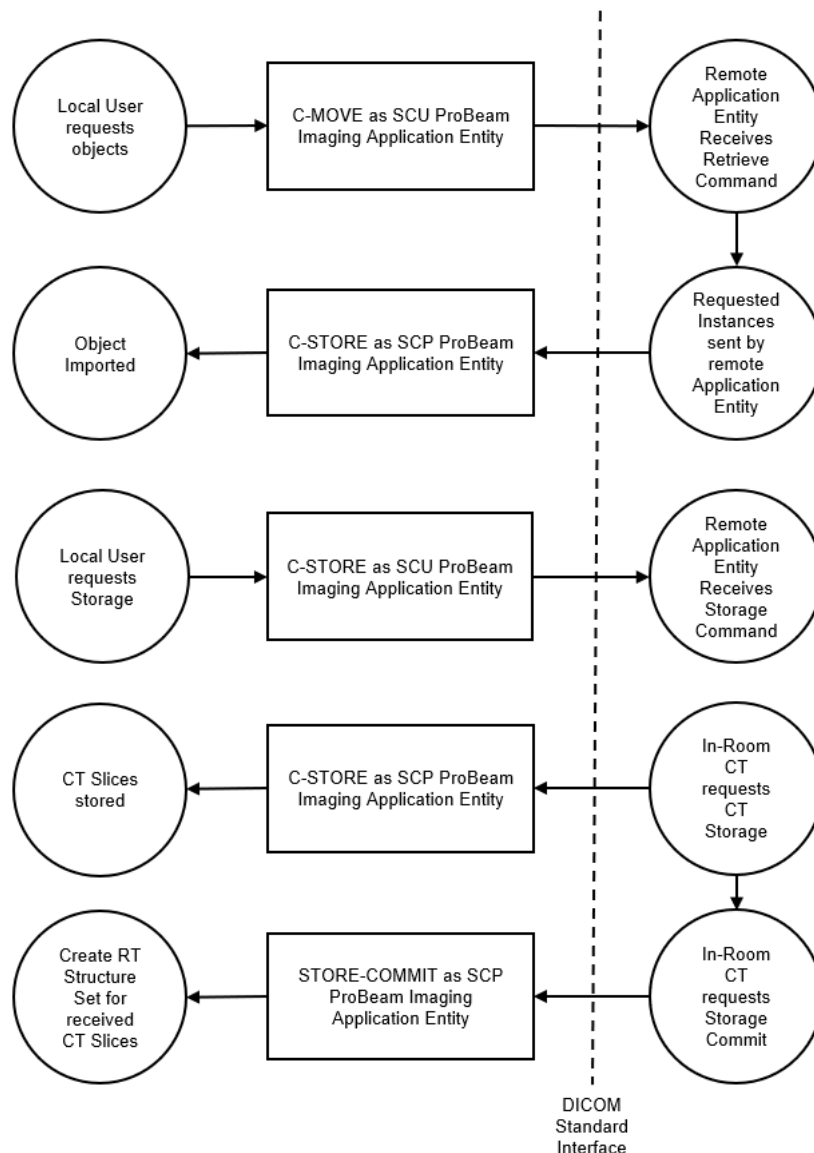


Fig. 1: Implementation Model

Conceptually, the network services may be modeled as the following separate AEs, which share a single (configurable) AE Title:

- **STORAGE-SCP**, which receives incoming RT images, CT images, RT Ion Plans and Structure Sets.

- **STORAGE-SCU**, which sends outbound RT images, CT images, Structure Sets and Spatial Registrations.
- **MOVE-SCU**, which retrieves selected studies, series or instances.
- **ECHO-SCU**, which sends outgoing echo request to Remote Application Entity.

For the In-Room CT functionality, the network services may be modeled as the following separate AEs, which share a single (configurable) AE Title, different than the one above:

- **STORAGE-SCP**, which receives CT images from the In-Room CT.
- **Storage-Commitment-SCP**, which receives a list of sent objects for which the In-Room CT requests storage commitment.

2.1.2 Functional Definition of AEs

Conceptually, the network services may be modeled as the following separate AEs:

2.1.2.1 ProBeam Imaging Client Storage SCU Application Entity

The Storage SCU Application Entity is invoked if:

- A 2D/3D, Marker, 3D/3D, or In-Room CT matching has been performed, and Spatial Registrations must be sent to the Remote AE.
- A 2D/3D matching has been performed as part of the In-Room CT workflow, and the corresponding 2D/2D Spatial Registration and two DRRs must be sent to the remote AE.
- CBCT has been acquired or a CT was acquired during the In-Room CT workflow, and the acquired CT set must be sent to the Remote AE.
- 2D images have been acquired and must be sent to the Remote AE.
- Marker Detection has been performed, and the markers must be sent to the Remote AE as a Structure Set linked to the current reference CT image. Each marker is defined as its own point set with a single point in it.
- Marker Match has been performed, and the image object including markers must be sent to the Remote AE. (Note: The markers are stored as curves in the image object.)

The objects are sent to the Remote AE when:

- The user presses the **Save** button on the UI.
- The patient session is closed.

2.1.2.2 ProBeam Imaging Client Query/Retrieve SCU Application Entity

The Query/Retrieve Application Entity is invoked when

- The patient is loaded in the ProBeam Treatment application.
- Structure Set and CT images must be loaded in order to perform marker detection/matching, 2D/3D matching, 3D/3D matching or to generate DRRs.

2.1.2.3 ProBeam Imaging Client Storage SCP Application Entity

The Storage SCP Application Entity is invoked in order to receive objects requested from a remote Query/Retrieve SCP, such as:

- Structure Sets
- RT Ion Plan
- Reference CT image set

2.1.2.4 ProBeam Imaging Client Storage SCP Application Entity for In-Room CT

The Storage SCP application entity is invoked when an In-Room CT imaging field is active, in order to receive a CT image set acquired with the In-Room CT.

2.1.2.5 ProBeam Imaging Client Storage Commitment SCP Application Entity for In-Room CT

The Storage Commitment SCP application entity is invoked when an In-Room CT imaging field is active, to confirm storage for a list of received objects from the In-Room CT.

2.1.3 Sequencing of Real-World Activities

When a patient is loaded into the application, the application loads each reference image by requesting it from the remote AE.

Referenced structure set and related CT images are loaded if the plan defines the RT structure set on which the RT Ion plan is based in the plan's Referenced Structure Set Sequence (300C, 0060). The application invokes a move command for each CT Image related to the structure set represented by the *CT Image Query/Retrieve SCU*. For this purpose, the application provides the *CT Image Storage SCP*.

When CT slices are sent by the In-Room CT, they are stored if the Patient ID (0010,0020), Patient's Last Name (taken from (0010,0010)), Patient Position (0018,5100), and Patient's Birth Date (0010,0030) are equal to the values in the RT Ion Plan, and if the image orientation (taken from (0008, 0008)) is axial. After the application receives a Storage Commitment request, the structure set is generated and stored.

When Marker Detection is performed, the Storage SCU entity is invoked and the Marker Data (as Structure Set) are stored to the remote AE.

When either a 2D/3D, 3D/3D or marker matching is performed, the Storage SCU entity is invoked and stores a Spatial Registration to the remote AE. A special case of this is when a 2D/3D match is performed as part of the In-Room CT workflow, where the Spatial Registration stored to the remote AE by the Storage SCU Entity is a 2D/2D spatial registration.

When loading from or saving to the Remote Application Entity, the ECHO-SCU entity is typically invoked to ensure that the remote AE is alive and responsive.

The loading of a reference CT set is described by the following sequence diagram, which illustrates, that the plan and the structure set is retrieved as well to follow the appropriate references:

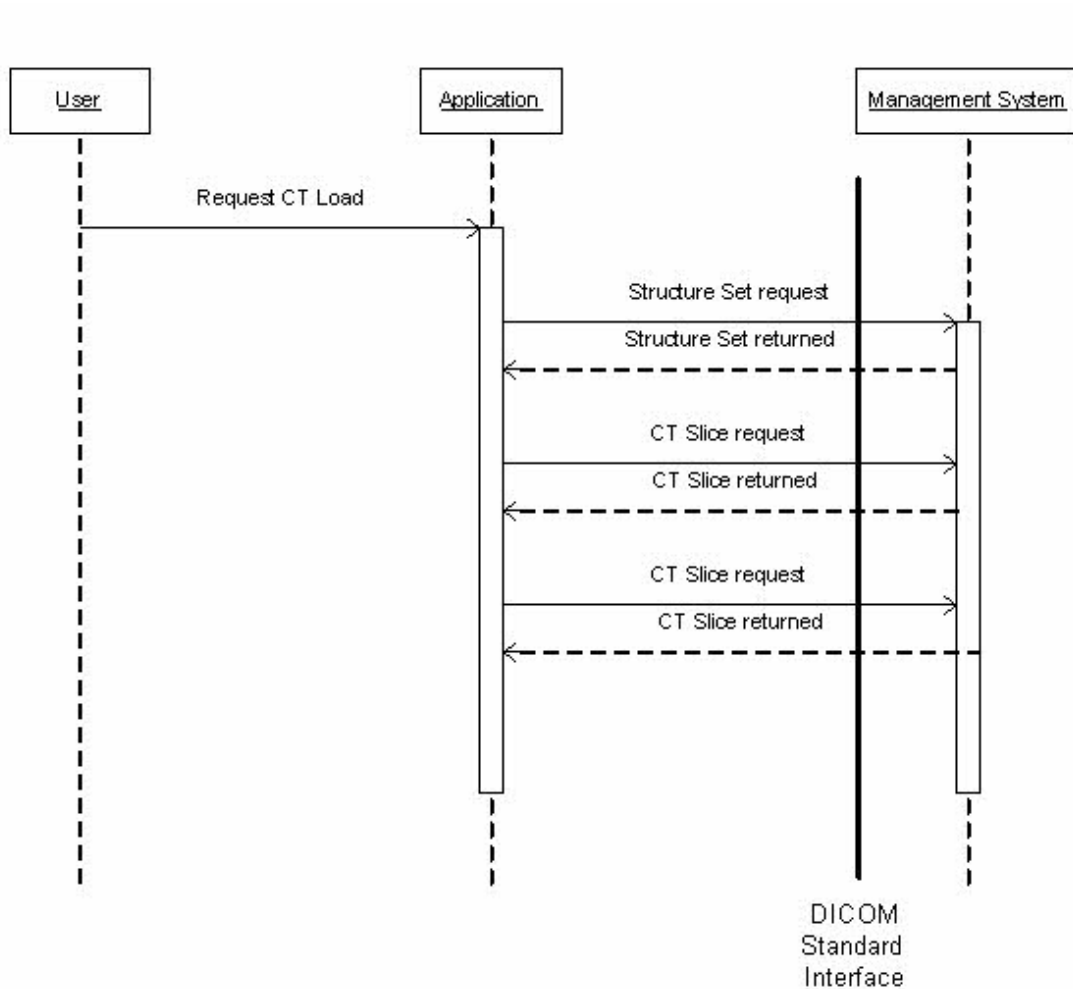


Fig. 2: Sequence Diagram for CT Set loading

2.2 AE Specifications

2.2.1 SOP Classes

The PTI Application Entity provides standard conformance to the DICOM SOP classes listed in the table below.

Tab. 3: Supported SCU/SCP SOP Classes for ProBeam Imaging Entity

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.48 1.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2 .1	SCP	None
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66 .1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2 .1	SCP	None
RT Image Storage	1.2.840.10008.5.1.4.1.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2 .1	SCP	None
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.8	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2 .1	SCP	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Study Root Query/Retrieve information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None

2.2.2 Association Policies

2.2.2.1 General

The DICOM standard application context name for DICOM 3.0 is always proposed. The DICOM Application Context Name for the PTI client Application Entity is 1.2.840.10008.3.1.1.1.

2.2.2.2 Number of Associations

The PTI client Application Entity can initiate (by default) up to three associations at a time. This value is configurable.

2.2.2.3 Asynchronous Nature

The PTI client Application Entity does not support asynchronous communication.

2.2.2.4 Implementation-Identifying Information

The following Implementation Class UID is used. This UID is not configurable.

Tab. 4: Implementation Class UIDs Used

UID Value	UID Name
1.2.246.352.70.2.1.170.1	PTI Imaging for ProBeam (P2VA)

2.2.3 Association Initiation Policy

The PTI client Application Entity initiates Associations.

2.2.3.1 Activity – Store

Description and Sequencing of Activities

When the user performs a 2D/3D, marker, or 3D/3D matching, the match transformation is stored as a Spatial Registration IOD.

If the 2D/3D match is performed as part of the In-Room CT workflow, the corresponding 2D/2D match is stored as a Spatial Registration IOD between two DRR RT Images. Those RT Images are created from the acquired CT using the Init Laser Isocenter of its structure set and the current gantry angle, and stored along with the Spatial Registration.

When the user performs marker detection on the reference CT image, the positions of the detected markers are stored in the Structure Set and linked to the current reference CT image. When the user performs a marker match, the positions of the matched markers are stored in the acquired RT Image object as curves with the following values:

- Curve Dimensions (5002,0005): 2
- Number of Points (5002,0010): 1
- Type of Data (5000,0020): POLY
- Axis Units (5000,0030): PIXL\PIXL
- Axis Labels (5000,0040): Marker\Marker
- Data Value Representation (5000,0103): 3

When the user acquires a verification CT set, each CT Image is stored. The following isocenters are stored as Points in the Structure Set, which is linked to the acquired verification CT set. The values of the RT ROI Interpreted Type (3006,00A4) are as follows:

- Initial Laser Isocenter (position before acquisition, e.g. initial setup position): INIT-LASERISO
- Acquisition Isocenter (position during acquisition): ACQ_ISOCENTER
- Initial Match Isocenter (position when first match was started): INITMATCHISO

Note that this value is not defined if the verification CT was acquired with the In-Room CT. The Storage SCU is invoked and attempts to initiate a new Association. If multiple objects are to be transferred, then multiple C-STORE requests are issued over this Association.

The table below lists the object categories used by the PTI client Storage SCU Application Entity.

Tab. 5: Object Categories Used by ProBeam Imaging Client Storage SCU Application Entity

Object Category	SOP Class Name	SOP Class UID
Structure Set	RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
Spatial Registration	Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1
RT Image	RT Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image	CT Image Storage	1.2.840.10008.5.1.4.1.1.2

Proposed Presentation Contexts

The PTI client Storage SCU Application Entity is capable of proposing the Presentation Contexts shown in the table below.

Tab. 6: Proposed Presentation Contexts for ProBeam Imaging Client Storage SCU Application Entity

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.48.1.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Image Storage	1.2.840.10008.5.1.4.1.1.48.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

SOP-Specific Conformance for All Storage SOP Classes

The C-STORE response status-handling behavior of the PTI client Storage SCU upon storage is summarized in the table below.

Tab. 7: ProBeam Imaging Client C-STORE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of Resources	A7xx	The user is informed that the C-STORE request has failed. Status Comment (0000,0902) is logged and displayed along with additional error information.
Failure	Data Set does not match SOP Class	A9xx	
	Cannot understand	Cxxx	

Service Status	Further Meaning	Error Code	Behavior
Warning	Coercion of Data Elements	B000	The SCP has successfully stored the SOP Instance. Because a warning status was received Status Comment (0000,0902) is logged .
	Data Set does not match SOP Class	B007	
	Elements Discarded	B006	
Success	Success	0000	The SCP has successfully stored the SOP Instance. No user feedback is received.
*	*	any other status code	Depending on the type of the Error Code it is either handled like a Failure or Warning. However, Error Codes other than listed above in this table should not occur, as they are not defined for C-STORE (see [1] ▶ Page: 9], PS 3.4, Table B.2-1).

After sending all SOP Instances, either successfully or not, the Association is released using A-RELEASE, and the results are presented to the user. PTI client Storage SCU communication failure behavior is listed in the table below.

Tab. 8: ProBeam Imaging Client Storage SCU Communication Failure Behavior

Exception	Behavior
Timeout	The Association is released using A-RELEASE and the whole task of sending SOP Instances is aborted. The user is informed about the timeout and available information about it is logged.
Association aborted by the SCP or network layers	The whole task of sending SOP Instances is aborted. The user is informed about the aborted associations and available information about it is logged.

SOP-Specific Conformance for RT Structure Set Storage

Detected marker positions will be saved to a new structure set. This structure set references the planning CT Frame of Reference and contains the detected marker positions as they are projected on the planning CT. The modified structure set gets a new UID and the private referenced structure set sequence (3263,1001) is used to denote the original structure set (with the old UID). This sequence maybe used by the Treatment Management System to combine the new structure set and the original one to add the markers as detected by ProBeam Imaging.

The ROI Contour Sequence (3006, 0040) shall have the following definitions:

- Contour Geometric type (3006, 0042) = POINT
- Number of Contour Points (3006, 0046) = 1

The ROI observation module shall have the following definitions:

- RT ROI Interpreted Type (3006,00A4) = MARKER

Marker position may be located between slice positions.

Before exporting modified volumetric structures, they get resampled onto the planes of the 3D patient model. The volumetric ROI Contours of an exported RT Structure Set will thus always reference an image slice.

All images used to construct the 3D patient model are referenced in Contour Image Sequence (3006,0016) of RT Structure Set Module, even if they do not have any contours defined on them.

SOP-Specific Conformance for Spatial Registration Storage

If the application is configured to store spatial registration IODs according to the IHE Radiation Oncology format, then spatial registration storage complies to IHE-RO_MMRO-II Supplement (see [4] Page: 9).

Otherwise, the following SOP-specific conformance applies:

The spatial registration of the 3D/3D Match will be used in the following way:

- The FOR of the spatial registration is identical to the FOR of the acquired verification CT image slices.
- The transformation matrix type will be RIGID.

The spatial registration of the 2D/3D Match will be used in the following way:

- The FOR of the spatial registration is identical to the FOR of the acquired verification RT images.
- The transformation matrix type will be RIGID.

If a 2D/3D match was performed as part of the In-Room CT workflow, then a spatial registration of the corresponding 2D/2D match is used in the following way:

- The FOR of the spatial registration is identical to the FOR of the acquired verification RT images.
- The transformation matrix type will be RIGID.

The spatial registration of the Marker Match will be used in the following way:

- The FOR of the spatial registration is identical to the FOR of the acquired verification RT images.
- The transformation matrix type will be RIGID.

2.2.3.2 Activity – Query/Retrieve

Description and Sequencing of Activities

This function is typically performed by the application to load the reference images and to load the reference CT and its structure set. At this time, an association is requested.

This application supports Query/Retrieve in the SCU role. The table below shows the supported values for the tag Query/Retrieve Level (0008,0052).

Tab. 9: Supported Query/Retrieve Levels for Query/Retrieve SCU

Query/Retrieve Level	Value in (0008,0052)
Composite Object Instance Information	IMAGE

Proposed Presentation Contexts

The PTI client Q/R SCU Application Entity is capable of proposing the presentation context shown in the table below.

Tab. 10: Proposed Presentation Contexts for ProBeam Imaging Client Q/R SCU Application Entity

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Study Root Query/ Retrieve information model – MOVE	1.2.840.10008.5.1.4.1.2.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

SOP-Specific Conformance for C-MOVE SOP Classes

The behavior of the PTI client Query/Retrieve SCU when encountering status codes in a C-MOVE response is summarized in the table below.

Tab. 11: ProBeam Imaging Client C-MOVE Response Status Handling Behavior

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of Resources – Unable to calculate number of matches	A701	None of the requested SOP Instances could be retrieved. The user will be informed about the failure.
	Out of Resources – Unable to perform sub-operations	A702	
	Move Destination unknown	A801	
Failure	Identifier does not match SOP Class	A900	
	Unable to Process	Cxxx	
Cancel	Sub-operations terminated due to Cancel Indication	FE00	Cancel is handled like Failure.
Warning	Sub-operations complete – One or more Failures	B000	Some or all SOP Instances have not been transmitted successfully. The user is informed.
Success	Sub-operations complete – No Failures	0000	All SOP Instances have successfully been transmitted.
Pending	Sub-operations are continuing	FF00	Transferring requested SOP Instances is continuing. This message is ignored.
*	*	Any other status code.	Any other status code is handled like Failure.

After having received all requested SOP Instances, or when the user aborts the operation, the Association is released using A-RELEASE. All events occurring during querying and retrieving SOP Instances are logged. If any log entries are marked with the internal category Error, they are shown to the user automatically.

No C-CANCEL-MOVE requests are ever issued.

PTI Q/R C-MOVE SCU communication failure behavior is shown in the table below.

Tab. 12: ProBeam Imaging Q/R C-MOVE SCU Communication Failure Behavior

Exception	Behavior
Timeout	The user is informed that the operation has timed out.
Association aborted by the SCP or network layers	The user is informed when the association is aborted during a C-MOVE operation.

The attributes that are sent by the C-MOVE SCU are listed in the table below.

Tab. 13: Study Root Request Identifier for ProBeam Imaging Client Q/R C-MOVE SCU

Name	Tag	VR	Type
Query/Retrieve Level	(0008,0052)	CS	R
SOP Instance UID	(0008,0018)	UI	U
Study Instance UID	(0020,000D)	UI	U
Series Instance UID	(0020,000E)	UI	U

The values in the **Type** column in the above table should be read as follows:

U - Universal Matching

R - Range Matching

One or more matching types of the above list can be supported per attribute.

Supported Operations

This application performs only the operations listed in the table below. This table also shows which of the key values (see *Digital Imaging and Communications in Medicine (DICOM)*) are used for a request.

Tab. 14: Supported Operations

Operation	Target IOD	Key Value Used for Request
C-MOVE	RT Structure Set	SOP Instance UID
C-MOVE	RT Ion Plan	SOP Instance UID
C-MOVE	RT Image	SOP Instance UID
C-MOVE	CT Image	SOP Instance UID

2.2.3.3 Activity – Send Storage Commitment Result

The storage commitment result is sent in the same association opened by the In-Room CT as described in section 2.2.4.3. If this association has been closed already, a new association is not requested.

2.2.4 Association Acceptance Policy

The ProBeam Imaging Client Application Entity does accept storage requests for those objects requested by the MOVE SCU

2.2.4.1 Activity – Receive Storage Request

Description and Sequencing of Activities

Received SOP Instances are cached on the file system and passed on to the application.

General Preconditions

ProBeam Imaging supports only ad-hoc imaging. Setup fields in the RT Ion plan are ignored. If the plan contains treatment beams having different isocenters, the couch shift found by the image-guided patient positioning for the active treatment beam/isocenter is only applied to treatment beams/isocenters that are within a given distance to the active treatment beam/isocenter. That distance is user configurable and is controlled by the Proton Treatment Console (see [2] [▶ Page: 9]).

Preconditions for reference CT Images

To load the slices of the reference CT image ProBeam Imaging loads the plan's structure set, which corresponds to the Referenced RT Structure Set (300C,0060), from the Treatment Management System, and subsequently loads all CT slices referenced in the Contour Image Sequence (3006,0016).

Conditions for CT Slices:

- All CT slices shall have the same Frame of Reference.
- The spacing between CT slices positions in z-direction (DICOM Patient coordinate system) may vary, although it is recommended, that they are equal throughout all slices referenced by the Structure Set.
- The maximal difference in x-direction and in y-direction (DICOM Patient coordinate system) between all CT slices shall be less or equal 0.1 mm.

Conditions for Structure Set (except Structures of Contour Geometric type (3006, 0042) POINT):

- The contour points within a contour shall be positioned on the same contour plane within a maximal Epsilon of 10^{-6} in z direction (DICOM Patient coordinate system).
- Structures with contour(s) having contour points that are not positioned on the same contour plane (see point above, i.e. non-transversal structures) are ignored (they are not imported and a corresponding warning message is issued) and the import will continue with the other structures.
- Contour Geometric Type (3006, 0042) has to be either CLOSED_PLANAR or OPEN_PLANAR for all contours of the structure. Structures with mixed contour types are not supported.

- Contour Geometric type (3006, 0042) POINT doesn't need to fulfill the conditions mentioned above.

Preconditions for 2D/3D Match

Besides the General Preconditions, the following condition shall be fulfilled:

At least one acquired kV image is required.

For In-room CT workflow, two images--one from each kV system--are required.

To load the slices of the reference CT image, the conditions listed in paragraph 2.2.1.4.1.3

[▶ Page: 23] apply.

Preconditions for Marker Match

Besides the General Preconditions, the following condition shall be fulfilled:

A delta of 45.0 degrees between the gantry/source angles (300A,011E) of the two acquired images is required.

To load the slices of the reference CT image the conditions listed in paragraph 2.2.1.4.1.3

[▶ Page: 23] apply.

Conditions for Marker Point Structures:

- The markers shall be in the structure set referenced by the plan.
- Marker position may be located between slice positions.
- The ROI Contour Sequence (3006, 0040) shall have the following definitions:
 - Contour Geometric type (3006, 0042) = POINT
 - Number of Contour Points (3006, 0046) = 1
- The ROI observation module shall have the following definitions:
 - RT ROI Interpreted Type (3006,00A4) = MARKER.
 - Private tag: Marker Subtype (3271,1000) = MARKER

Preconditions for 3D/3D Match

Besides the General Preconditions, the following condition shall be fulfilled:

To load the slices of the reference CT image the conditions listed in paragraph 2.2.1.4.1.3

[▶ Page: 23] apply.

Accepted Presentation Contexts

ProBeam Imaging Client Storage SCP Application Entity accepts Presentation Contexts shown in the following table.

Tab. 15: Acceptable Presentation Contexts for ProBeam Imaging Client Storage SCP Application Entity and Receive Storage Request

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
All Storage SOP Classes in Table 4-1	All Storage SOP Classes in Table 4-1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1		

SOP Specific Conformance for all Storage SOP Classes

Presentation Context Acceptance Criterion

ProBeam Imaging Client Storage SCP will always accept any Presentation Context for the supported SOP Classes with the supported Transfer Syntaxes. More than one proposed Presentation Context will be accepted for the same Abstract Syntax if the Transfer Syntax is supported, whether or not it is the same as another Presentation Context.

Transfer Syntax Selection Policies

If offered a choice of Transfer Syntaxes in a Presentation Context, ProBeam Imaging Client Storage SCP will select the first Transfer Syntax that is listed in the Presentation Context.

ProBeam Imaging Client Storage SCP will accept duplicate Presentation Contexts, that is, if it is offered multiple Presentation Contexts, each of which offers acceptable Transfer Syntaxes, it will accept all Presentation Contexts, applying the same rule for selecting a Transfer Syntax for each as described above.

Response Status

ProBeam Imaging Client Storage SCP will behave as described in the Table below when generating the C-STORE response command message.

Tab. 16: Response Status of ProBeam Imaging Client Storage SCP and Receive Storage Request

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of Resources	A700	Failed to receive incoming DICOM Stream. Problem is logged on the SCP side.
	Out of Resources	A7xx	
Failure	Invalid object instance	0117	
	Data Set does not match SOP Class	A9xx	
	Invalid C-STORE request	C000	
Warning	Coercion of Data Elements	B000	
	Data Set does not match SOP Class	B007	
	Elements Discarded	B006	
Success		0000	Instance successfully stored in temporary file.

2.2.4.2 Activity - Receive Storage Request from In-Room CT

Description and Sequencing of Activities

Received SOP Instances are received and cached on the file system.

General Preconditions

An In-Room CT ad hoc imaging field must be active.

To store the CT images, the following conditions must be fulfilled:

- The Patient's ID (0010, 0020), Patient's Last Name (taken from (0010,0010)), Patient Position (0018,5100), and Patient's Birth Date (0010,0030) must be equal to the values contained in the RT Ion Plan.
- The image orientation (taken from (0008,0008)) must be axial.

Accepted Presentation Context

The accepted presentation context for Receive Storage Request from In-Room CT is shown in the table below.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1		

Response Status

ProBeam Imaging Client Storage SCP for In-Room CT behaves as the ProBeam Imaging Client Storage SCP, with the additional handling behavior shown in the table below.

Service Status	Further Meaning	Error Code	Behavior
Failure	Data Set is invalid	A900	The user is informed that the C-STORE request has failed. A status comment is logged and displayed along with additional error information. Possible root causes: Patient ID (0010,0020), Patient's Last Name (taken from (0010,0010)), Patient Position (0018,5100), or Patient's Birth Date (0010,0030) do not match with the values in the RT Ion Plan, and/or the image orientation (taken from (0008, 0008)) is not axial.

2.2.4.3 Activity - Receive Storage Commitment Request from In-Room CT

Description and Sequencing of Activities

Upon receipt of a storage commitment request from the In-Room CT SCU, correct receipt of CT images is confirmed to the SCU or a failure code is sent.

If correct receipt of CT images is confirmed, a structure set is generated for the list of CT images and is available for loading within the In-Room CT workflow.

General Preconditions

An In-Room CT ad-hoc imaging field must be active.

Accepted Presentation Context

The accepted presentation context for Receive Storage Commitment Request from In-Room CT is shown in the table below.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.1.20.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1		

Response Status

ProBeam Imaging Client Storage SCP for In-Room CT behaves as described in the table below when generating the Storage Commitment Request response command message.

Service Status	Further Meaning	Error Code	Behavior
Success		0000	Message sent to the SCU.
Failure		0110	The received CT images do not coincide with the commit request list provided by the SCU. There are missing or duplicate images in cache. Problem is logged on the SCP side and the user is informed.

2.3 Network Interfaces

See *Varian System Server DICOM Conformance Statement*.

2.4 Configuration

2.4.1 AE Title/Presentation Address Mapping

2.4.1.1 Local AE Titles

The local PTI client Application Entity uses the AE Title and TCP/IP port number configured via the treatment daemon configuration tool. Note that conceptually, the network services have been modeled as separate AEs, though in fact all AEs below share a single (configurable) AE Title.

Tab. 17: AE Title Configuration

Application Entity	Default AE Title	Default TCP/IP Port
PTI Application Entity	PTImageClient (configurable)	51700 (configurable)
PTI Storage SCU	See above	See above
PTI Query/Retrieve SCU	See above	See above

2.4.1.2 Local AE Titles for In-Room CT

The local PTI client Application Entity for In-Room CT uses the AE Title and TCP/IP port number as configured on PTICalibration, if the room is set as "Equipped with In-Room CT."

Application Entity	Default AE Title	Default TCP/IP Port
PTI Application Entity for Storage In-Room CT	PTI-SCP	9076
PTI Storage Commitment SCP	See above	See above

2.4.1.3 Remote AE Title/Presentation Address Mapping

PTI Client Storage SCU

For the PTI client Storage SCU, the TCP/IP address, called AE title, and port number of the destination are configurable as well as the calling AE title used by PTI.

PTI Client Query/Retrieve SCU

For the PTI client Query/Retrieve SCU, the TCP/IP address, called AE title, and port number of the provider are configurable. The calling AE title of the local application, which is also the Move Destination AE title, is configurable, too. The local port is the port of the Storage SCP for receiving the data. The Storage SCP accepts only connection requests from the configured remote AE title and IP address.

2.4.2 Parameters

The table below shows DICOM-relevant configuration parameters. While some of them can be configured directly via a configuration dialog or a configuration application, other values can either be accessed only via the Registry or cannot be configured at all.

Tab. 18: Configuration Parameters

Parameter	Configurable (Yes/No)	Default Value
General Parameters		
Max PDU Receive Size	No	Unlimited
Max PDU Send Size	No	32768 Bytes (32kB)
Time-out waiting for an acceptance or rejection response to an Association request or Association Release request (Application Level Timeout)	No	300s

Parameter	Configurable (Yes/No)	Default Value
Spatial Registration formatted along IHE-RO specification 2008	No	Yes
ProBeam Imaging Client Storage SCU Specific Parameters ProBeam Imaging Client Query/Retrieve SCU Specific Parameters		
Time-out awaiting a Response to a DIMSE Request (Low-Level Timeout)	No	300s
Maximum number of simultaneously initiated Associations	No	3

3 Media Interchange

The PTI client Application Entity allows importing and exporting of DICOM media files. Various import and export filters are available in the PTI client application to read and create DICOM media files. This functionality is available only when the PTI application is operating in file mode.

The files conform to the Part 10 format; however, the Basic Directory IOD as defined in Media Interchange Application Profiles is not present.

The table below shows transfer syntaxes used in DICOM media files created by ProBeam. The transfer syntax to be used for writing a file is DICOM Implicit VR Little Endian (UID: 1.2.840.10008.1.2) for all IODs.

Tab. 19: Transfer Syntaxes used in DICOM Media Files

Context of Usage	Transfer Syntax	
IOD	Name	UID
All IODs	DICOM Implicit VR Little Endian	1.2.840.10008.1.2

4 Support of Character Sets

No support for character sets beyond the Default Character Repertoire is available.

5 Security

5.1 Security Profiles

No security profiles are supported.

5.2 Association Level Security

The Storage SCU does not support association level security.

The Storage SCP instantiated to receive Instances requested by the Query/Retrieve SCU checks the following additional values when determining whether to accept association open requests:

- Called AE Title
- Calling AE Title
- IP address of Association Request originator

The Storage SCP instantiated to receive Instances and perform storage commitment by the In-Room CT SCU checks the following values when determining whether to accept association open requests:

- Calling AE Title
- IP address of Association Request originator

5.3 Application Level Security

To load patient information into the Proton Therapy Imaging application, the user opens the patient in the treatment application, which requires user identification in the form of a user name and password.

Appendix A - Specialization

A.1 IOD Contents

A.1.1 Created SOP Instances

Objects created by the ProBeam Imaging Application Entity are listed in Appendix B - IOD Details.

A.1.2 Usage of Attributes from Received IODs

The PTI Application Entity requires all Type 1 attributes to be present.

A.2 Data Dictionary of Private Attributes

Private attributes are used by the PTI Application are:

- Referenced in this document:
 - (3275,xx00) Registration Sub Type
 - (3273, xx00) RT Image Isocenter Position
 - (3273,xx01) RT Image Patient Position
 - (3263,xx01) Referenced Structure Set Relationship Sequence
- Referenced in the *Varian System Server DICOM Conformance Statement*:
 - (3253,xx01)
 - (3253,xx02)

A.3 Coded Terminology and Templates

A.3.1 Context Groups

Information will be published in a future version of this document.

A.3.2 Template Specifications

No standard templates are extended and no private templates are used.

A.3.3 Private Code Definitions

There are no private code definitions.

A.4 Grayscale Image Consistency

Not supported.

A.5 Standard Extended/Specialized/Private SOP Classes

Not used.

A.6 Private Transfer Syntaxes

No private transfer syntaxes are used.

Appendix B - IOD Details

B.1 Supported IODs

For better correlation with the DICOM Standard, the subsection headings in this section include the corresponding section in the DICOM Standard.

B.1.1 Computed Tomography Image – A.3.3

IE	Module	Reference	DICOM Usage	Support
Patient	Patient	C.7.1.1	M	
Patient	Clinical Trial Subject	C.7.1.3	U	Not supported
Study	General Study	C.7.2.1	M	
Study	Patient Study	C.7.2.2	U	Not supported
Study	Clinical Trial Study	C.7.2.3	U	Not supported
Series	General Series	C.7.3.1	M	
Series	Clinical Trial Series	C.7.3.2	U	Not supported
Frame of Reference	Frame of Reference	C.7.4.1	M	
Equipment	General Equipment	C.7.5.1	M	
Image	General Image	C.7.6.1	M	
Image	Image Plane	C.7.6.2	M	
Image	Image Pixel	C.7.6.3	M	
Image	Contrast/Bolus	C.7.6.4	C	Not supported
Image	Device	C.7.6.12	U	Not supported
Image	Specimen	C.7.6.22	U	Not supported
Image	CT Image	C.8.2.1	M	
Image	Overlay Plane	C.9.2	U	Not supported
Image	VOI LUT	C.11.2	U	
Image	SOP Common	C.12.1	M	

IE	Module	Reference	DICOM Usage	Support
Image	Common Instance Reference	C.12.2	U	Not supported

B.1.2 Spatial Registration – A.39.1.3

IE	Module	Reference	DICOM Usage	Support
Patient	Patient	C.7.1.1	M	
Patient	Clinical Trial Subject	C.7.1.3	U	Not supported
Study	General Study	C.7.2.1	M	
Study	Patient Study	C.7.2.2	U	Not supported
Study	Clinical Trial Study	C.7.2.3	U	Not supported
Series	General Series	C.7.3.1	M	
Series	Clinical Trial Series	C.7.3.2	U	Not supported
Series	Spatial Registration Series	C.20.1	M	
Frame of Reference	Frame of Reference	C.7.4.1	M	
Equipment	General Equipment	C.7.5.1	M	
Spatial Registration	Spatial Registration	C.20.2	M	
Spatial Registration	Common Instance Reference	C.12.2	M	
Spatial Registration	SOP Common	C.12.1	M	

B.1.3 RT Structure Set – A.19.3

IE	Module	Reference	DICOM Usage	Support
Patient	Patient	C.7.1.1	M	
Patient	Clinical Trial Subject	C.7.1.3	U	Not supported
Study	General Study	C.7.2.1	M	
Study	Patient Study	C.7.2.2	U	Not supported
Study	Clinical Trial Study	C.7.2.3	U	Not supported
Series	RT Series	C.8.8.1	M	

IE	Module	Reference	DICOM Usage	Support
Series	Clinical Trial Series	C.7.3.2	U	Not supported
Equipment	General Equipment	C.7.5.1	M	
Structure Set	Structure Set	C.8.8.5	M	
Structure Set	ROI Contour	C.8.8.6	M	
Structure Set	RT ROI Observations	C.8.8.8	M	
Structure Set	Approval	C.8.8.16	U	
Structure Set	SOP Common	C.12.1	M	
Structure Set	Common Instance Reference	C.12.2	U	Not supported

B.1.4 RT Image – A.17.3

IE	Module	Reference	DICOM Usage	Support
Patient	Patient	C.7.1.1	M	
Patient	Clinical Trial Subject	C.7.1.3	U	Not supported
Study	General Study	C.7.2.1	M	
Study	Patient Study	C.7.2.2	U	Not supported
Study	Clinical Trial Study	C.7.2.3	U	Not supported
Series	RT Series	C.8.8.1	M	
Series	Clinical Trial Series	C.7.3.2	U	Not supported
Frame of Reference	Frame of Reference	C.7.4.1	U	Supported and required for Import
Equipment	General Equipment	C.7.5.1	M	
Image	General Image	C.7.6.1	M	
Image	Image Pixel	C.7.6.3	M	
Image	Contrast/Bolus	C.7.6.4	C	Not supported
Image	Cine	C.7.6.5	C	Not supported
Image	Multi Frame	C.7.6.6	C	Not supported
Image	Device	C.7.6.12	U	Not supported
Image	RT Image	C.8.8.2	M	

IE	Module	Reference	DICOM Usage	Support
Image	Modality LUT	C.11.1	U	
Image	VOI LUT	C.11.2	U	
Image	Approval	C.8.8.16	U	Not supported
Image	Curve (Retired)	C.10.2	U	Not supported
Image	SOP Common	C.12.1	M	
Image	Common Instance Reference	C.12.2	U	Not supported
Image	Frame Extraction	C.12.3	C	Not supported
Extended Interface	Extended Interface	N/A	U	Private

B.2 Modules and Attributes

For better correlation with the DICOM Standard, the subsection headings in this section include the corresponding section in the DICOM Standard.

The first four columns in the following tables contain definitions from the DICOM standard. References in those columns refer to the DICOM standard and not to this document.

The **Handling** column describes for each attribute whether it is supported and the value in the ProBeam Imaging system to which it maps. A value of "Not Supported" indicates that an attribute is unknown and therefore ignored by the application.

The application creates objects of the types RT Image, CT Image, RT Structure Set, and Spatial Registration. These objects are exported through DICOM; therefore, only the export is described in the tables.

B.2.1 Patient – C.7.1.1

Attribute Name	Tag	Type	Description	Handling
Patient's Name	(0010,0010)	2	Patient's full name.	Supported
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient.	Supported
Issuer of Patient ID	(0010,0021)	3	Identifier of the Assigning Authority that issued the Patient ID.	Not supported
Patient's Birth Date	(0010,0030)	2	Birth date of the patient.	Supported

Attribute Name	Tag	Type	Description	Handling
Patient's Sex	(0010,0040)	2	Sex of the named patient. Enumerated Values: M = male F = female O = other	Supported Export: 'Female': F, 'Male': M, anything else: O
Referenced Patient Sequence	(0008,1120)	3	A sequence that provides reference to a Patient SOP Class/ Instance pair. Only a single Item shall be permitted in this Sequence.	Not supported
<i>> Content of not supported sequence is not listed.</i>				
Patient's Birth Time	(0010,0032)	3	Birth time of the Patient.	Supported
Other Patient IDs	(0010,1000)	3	Other identification numbers or codes used to identify the patient.	Not supported
Other Patient Names	(0010,1001)	3	Other names used to identify the patient.	Not supported
Ethnic Group	(0010,2160)	3	Ethnic group or race of the patient.	Not supported
Patient Comments	(0010,4000)	3	User-defined additional information about the patient.	Not supported
Patient Identify Removed	(0012,0062)	3	The true identity of the patient has been removed from the Attributes and the Pixel Data Enumerated Values: YES NO	Not supported
De-identification Method	(0012,0063)	1C	A description or label of the mechanism or method use to remove the patient's identity. May be multi-valued if successive de-identification steps have been performed. Note: This may be used to describe the extent or thoroughness of the de- identification, for example whether or not the de-identification is for a "Limited Data Set" (as per HIPAA Privacy Rule). Required if Patient Identity Removed (0012,0062) is present and has a value of YES and De-identification Method Code Sequence (0012,0064) is not present.	Not supported

Attribute Name	Tag	Type	Description	Handling
De-identification Method Code Sequence	(0012,0064)	1C	A code describing the mechanism or method use to remove the patient's identity. One or more Items shall be present. Multiple items are used if successive de-identification steps have been performed Required if Patient Identity Removed (0012,0062) is present and has a value of YES and De-identification Method (0012,0063) is not present.	Not supported
> Content of not supported sequence is not listed				

B.2.2 General Study - C.7.2.1

Attribute Name	Tag	Type	Description	Handling
Study Instance UID	(0020,000D)	1	Unique identifier for the Study.	Supported
Study Date	(0008,0020)	2	Date the Study started.	Supported
Study Time	(0008,0030)	2	Time the Study started.	Supported
Referring Physician's Name	(0008,0090)	2	Name of the patient's referring physician	Not supported
Referring Physician Identification Sequence	(0008,0096)	3	Identification of the patient's referring physician. Only a single item shall be permitted in this sequence.	Not supported
> Content of not supported sequence is not listed				
Study ID	(0020,0010)	2	User or equipment generated Study identifier.	Supported
Accession Number	(0008,0050)	2	A RIS generated number that identifies the order for the Study.	Supported
Study Description	(0008,1030)	3	Institution-generated description or classification of the Study (component) performed.	Supported
Physician(s) of Record	(0008,1048)	3	Names of the physician(s) who are responsible for overall patient care at time of Study (see Section C.7.3.1 for Performing Physician)	Not supported
Physician(s) of Record Identification Sequence	(0008,1049)	3	Identification of the physician(s) who are responsible for overall patient care at time of Study. One or more items shall be included in this sequence. If more than one Item, the number and order shall correspond to the value of Physician(s) of Record (0008,1048), if present.	Not supported

Attribute Name	Tag	Type	Description	Handling
<i>> Content of not supported sequence is not listed</i>				
Name of Physician(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study.	Not supported
Physician(s) Reading Study Identification Sequence	(0008,1062)	3	Identification of the physician(s) reading the Study. One or more items shall be included in this sequence. If more than one Item, the number and order shall correspond to the value of Name of Physician(s) Reading Study (0008,1060), if present.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Referenced Study Sequence	(0008,1110)	3	A sequence that provides reference to a Study SOP Class/ Instance pair. The sequence may have zero or more Items.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Procedure Code Sequence	(0008,1032)	3	A Sequence that conveys the type of procedure performed. One or more Items may be included in this Sequence.	Not supported
<i>> Content of not supported sequence is not listed</i>				

B.2.3 General Series – C.7.3.1

Attribute Name	Tag	Type	Description	Handling
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. See C.7.3.1.1.1 for Defined Terms.	Supported
Series Instance UID	(0020,000E)	1	Unique identifier of the Series.	Supported
Series Number	(0020,0011)	2	A number that identifies this Series.	Supported Export: A number incrementing with every series created throughout a session. It starts with 1 and is reset at the end of a session.

Attribute Name	Tag	Type	Description	Handling
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this image.	Not supported
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined. Required if the body part examined is a paired structure and Image Laterality (0020,0062) or Frame Laterality (0020,9072) are not sent. Enumerated Values: R = right L = left Note: Some IODs support Image Laterality (0020,0062) at the Image level or Frame Laterality(0020,9072) at the Frame level in the Frame Anatomy functional group macro, which can provide a more comprehensive mechanism for specifying the laterality of the body part(s) being examined.	Not supported
Series Date	(0008,0021)	3	Date the Series started.	Supported for: Computed Tomography Image Spatial Registration
Series Time	(0008,0031)	3	Time the Series started.	Supported for: Computed Tomography Image Spatial Registration
Performing Physician's Name	(0008,1050)	3	Name of the physician(s) administering the Series.	Not supported
Performing Physician Identification Sequence	(0008,1052)	3	Identification of the physician(s) administering the Series. One or more items shall be included in this sequence. If more than one Item, the number and order shall correspond to the value of Performing Physicians' Name (0008,1050), if present.	Not supported
<i>> Content of not supported sequence is not listed</i>				

Attribute Name	Tag	Type	Description	Handling
Protocol Name	(0018,1030)	3	User-defined description of the conditions under which the Series was performed. Note: This attribute conveys series-specific protocol identification and may or may not be identical to the one presented in the Performed Protocol Code Sequence (0040,0260).	Not supported
Series Description	(0008,103E)	3	User provided description of the Series	Not supported
Operators' Name	(0008,1070)	3	Name(s) of the operator(s) supporting the Series.	Supported Note: in case of acquired CBCTs the operator's name is not exported.
Operator Identification Sequence	(0008,1072)	3	Identification of the operator(s) supporting the Series. One or more items shall be included in this sequence. If more than one Item, the number and order shall correspond to the value of Operators' Name (0008,1070), if present.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Referenced Performed Procedure Step Sequence	(0008,1111)	3	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related (e.g. a Modality or General-Purpose Performed Procedure Step SOP Instance). The Sequence shall have zero or one Item.	Not supported
<i>> Content of not supported sequence is not listed</i>				

Attribute Name	Tag	Type	Description	Handling
Related Series Sequence	(0008,1250)	3	<p>Identification of Series significantly related to this Series. Zero or more Items may be present.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. For example, for a combined CT and PET acquisition, the CT images and PET images would be in separate series that could cross- reference each other with multiple purpose of reference codes meaning same anatomy, simultaneously acquired and same indication. 2. The related series may have different Frames of Reference and hence require some sort of registration before spatial coordinates can be directly compared. 3. This attribute is not intended for conveying localizer reference information, for which Referenced Image Sequence (0008,1140) should be used. 	Not supported
<i>> Content of not supported sequence is not listed</i>				
Body Part Examined	(0018,0015)	3	<p>Text description of the part of the body examined.</p> <p>Defined Terms: SKULL, CSPINE, TSPINE, LSPINE, SSPINE, COCCYX, CHEST, CLAVICLE, BREAST, ABDOMEN, PELVIS, HIP, SHOULDER, ELBOW, KNEE, ANKLE, HAND, FOOT, EXTREMITY, HEAD, HEART, NECK, LEG, ARM, JAW</p> <p>Note: Some IODs support the Anatomic Region Sequence (0008,2218), which can provide a more comprehensive mechanism for specifying the body part being examined.</p>	Not supported
Patient Position	(0018,5100)	2C	<p>Patient position descriptor relative to the equipment. Required for CT and MR images; shall not be present if Patient Orientation Code Sequence (0054,0410) is present; may be present otherwise. See C.7.3.1.1.2 for Defined Terms and further explanation.</p>	Supported for: RT Image Computed Tomography Image Spatial Registration
Smallest Pixel Value in Series	(0028,0108)	3	<p>The minimum value of all images in this Series.</p>	Not supported
Largest Pixel Value in Series	(0028,0109)	3	<p>The maximum value of all images in this Series.</p>	Not supported

Attribute Name	Tag	Type	Description	Handling
Request Attributes Sequence	(0040,0275)	3	Sequence that contains attributes from the Imaging Service Request. The sequence may have one or more Items.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Performed Procedure Step ID	(0040,0253)	3	User or equipment generated identifier of that part of a Procedure that has been carried out within this step.	Not supported
Performed Procedure Step Start Date	(0040,0244)	3	Date on which the Performed Procedure Step started.	Not supported
Performed Procedure Step Start Time	(0040,0245)	3	Time on which the Performed Procedure Step started.	Not supported
Performed Procedure Step Description	(0040,0254)	3	Institution-generated description or classification of the Procedure Step that was performed.	Not supported
Performed Protocol Code Sequence	(0040,0260)	3	Sequence describing the Protocol performed for this Procedure Step. One or more Items may be included in this Sequence.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Comments on the Performed Procedure Step	(0040,0280)	3	User-defined comments on the Performed Procedure Step.	Not supported

B.2.4 Frame of Reference – C.7.4.1

Attribute Name	Tag	Type	Description	Handling
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series. See C.7.4.1.1.1 for further explanation.	Supported
Position Reference Indicator	(0020,1040)	2	Part of the patient's anatomy used as a reference, such as the iliac crest, orbital- medial, sternal notch, symphysis pubis, xiphoid, lower costal margin, external auditory meatus. See C.7.4.1.1.2 for further explanation.	Supported Export: Empty

B.2.5 General Equipment – C.7.5.1

Attribute Name	Tag	Type	Description	Handling
Manufacturer	(0008,0070)	2	Manufacturer of the equipment that produced the composite instances.	Supported

Attribute Name	Tag	Type	Description	Handling
Institution Name	(0008,0080)	3	Institution where the equipment that produced the composite instances is located.	Not supported
Institution Address	(0008,0081)	3	Mailing address of the institution where the equipment that produced the composite instances is located.	Not supported
Station Name	(0008,1010)	3	User defined name identifying the machine that produced the composite instances.	Supported
Institutional Department Name	(0008,1040)	3	Department in the institution where the equipment that produced the composite instances is located.	Not supported
Manufacturer's Model Name	(0008,1090)	3	Manufacturer's model name of the equipment that produced the composite instances.	Supported
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the composite instances.	Not supported
Software Version(s)	(0018,1020)	3	Manufacturer's designation of software version of the equipment that produced the composite instances.	Supported
Spatial Resolution	(0018,1050)	3	The inherent limiting resolution in mm of the acquisition equipment for high contrast objects for the data gathering and reconstruction technique chosen. If variable across the images of the series, the value at the image center.	Not supported
Date of Last Calibration	(0018,1200)	3	Date when the image acquisition device calibration was last changed in any way. Multiple entries may be used for additional calibrations at other times. See C.7.5.1.1.1 for further explanation.	Not supported
Time of Last Calibration	(0018,1201)	3	Time when the image acquisition device calibration was last changed in any way. Multiple entries may be used. See C.7.5.1.1.1 for further explanation.	Not supported
Pixel Padding Value	(0028,0120)	1C	Single pixel value or one limit (inclusive) of a range of pixel values used in an image to pad to rectangular format or to signal background that may be suppressed. See C.7.5.1.1.2 for further explanation. Required if Pixel Padding Range Limit (0028,0121) is present. May be present otherwise. Note: The Value Representation of this Attribute is determined by the value of Pixel Representation (0028,0103).	Not supported

B.2.6 General Image – C.7.6.1

Attribute Name	Tag	Type	Description	Handling
Instance Number	(0020,0013)	2	A number that identifies this image. Note: This Attribute was named Image Number in earlier versions of this Standard.	Supported for: RT Image Computed Tomography Image
Patient Orientation	(0020,0020)	2C	Patient direction of the rows and columns of the image. Required if image does not require Image Orientation (Patient) (0020,0037) and Image Position (Patient) (0020,0032). See C.7.6.1.1.1 for further explanation. Note: IOD's may have attributes other than Patient Orientation, Image Orientation, or Image Position (Patient) to describe orientation in which case this attribute will be zero length.	Not supported
Content Date	(0008,0023)	2C	The date the image pixel data creation started. Required if image is part of a series in which the images are temporally related. Note: This Attribute was formerly known as Image Date.	Supported for: RT Image Computed Tomography Image
Content Time	(0008,0033)	2C	The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related.	Supported for: RT Image Computed Tomography Image

Attribute Name	Tag	Type	Description	Handling
Image Type	(0008,0008)	3	Image identification characteristics. See C.7.6.1.1.2 for Defined Terms and further explanation.	Supported for: RT Image Computed Tomography Image Export RT Image ORIGINAL\PRI-MARY\PORTAL Export Computed Tomography Image: ORIGINAL\PRI-MARY\AXIAL
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this image.	Supported for: RT Image Computed Tomography Image
Acquisition Date	(0008,0022)	3	The date the acquisition of data that resulted in this image started	Not supported
Acquisition Time	(0008,0032)	3	The time the acquisition of data that resulted in this image started	Not supported
Acquisition Datetime	(0008,002A)	3	The date and time that the acquisition of data that resulted in this image started. Note: The synchronization of this time with an external clock is specified in the Synchronization Module in Acquisition Time Synchronized (0018,1800).	Not supported
Referenced Image Sequence	(0008,1140)	3	A sequence that references other images significantly related to this image (e.g. post-localizer CT image or Mammographic biopsy or partial view images). One or more Items may be included in this sequence.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Derivation Description	(0008,2111)	3	A text description of how this image was derived. See C.7.6.1.1.3 for further explanation.	Not supported

Attribute Name	Tag	Type	Description	Handling
Derivation Code Sequence	(0008,9215)	3	A coded description of how this image was derived. See C.7.6.1.1.3 for further explanation. One or more Items may be included in this Sequence. More than one Item indicates that successive derivation steps have been applied.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Source Image Sequence	(0008,2112)	3	A Sequence that identifies the set of Image SOP Class/Instance pairs of the Images that were used to derive this Image. Zero or more Items may be included in this Sequence. See C.7.6.1.1.4 for further explanation.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Referenced Instance Sequence	(0008,114A)	3	Sequence specifying SOP Instances significantly related to the current SOP Instance.	Supported for: CT Image Export Reference to the plan in which context the CT Image was acquired.
> Referenced SOP Class UID	(0008,1150)	3	Uniquely identifies the referenced SOP Class.	Supported Export RT Ion Plan Storage
> Referenced SOP Instance UID	(0008,1155)	3	Uniquely identifies the referenced SOP Instance.	Supported Export UID of the RT Ion Plan
> Purpose of Reference Code Sequence	(0040,a170)	3	Describes the purpose for which the reference is made. Only a single Item shall be permitted in this sequence.	Supported
>> Code Value	(0008,0100)	1C	See Section 8.1. Required if a sequence item is present.	Supported Export Value set to 1000

Attribute Name	Tag	Type	Description	Handling
>> Coding Scheme Designator	(0008,0102)	1C	See Section 8.2. Required if a sequence item is present.	Supported Export Value set to 99VMS_PURPRE- FOBJ
>> Coding Scheme Version	(0008,0103)	1C	See Section 8.2. Required if a sequence item is present and the value of Coding Scheme Designator (0008,0102) is not sufficient to identify the Code Value (0008,0100) unambiguously.	Supported Export Value set to 1.0
>> Code Meaning	(0008,0104)	1C	See Section 8.3. Required if a sequence item is present.	Supported Export Value set to " RT Plan or RT Ion Plan or Radiation Set to be verified"
Images in Acquisition	(0020,1002)	3	Number of images that resulted from this acquisition of data	Not supported
Image Comments	(0020,4000)	3	User-defined comments about the image	Not supported
Quality Control Image	(0028,0300)	3	Indicates whether or not this image is a quality control or phantom image. Enumerated Values: YES NO If this Attribute is absent, then the image may or may not be a quality control or phantom image.	Not supported
Burned In Annotation	(0028,0301)	3	Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired. Enumerated Values: YES NO If this Attribute is absent, then the image may or may not contain burned in annotation.	Not supported

Attribute Name	Tag	Type	Description	Handling
Lossy Image Compression	(0028,2110)	3	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression. See C.7.6.1.1.5	Not supported
Lossy Image Compression Ratio	(0028,2112)	3	Describes the approximate lossy compression ratio(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied. Notes: 1. For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. 2. For historical reasons, the lossy compression ratio may also be described in Derivation Description (0008,2111).	Not supported
Lossy Image Compression Method	(0028,2114)	3	A label for the lossy compression method(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112). Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111).	Not supported
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image.	Not supported
> Content of not supported sequence is not listed				

Attribute Name	Tag	Type	Description	Handling
Presentation LUT Shape	(2050,0020)	3	When present, specifies an identity transformation for the Presentation LUT such that the output of all grayscale transformations, if any, are defined to be in P-Values. Enumerated Values are: IDENTITY = output is in P-Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME2 or any color photometric interpretation. INVERSE = output after inversion is in P- Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME1. When this attribute is used with a color photometric interpretation then the luminance component is in P-Values.	Not supported
Irradiation Event UID	(0008,3010)	3	Unique identification of the irradiation event(s) associated with the acquisition of this image. See C.7.6.1.1.7.	Supported

B.2.7 Image Plane – C.7.6.2

Attribute Name	Tag	Type	Description	Handling
Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.	Supported for: Computed Tomography Image
Image Orientation (Patient)	(0020,0037)	1	The direction cosines of the first row and the first column with respect to the patient. See C.7.6.2.1.1 for further explanation.	Supported for: Computed Tomography Image
Image Position (Patient)	(0020,0032)	1	The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm. See C.7.6.2.1.1 for further explanation.	Supported for: Computed Tomography Image
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.	Supported for: Computed Tomography Image
Slice Location	(0020,1041)	3	Relative position of exposure expressed in mm. C.7.6.2.1.2 for further explanation.	Not supported

B.2.8 Image Pixel – C.7.6.3

Attribute Name	Tag	Type	Description	Handling
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. See C.7.6.3.1.1 for further explanation.	Supported for: RT Image Computed Tomography Image Export Value set to 1.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.7.6.3.1.2 for further explanation.	Supported for: RT Image Computed Tomography Image Export Value set to MONO-CHROME2
Rows	(0028,0010)	1	Number of rows in the image.	Supported for: RT Image Computed Tomography Image
Columns	(0028,0011)	1	Number of columns in the image.	Supported for: RT Image Computed Tomography Image
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See PS 3.5 for further explanation.	Supported for: RT Image Computed Tomography Image
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See PS 3.5 for further explanation.	Supported for: RT Image Computed Tomography Image

Attribute Name	Tag	Type	Description	Handling
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See PS 3.5 for further explanation.	Supported for: RT Image Computed Tomography Image
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer. 0001H = 2's complement	Supported for: RT Image Computed Tomography Image
Pixel Data	(7FE0,0010)	1C	A data stream of the pixel samples that comprise the Image. See C.7.6.3.1.4 for further explanation. Required if Pixel Data Provider URL (0028,7FE0) is not present.	Supported for: RT Image Computed Tomography Image
Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1. See C.7.6.3.1.3 for further explanation.	Supported
Pixel Aspect Ratio	(0028,0034)	1C	Ratio of the vertical size and horizontal size of the pixels in the image specified by a pair of integer values where the first value is the vertical pixel size, and the second value is the horizontal pixel size. Required if the aspect ratio is not 1 and the Image Plane Module or the Pixel Measures Macro is not applicable to this Image. See C.7.6.3.1.7.	Not supported
Smallest Image Pixel Value	(0028,0106)	3	The minimum actual pixel value encountered in this image.	Not supported
Largest Image Pixel Value	(0028,0107)	3	The maximum actual pixel value encountered in this image.	Not supported
Red Palette Color Lookup Table Descriptor US or	(0028,1101)	1C	Specifies the format of the Red Palette Color Lookup Table Data (0028,1201) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.5 for further explanation.	Not supported

Attribute Name	Tag	Type	Description	Handling
Green Palette Color Lookup Table Descriptor US or	(0028,1102)	1C	Specifies the format of the Green Palette Color Lookup Table Data (0028,1202) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.5 for further explanation.	Not supported
Blue Palette Color Lookup Table Descriptor US or	(0028,1103)	1C	Specifies the format of the Blue Palette Color Lookup Table Data (0028,1203) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.5 for further explanation.	Not supported
Red Palette Color Lookup Table Data	(0028,1201)	1C	Red Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.6 for further explanation.	Not supported
Green Palette Color Lookup Table Data	(0028,1202)	1C	Green Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.6 for further explanation.	Not supported
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Blue Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or Pixel Presentation (0008,9205) at the image level equals COLOR or MIXED. See C.7.6.3.1.6 for further explanation.	Not supported
ICC Profile	(0028,2000)	3	An ICC Profile encoding the transformation of device-dependent color stored pixel values into PCS-Values. See Section C.11.15.1.1.1. When present, defines the color space of color Pixel Data (7FE0,0010) values, and the output of Palette Color Lookup Table. Data (0028,1201-1203). Note: The profile applies only to the Pixel Data (7FE0,0010) attribute at the same level of the dataset and not to any icons nested within sequences, which may or may not have their own ICC profile specified.	Not supported

Attribute Name	Tag	Type	Description	Handling
Pixel Data Provider URL	(0028,7FE0)	1C	A URL of a provider service that supplies the pixel data of the Image. Required if the image is to be transferred in one of the following presentation contexts identified by Transfer Syntax UID: 1.2.840.10008.1.2.4.94 (DICOM JPIP Referenced Transfer Syntax) 1.2.840.10008.1.2.4.95 (DICOM JPIP Referenced Deflate Transfer Syntax)	Not supported

B.2.9 CT Image – C.8.2.1

Attribute Name	Tag	Type	Description	Handling
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.2.1.1.1 for specialization.	Supported Export ORIGINAL\PRI-MARY\AXIAL
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. See C.8.2.1.1.2 for specialization.	Supported Export Value set to 1
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.8.2.1.1.3 for specialization.	Supported Export Value set to MONO-CHROME2
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See C.8.2.1.1.4 for specialization.	Supported
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See C.8.2.1.1.5 for specialization.	Supported
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See C.8.2.1.1.6 for specialization.	Supported

Attribute Name	Tag	Type	Description	Handling
Rescale Intercept	(0028,1052)	1	The value b in relationship between stored values (SV) and Hounsfield (HU). $HU = m \cdot SV + b$	Supported
Rescale Slope	(0028,1053)	1	m in the equation specified in Rescale Intercept (0028,1052).	Supported
KVP	(0018,0060)	2	Peak kilo voltage output of the x-ray generator used	Supported
Acquisition Number	(0020,0012)	2	A number identifying the single continuous gathering of data over a period of time which resulted in this image	Supported
Scan Options	(0018,0022)	3	Parameters of scanning sequence.	Supported
Data Collection Diameter	(0018,0090)	3	The diameter in mm of the region over which data were collected	Supported
Reconstruction Diameter	(0018,1100)	3	Diameter in mm of the region from within which data were used in creating the reconstruction of the image. Data may exist outside this region and portions of the patient may exist outside this region.	Supported
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center. Note: This value is traditionally referred to as Source Image Receptor Distance (SID).	Supported
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to isocenter (center of field of view). Note: This value is traditionally referred to as Source Object Distance (SOD).	Supported Export Value set to SAD.
Gantry/Detector Tilt	(0018,1120)	3	Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations.	Supported Export Value set to 0.
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation; below the center is positive.	Supported (See note below this table.)
Table Top Longitudinal Position	(300A,0129)	3	Table Top Longitudinal position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
Table Top Lateral Position	(300A,012A)	3	Table Top Lateral position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)

Attribute Name	Tag	Type	Description	Handling
Patient Support Angle	(300A,0122)	3	IEC PATIENT SUPPORT (turntable) coordinate system with respect to IEC FIXED REFERENCE coordinate system (degrees).	Supported (See note below this table.)
Table Top Pitch Angle	(300A,0140)	3	Table Top Pitch Angle, i.e., the rotation of the IEC TABLE TOP coordinate system about the X-axis of the IEC TABLE TOP coordinate system (degrees).	Supported (See note below this table.) Import: If missing, 0deg is assumed
Table Top Roll Angle	(300A,0144)	3	Table Top Roll Angle, i.e., the rotation of the IEC TABLE TOP coordinate system about the Y-axis of the IEC TABLE TOP coordinate system (degrees).	Supported (See note below this table.) Import: If missing, 0deg is assumed
Rotation Direction	(0018,1140)	3	Direction of rotation of the source when relevant, about nearest principal axis of equipment. Enumerated Values: CW = clockwise CC = counter clockwise	Supported
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec.	Supported
X-ray Tube Current	(0018,1151)	3	X-ray Tube Current in mA.	Supported
Exposure	(0018,1152)	3	The exposure expressed in mAs, for example calculated from Exposure Time and X-ray Tube Current.	Supported
Exposure in uAs	(0018,1153)	3	The exposure expressed in μ As, for example calculated from Exposure Time and X-ray Tube Current.	Not supported
Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam.	Supported
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.	Not supported
Focal Spot(s)	(0018,1190)	3	Size of the focal spot in mm. For devices with variable focal spot or multiple focal spots, small dimension followed by large dimension.	Supported
Convolution Kernel	(0018,1210)	3	A label describing the convolution kernel or algorithm used to reconstruct the data	Supported

Attribute Name	Tag	Type	Description	Handling
Revolution Time	(0018,9305)	3	The time in seconds of a complete revolution of the source around the gantry orbit.	Not supported
Single Collimation Width	(0018,9306)	3	The width of a single row of acquired data (in mm). Note: Adjacent physical detector rows may have been combined to form a single effective acquisition row.	Not supported
Total Collimation Width	(0018,9307)	3	The width of the total collimation (in mm) over the area of active x-ray detection. Note: This is equal the number of effective detector rows multiplied by single collimation width.	Not supported
Table Speed	(0018,9309)	3	The distance in mm that the table moves in one second during the gathering of data that resulted in this image.	Not supported
Table Feed per Rotation	(0018,9310)	3	Motion of the table (in mm) during a complete revolution of the source around the gantry orbit.	Not supported
Spiral Pitch Factor	(0018,9311)	3	Ratio of the Table Feed per Rotation (0018,9310) to the Total Collimation Width (0018,9307).	Not supported
Exposure Modulation Type	(0018,9323)	3	A label describing the type of exposure modulation used for the purpose of limiting the dose. Defined Terms: NONE	Not supported
Estimated Dose Saving	(0018,9324)	3	A percent value of dose saving due to the use of Exposure Modulation Type (0018,9323). A negative percent value of dose savings reflects an increase of exposure.	Not supported
CTDIvol	(0018,9345)	3	Computed Tomography Dose Index (CTDIvol), in mGy according to IEC 60601-2-44, Ed.2.1 (Clause 29.1.103.4), The Volume CTDIvol. It describes the average dose for this image for the selected CT conditions of operation.	Not supported
Anatomic Region Sequence	(0008,2218)	3	Sequence that identifies the anatomic region of interest in this Instance (i.e. external anatomy, surface anatomy, or general region of the body). Only a single Item shall be permitted in this sequence.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Primary Anatomic Structure Sequence	(0008,2228)	3	Sequence of Items that identifies the primary anatomic structure(s) of interest in this Instance. One or more Items may be included in this Sequence.	Not supported

Attribute Name	Tag	Type	Description	Handling
> Content of not supported sequence is not listed				

Note: Table Top Pitch and Roll are not rotations around the isocenter, but instead around the origin of the IEC TABLE TOP coordinate system that is translated with respect to the IEC PATIENT SUPPORT system by Table Top Lateral, Table Top Longitudinal Position, and negative Table Height. To correctly interpret the position and orientation of the Table Top relative to the isocenter, all six of the following values must be taken into account:

- Table Top Pitch Angle (300A,0140)
- Table Top Roll Angle (300A,0144)
- Patient Support Angle (300A,0122)
- Table Top Lateral Position (300A,012A)
- Table Top Longitudinal Position (300A,0129)
- Table Height (0018,1130)

B.2.10 RT Series – C.8.8.1

Attribute Name	Tag	Type	Description	Handling
Modality	(0008,0060)	1	Type of equipment that originally acquired the data. Enumerated Values: RTIMAGE - RT Image RTDOSE - RT Dose RTSTRUCT - RT Structure Set RTPLAN - RT Plan RTRECORD - RT Treatment Record	Supported
Series Instance UID	(0020,000E)	1	Unique identifier of the series.	Supported
Series Number	(0020,0011)	2	A number that identifies this series.	Supported
Series Date	(0008,0021)	3	Date the Series started.	Not supported
Series Time	(0008,0031)	3	Time the Series started.	Not supported
Series Description	(0008,103E)	3	Description of the series.	Not supported
Series Description Code Sequence	(0008,103F)	3	A coded description of the Series. Only a single Item is permitted in this sequence.	Not supported
> Content of not supported sequence is not listed				
Operators' Name	(0008,1070)	2	Name(s) of the operator(s) supporting the Series.	Not supported

Attribute Name	Tag	Type	Description	Handling
Referenced Performed Procedure Step Sequence	(0008,1111)	3	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related. One or more items are permitted in this sequence.	Not supported
> Content of not supported sequence is not listed				
Request Attributes Sequence	(0040,0275)	3	Sequence that contains attributes from the Imaging Service Request. One or more Items are permitted in this sequence.	Not supported
> Content of not supported sequence is not listed				
> Content of not supported sequence is not listed				

B.2.11 RT Image – C.8.8.2

Attribute Name	Tag	Type	Description	Handling
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. See C.8.8.2.6.1 for specialization.	Supported
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.7.6.3.1.2 for further explanation.	Supported Export Value set to MONO-CHROME2
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See PS 3.5 for further explanation.	Supported
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See PS 3.5 for further explanation.	Supported
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See PS 3.5 for further explanation.	Supported
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer. 0001H = 2's complement	Supported

Attribute Name	Tag	Type	Description	Handling
Pixel Intensity Relationship	(0028,1040)	3	The relationship between the Pixel sample values and the X-Ray beam intensity. Enumerated Values: LIN = Linearly proportional to X-Ray beam intensity LOG = Logarithmically proportional to X-Ray beam intensity See C.8.11.3.1.2 for further explanation.	Supported
Pixel Intensity Relationship Sign	(0028,1041)	1C	The sign of the relationship between the Pixel sample values stored in Pixel Data (7FE0,0010) and the X-Ray beam intensity. Required if Pixel Intensity Relationship (0028,1040) is present. Enumerated Values; 1 = Lower pixel values correspond to less X-Ray beam intensity -1 = Higher pixel values correspond to less X-Ray beam intensity See C.8.11.3.1.2 for further explanation.	Supported
RT Image Label	(3002,0002)	1	User-defined label for RT Image.	Supported Export Used as Image ID.
RT Image Name	(3002,0003)	3	User-defined name for RT Image.	Not supported
RT Image Description	(3002,0004)	3	User-defined description of RT Image.	Supported
Operators' Name	(0008,1070)	2	Name of operator(s) acquiring or creating RT Image.	Supported
Image Type	(0008,0008)	1	Image identification characteristics (see Section C.7.6.1.1.2). RT Images shall use one of the following Defined Terms for Value 3: DRR = digitally reconstructed radiograph PORTAL = digital portal image or portal film image SIMULATOR = conventional simulator image RADIOGRAPH = radiographic image BLANK = image pixels set to background value FLUENCE = fluence map	Supported Export ORIGINAL\PRI-MARY\PORTAL
Conversion Type	(0008,0064)	2	Describes the kind of image conversion. Defined Terms: DV = Digitized Video DI = Digital Interface DF = Digitized Film WSD = Workstation	Supported Value set to DI

Attribute Name	Tag	Type	Description	Handling
Reported Values Origin	(3002,000A)	2C	Describes the origin of the parameter values reported in the image. Required if Value 3 of Image Type (0008,0008) is SIMULATOR or PORTAL. Enumerated Values: OPERATOR = manually entered by operator PLAN = planned parameter values ACTUAL = electronically recorded	Supported Export Value set to ACTUAL
RT Image Plane	(3002,000C)	1	Describes whether or not image plane is normal to beam axis. Enumerated Values: NORMAL = image plane normal to beam axis NON_NORMAL = image plane non-normal to beam axis	Supported Export Value set to NORMAL
X-Ray Image Receptor Translation	(3002,000D)	3	Position in (x,y,z) coordinates of origin of IEC X-RAY IMAGE RECEPTOR System in the IEC GANTRY coordinate system (mm). See Note 2.	Supported
X-Ray Image Receptor Angle	(3002,000E)	2	X-Ray Image Receptor Angle i.e. orientation of IEC X-RAY IMAGE RECEPTOR coordinate system with respect to IEC GANTRY coordinate system (degrees). See C.8.8.2.2.	Supported
RT Image Orientation	(3002,0010)	2C	The direction cosines of the first row and the first column with respect to the IEC XRAY IMAGE RECEPTOR coordinate system. Required if RT Image Plane (3002,000C) is NON_NORMAL. May be present otherwise.	Supported
Image Plane Pixel Spacing	(3002,0011)	2	Physical distance (in mm) between the center of each image pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing. See C.8.8.2.3.	Supported
RT Image Position	(3002,0012)	2	The x and y coordinates (in mm) of the upper left hand corner of the image, in the IEC X-RAY IMAGE RECEPTOR coordinate system. This is the center of the first pixel transmitted. See C.8.8.2.7.	Supported
Radiation Machine Name	(3002,0020)	2	User-defined name identifying radiation machine used in acquiring or computing image (i.e. name of conventional simulator, electron accelerator, X-ray device, or machine modeled when calculating DRR).	Supported

Attribute Name	Tag	Type	Description	Handling
Primary Dosimeter Unit	(300A,00B3)	2	Measurement unit of machine dosimeter. Enumerated Values: MU = Monitor Unit MINUTE = minute	Supported Export Value set to: MINUTE
Radiation Machine SAD	(3002,0022)	2	Radiation source to Gantry rotation axis distance of radiation machine used in acquiring or computing image (mm).	Supported
Radiation Machine SSD	(3002,0024)	3	Source to patient surface distance (in mm) of radiation machine used in acquiring or computing image.	Not supported
RT Image SID	(3002,0026)	2	Distance from radiation machine source to image plane (in mm) along radiation beam axis. See C.8.8.2.3.	Supported
Source to Reference Object Distance	(3002,0028)	3	Source to reference object distance (in mm), as used for magnification calculation of RADIOGRAPH and SIMULATOR images.	Not supported
Referenced RT Plan Sequence	(300C,0002)	3	Introduces sequence of one Class/Instance pair describing RT Plan associated with image. Only a single item shall be permitted in this sequence.	Supported
> Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced RT Plan Sequence (300C,0002) is sent.	Supported Export Supported values: SOP Class UID of RT Ion Plan.
> Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced RT Plan Sequence (300C,0002) is sent.	Supported Export Plan UID of the plan where this image is a field image.
Referenced Beam Number	(300C,0006)	3	Uniquely identifies the corresponding N- segment treatment beam specified by Beam Number (300A,00C0) within Beam Sequence in RT Beams Module within the RT Plan referenced in Referenced RT Plan Sequence (300C,0002).	Supported
Referenced Fraction Group Number	(300C,0022)	3	Identifier of Fraction Group within RT Plan referenced in Referenced RT Plan Sequence (300C,0002).	Supported

Attribute Name	Tag	Type	Description	Handling
Fraction Number	(3002,0029)	3	Fraction Number of fraction during which image was acquired, within Fraction Group referenced by Referenced Fraction Group Number (300C,0022) within RT Plan referenced in Referenced RT Plan Sequence (300C,0002).	Supported
Start Cumulative Meterset Weight	(300C,0008)	3	Cumulative Meterset Weight within Beam referenced by Referenced Beam Number (300C,0006) at which image acquisition starts.	Supported
End Cumulative Meterset Weight	(300C,0009)	3	Cumulative Meterset Weight within Beam referenced by Referenced Beam Number (300C,0006) at which image acquisition ends.	Supported
Exposure Sequence	(3002,0030)	3	Introduces sequence of Exposure parameter sets, corresponding to exposures used in generating the image. One or more items may be included in this sequence. See C.8.8.2.4.	Supported
> Referenced Frame Number	(0008,1160)	1C	Identifies corresponding image frame in multi-frame image. Required if Exposure Sequence (3002,0030) is sent, there is more than one item in Exposure Sequence (3002,0030), and image is a multi-frame image.	Supported
> KVP	(0018,0060)	2C	Peak kilo voltage output (kV) of X-ray generator used to acquire image. Required if Value 3 of Image Type (0008,0008) is PORTAL, SIMULATOR or RADIOGRAPH and Exposure Sequence (3002,0030) is sent.	Supported
> X-ray Tube Current	(0018,1151)	2C	Imaging device X-ray Tube Current (mA). Required if Value 3 of Image Type (0008,0008) is SIMULATOR or RADIOGRAPH and Exposure Sequence (3002,0030) is sent.	Supported
> Exposure Time	(0018,1150)	2C	Time of X-ray exposure (msec). Required if Value 3 of Image Type (0008,0008) is SIMULATOR or RADIOGRAPH and Exposure Sequence (3002,0030) is sent.	Supported
> Meterset Exposure	(3002,0032)	2C	Treatment machine Meterset duration over which image has been acquired, specified in Monitor units (MU) or minutes as defined by Primary Dosimeter Unit (300A,00B3). Required if Value 3 of Image Type (0008,0008) is PORTAL and Exposure Sequence (3002,0030) is sent.	Supported

Attribute Name	Tag	Type	Description	Handling
> Diaphragm Position	(3002,0034)	3	Positions of diaphragm jaw pairs (in mm) in IEC BEAM LIMITING DEVICE coordinate axis in the IEC order X1, X2, Y1, Y2.	Not supported
> Beam Limiting Device Sequence	(300A,00B6)	3	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) positions for given exposure. One or more items may be included in this sequence.	Supported
>> RT Beam Limiting Device Type	(300A,00B8)	1C	Type of beam limiting device (collimator). Required if Beam Limiting Device Sequence (300A,00B6) is sent. Enumerated Values: X = symmetric jaw pair in IEC X direction Y = symmetric jaw pair in IEC Y direction ASYMX = asymmetric jaw pair in IEC X direction ASYMY = asymmetric pair in IEC Y direction MLCX = multileaf (multi-element) jaw pair in IEC X direction MLCY = multileaf (multi-element) jaw pair in IEC Y direction	Supported Supported values: X, Y, ASYMX, ASYMY.
>> Source to Beam Limiting Device Distance	(300A,00BA)	3	Radiation source to beam limiting device (collimator) distance (mm).	Not supported
>> Number of Leaf/Jaw Pairs	(300A,00BC)	1C	Number of leaf (element) or jaw pairs (equal to 1 for standard beam limiting device jaws). Required if Beam Limiting Device Sequence (300A,00B6) is sent.	Supported
>> Leaf Position Boundaries	(300A,00BE)	2C	Boundaries (in mm) of beam limiting device (collimator) leaves (elements) in IEC BEAM LIMITING DEVICE coordinate axis appropriate to RT Beam Limiting Device Type (300A,00B8), i.e. X-axis for MLCY, Y- axis for MLCX. Contains N+1 values, where N is the Number of Leaf/Jaw Pairs (300A,00BC), starting from Leaf (Element) Pair 1. Required if RT Beam Limiting Device Type (300A,00B8) is MLCX or MLCY.	Not supported

Attribute Name	Tag	Type	Description	Handling
>> Leaf/Jaw Positions	(300A,011C)	1C	Positions of beam limiting device (collimator) leaf or jaw (element) pairs (in mm) in IEC BEAM LIMITING DEVICE coordinate axis appropriate to RT Beam Limiting Device Type (300A,00B8), e.g. X- axis for MLCX, Y-axis for MLCY). Contains 2N values, where N is the Number of Leaf/Jaw Pairs (300A,00BC), in IEC leaf (element) subscript order 101, 102, ... 1N, 201, 202, ... 2N. Required if Beam Limiting Device Sequence (300A,00B6) is sent.	Supported
> Applicator Sequence	(300A,0107)	3	Introduces sequence of Applicators associated with Beam. Only a single item shall be permitted in this sequence.	Not supported
>> <i>Content of not supported sequence is not listed</i>				
> Number of Blocks	(300A,00F0)	1C	Number of shielding blocks associated with Beam. Required if Exposure Sequence (3002,0030) is sent.	Supported Export Value always 0.
> Block Sequence	(300A,00F4)	2C	Introduces sequence of blocks associated with Beam. Required if Number of Blocks (300A,00F0) is non-zero. One or more items may be included in this sequence.	Not supported
>> <i>Content of not supported sequence is not listed</i>				
> Primary Fluence Mode Sequence	(3285,XX00)	3	Sequence defining whether the primary fluence of the treatment beam uses a non-standard fluence-shaping. Only a single Item shall be permitted in this sequence.	Not supported
>> <i>Content of not supported sequence is not listed</i>				
> Gantry Angle	(300A,011E)	3	Treatment machine gantry angle, i.e. orientation of IEC GANTRY coordinate system with respect to IEC FIXED REFERENCE coordinate system (degrees).	Supported
> Beam Limiting Device Angle	(300A,0120)	3	Treatment machine beam limiting device (collimator) angle, i.e. orientation of IEC BEAM LIMITING DEVICE coordinate system with respect to IEC GANTRY coordinate system (degrees).	Supported
> Patient Support Angle	(300A,0122)	3	Patient Support angle, i.e. orientation of IEC PATIENT SUPPORT coordinate system with respect to IEC FIXED REFERENCE coordinate system (degrees).	Supported (See note below this table.)

Attribute Name	Tag	Type	Description	Handling
> Table Top Vertical Position	(300A,0128)	3	Table Top Vertical position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
> Table Top Longitudinal Position	(300A,0129)	3	Table Top Longitudinal position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
> Table Top Lateral Position	(300A,012A)	3	Table Top Lateral position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
> Table Top Pitch Angle	(300A,0140)	3	Table Top Pitch Angle in IEC TABLE TOP coordinate system (deg)	Supported (See note below this table.)
> Table Top Roll Angle	(300A,0144)	3	Table Top Roll Angle in IEC TABLE TOP coordinate system (deg)	Supported (See note below this table.)
Fluence Map Sequence	(3002,0040)	1C	A Sequence of data describing the fluence map attributes for a radiotherapy beam. Only one item may be included in this sequence. Required if the third value of Image Type (0008,0008) is FLUENCE.	Not supported
<i>>> Content of not supported sequence is not listed</i>				
Gantry Angle	(300A,011E)	3	Treatment machine gantry angle, i.e. orientation of IEC GANTRY coordinate system with respect to IEC FIXED REFERENCE coordinate system (degrees).	Supported
Beam Limiting Device Angle	(300A,0120)	3	Treatment machine beam limiting device (collimator) angle, i.e. orientation of IEC BEAM LIMITING DEVICE coordinate system with respect to IEC GANTRY coordinate system (degrees).	Supported

Attribute Name	Tag	Type	Description	Handling
Patient Support Angle	(300A,0122)	3	Patient Support angle, i.e. orientation of IEC PATIENT SUPPORT coordinate system with respect to IEC FIXED REFERENCE coordinate system (degrees).	Supported (See note below this table.)
Table Top Eccentric Axis Distance	(300A,0124)	3	Distance (positive) from the IEC PATIENT SUPPORT vertical axis to the IEC TABLE TOP ECCENTRIC vertical axis (mm).	Not supported
Table Top Eccentric Angle	(300A,0125)	3	Table Top (non-isocentric) angle, i.e. orientation of IEC TABLE TOP ECCENTRIC coordinate system with respect to IEC PATIENT SUPPORT system (degrees).	Not supported
Table Top Vertical Position	(300A,0128)	3	Table Top Vertical position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
Table Top Longitudinal Position	(300A,0129)	3	Table Top Longitudinal position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
Table Top Lateral Position	(300A,012A)	3	Table Top Lateral position in IEC TABLE TOP coordinate system (mm).	Supported (See note below this table.)
Isocenter Position	(300A,012C)	3	Isocenter coordinates (x,y,z), in mm. Specifies the location of the machine isocenter in the patient-based coordinate system associated with the Frame of Reference. It allows transformation from the equipment-based IEC coordinate system to the patient-based coordinate system.	Supported
Table Top Pitch Angle	(300A,0140)	3	Table Top Pitch Angle in IEC TABLE TOP coordinate system (deg)	Supported (See note below this table.) Import: If missing, 0 deg is assumed

Attribute Name	Tag	Type	Description	Handling
Table Top Roll Angle	(300A,0144)	3	Table Top Roll Angle in IEC TABLE TOP coordinate system (deg)	Supported (See note below this table.) Import: If missing, 0deg is assumed
Patient Position	(0018,5100)	1C	<p>Patient position descriptor relative to the patient support device.</p> <p>Required if Isocenter Position (300A,012C) is present. May be present otherwise. See Section C.7.3.1.1.2 for Defined Terms and further explanation.</p> <p>Note: The orientation of the patient relative to the patient support device is denoted in the same manner as in the RT Patient Setup module. It defines the relation of the patient-based DICOM coordinate system identified by the frame of reference module of the RT Image to the IEC coordinate system and together with the Isocenter Position (300A,012C) allows the RT Image to be placed into the patient frame of reference. It also allows a system using an RT Image to verify that the patient is setup in a similar position relative to the patient support device.</p>	Supported
RT Image Isocenter Position	(3273,XX00)	3	The isocenter position in the FOR as defined in the FOR module. For DRRs, this is typically the FOR of the diagnostic image and the isocenter coordinate correspond to those of the associated beam. For treatment / simulator images, the acquisition systems create the FOR and define it's origin (typically the isocenter position of the first image acquired).	Supported
RT Image Patient Position	(3273,XX01)	3	The patient position at the time, when the image was taken (or created in case of DRRs).	Supported

Attribute Name	Tag	Type	Description	Handling
LT Archive Primary Reference Image Flag	(3279,XX00)	3	If present indicates if image is primary reference image of beam referenced by Referenced RT Plan Sequence (300C,0002) and Referenced Beam Number (300C,0006). If absent then it is not a primary reference image. Enumerated Values: PRIMARY NOT_PRIMARY	Not supported

Note: Table Top Pitch and Roll are not rotations around the isocenter, but instead around the origin of the IEC TABLE TOP coordinate system that is translated with respect to the IEC PATIENT SUPPORT system by Table Top Lateral, Longitudinal, and Vertical Position. To correctly interpret the position and orientation of the Table Top relative to the isocenter, all six of the following values must be taken into account:

- Table Top Pitch Angle (300A,0140)
- Table Top Roll Angle (300A,0144)
- Patient Support Angle (300A,0122)
- Table Top Lateral Position (300A,012A)
- Table Top Longitudinal Position (300A,0129)
- Table Top Vertical Position (300A,0128)

B.2.12 Structure Set – C.8.8.5

Attribute Name	Tag	Type	Description	Handling
Structure Set Label	(3006,0002)	1	User-defined label for Structure Set.	Supported
Structure Set Name	(3006,0004)	3	User-defined name for Structure Set.	Not supported
Structure Set Description	(3006,0006)	3	User-defined description for Structure Set.	Not supported
Instance Number	(0020,0013)	3	A number that identifies this object instance.	Supported
Structure Set Date	(3006,0008)	2	Date at which Structure Set was last modified.	Supported

Attribute Name	Tag	Type	Description	Handling
Structure Set Time	(3006,0009)	2	Time at which Structure Set was last modified.	Supported
Referenced Frame of Reference Sequence	(3006,0010)	3	Introduces sequence of items describing Frames of Reference in which the ROIs are defined. One or more items may be included in this sequence. See C.8.8.5.1.	Supported
> Frame of Reference UID	(0020,0052)	1C	Uniquely identifies Frame of Reference within Structure Set. Required if Referenced Frame of Reference Sequence (3006,0010) is sent.	Supported
> Frame of Reference Relationship Sequence	(3006,00C0)	3	Introduces sequence of transforms that relate other Frames of Reference to this Frame of Reference.	Not supported
<i>>> Content of not supported sequence is not listed</i>				
> RT Referenced Study Sequence	(3006,0012)	3	Introduces sequence of Studies containing series to be referenced. One or more items may be included in this sequence.	Supported
>> Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if RT Referenced Study Sequence (3006,0012) is sent.	Supported
>> Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if RT Referenced Study Sequence (3006,0012) is sent.	Supported
>> RT Referenced Series Sequence	(3006,0014)	1C	Introduces sequence of items describing series of images within the referenced study which are used in defining the Structure Set. Required if RT Referenced Study Sequence (3006,0012) is sent. One or more items may be included in this sequence.	Supported
>>> Series Instance UID	(0020,000E)	1C	Unique identifier for the series containing the images. Required if RT Referenced Series Sequence (3006,0014) is sent.	Supported
>>> Contour Image Sequence	(3006,0016)	1C	Introduces sequence of items describing images in a given series used in defining the Structure Set (typically CT or MR images). Required if RT Referenced Series Sequence (3006,0014) is sent. One or more items may be included in this sequence.	Supported
>>>> Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Supported
>>>> Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Supported

Attribute Name	Tag	Type	Description	Handling
>>>> Referenced Frame Number	(0008,1160)	1	Identifies the frame numbers within the Referenced SOP Instance to which the reference applies. The first frame shall be denoted as frame number 1. Note: This Attribute may be multi-valued. Required if the Referenced SOP Instance is a multi-frame image and the reference does not apply to all frames.	Not supported
Structure Set ROI Sequence	(3006,0020)	3	Introduces sequence of ROIs for current Structure Set. One or more items may be included in this sequence.	Supported
> ROI Number	(3006,0022)	1C	Identification number of the ROI. The value of ROI Number (3006,0022) shall be unique within the Structure Set in which it is created. Required if Structure Set ROI Sequence (3006,0020) is sent.	Supported
> Referenced Frame of Reference UID	(3006,0024)	1C	Uniquely identifies Frame of Reference in which ROI is defined, specified by Frame of Reference UID (0020,0052) in Referenced Frame of Reference Sequence (3006,0010). Required if Structure Set ROI Sequence (3006,0020) is sent.	Supported
> ROI Name	(3006,0026)	2C	User-defined name for ROI. Required if Structure Set ROI Sequence (3006,0020) is sent.	Supported
> ROI Description	(3006,0028)	3	User-defined description for ROI.	Not supported
> ROI Volume	(3006,002C)	3	Volume of ROI (cubic centimeters).	Not supported
> ROI Generation Algorithm	(3006,0036)	2C	Type of algorithm used to generate ROI. Required if Structure Set ROI Sequence (3006,0020) is sent. Defined Terms: AUTOMATIC = calculated ROI SEMIAUTOMATIC = ROI calculated with user assistance MANUAL = user-entered ROI	Supported
> ROI Generation Description	(3006,0038)	3	User-defined description of technique used to generate ROI.	Not supported
ROI Contour Sequence	(3006,0039)	1	Introduces sequence of Contour Sequences defining ROIs. One or more items may be included in this sequence.	Supported
> Referenced ROI Number	(3006,0084)	1	Uniquely identifies the referenced ROI described in the Structure Set ROI Sequence (3006,0020).	Supported

Attribute Name	Tag	Type	Description	Handling
> ROI Display Color	(3006,002A)	3	RGB triplet color representation for ROI, specified using the range 0-255.	Supported
> Contour Sequence	(3006,0040)	3	Introduces sequence of Contours defining ROI. One or more items may be included in this sequence.	Supported
>>> Contour Image Sequence	(3006,0016)	1C	Introduces sequence of items describing images in a given series used in defining the Structure Set (typically CT or MR images). Required if RT Referenced Series Sequence (3006,0014) is sent. One or more items may be included in this sequence.	Supported
>>>> Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Supported
>>>> Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Supported
>> Contour Geometric Type	(3006,0042)	1	Geometric type of contour. Enumerated Values: POINT = single point	Supported
>> Number of Contour Points	(3006,0046)	1	Number of points (triplets) in Contour Data (3006,0050).	Supported
>> Contour Number	(3006,0048)	3	Identification number of the contour. The value of Contour Number (3006,0048) shall be unique within the Contour Sequence (3006,0040) in which it is defined. No semantics or ordering shall be inferred from this attribute.	Not supported
>> Contour Data	(3006,0050)	1	Sequence of (x,y,z) triplets defining a contour in the patient based coordinate system (mm). Note: Contour Data may not be properly encoded if Explicit-VR transfer syntax is used and the VL of this attribute exceeds 65534 bytes.	Supported
RT ROI Observations Sequence	(3006,0080)	1	Introduces sequence of observations related to ROIs defined in the ROI Module. One or more items may be included in this sequence.	Supported
> Observation Number	(3006,0082)	1	Identification number of the Observation. The value of Observation Number (3006,0082) shall be unique within the RT ROI Observations Sequence (3006,0080).	Supported
> Referenced ROI Number	(3006,0084)	1	Uniquely identifies the referenced ROI described in the Structure Set ROI Sequence (3006,0020).	Supported

Attribute Name	Tag	Type	Description	Handling
> ROI Observation Label	(3006,0085)	3	User-defined label for ROI Observation. Defined Terms: InitLaserIso InitMatchIso AcqIsocenter	Supported
> RT ROI Interpreted Type	(3006,00A4)	2	Type of ROI. Defined Terms: INITLASERISO INITMATCHISO ACQ_ISOCENTER	Supported
> ROI Interpreter	(3006,00A6)	2	Name of person performing the interpretation.	Supported
> ROI Physical Properties Sequence	(3006,00B0)	3	Introduces sequence describing physical properties associated with current ROI interpretation. One or more items may be included in this sequence.	Supported
>> ROI Physical Property	(3006,00B2)	1	Physical property specified by ROI Physical Property Value (3006,00B4). Defined Terms: PAT SUPPORT_ANGLE T TOP_PITCH_ANGLE T TOP_ROLL_ANGLE	Supported
>> ROI Physical Property Value	(3006,00B4)	1	User-assigned value for physical property.	Supported
Referenced Structure Set Relationship Sequence	(3263,XX01)	3	Introduces sequence of related SOP Class/Instance pairs describing related instances of structure sets. One or more items may be included in this sequence.	Supported Export This sequence is exported for structure sets created during marker detection only.
> Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Supported
> Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Supported

Attribute Name	Tag	Type	Description	Handling
> Structure Set Relationship	(3263,XX02)	3	Relationship of referenced structure set with respect to current structure set. Required if Referenced Structure Set Sequence (3263,1002) is sent. Defined Terms: PREDECESSOR = structure set used in derivation of current structure set ADDITION = structure set, for which the current structure set is an addition	Supported Export ADDITION is used for new marker structures defined during marker detection

B.2.13 Approval – C.8.8.16

Attribute Name	Tag	Type	Description	Handling
Approval Status	(300E,0002)	1	Instance was created. Enumerated Values: APPROVED = Reviewer recorded that object met an implied criterion UNAPPROVED = No review of object has been recorded REJECTED = Reviewer recorded that object failed to meet an implied criterion	Supported in RT Structure Set Export: value always UNAPPROVED
Review Date	(300E,0004)	2C	Date on which object was reviewed. Required if Approval Status (300E,0002) is APPROVED or REJECTED.	Not supported
Review Time	(300E,0005)	2C	Time at which object was reviewed. Required if Approval Status (300E,0002) is APPROVED or REJECTED.	Not supported
Reviewer Name	(300E,0008)	2C	Name of person who reviewed object. Required if Approval Status (300E,0002) is APPROVED or REJECTED.	Not supported

B.2.14 Modality LUT – C.11.1

Attribute Name	Tag	Type	Description	Handling
Modality LUT Sequence	(0028,3000)	1C	Defines a sequence of Modality LUTs. Only one Item may be present. Shall not be present if Rescale Intercept (0028,1052) is present.	Not supported
<i>> Content of not supported sequence is not listed</i>				
Rescale Intercept	(0028,1052)	1C	The value b in relationship between stored values (SV) and the output units specified in Rescale Type (0028,1054). Output units = $m \cdot SV + b$. Required if Modality LUT Sequence (0028,3000) is not present. Shall not be present otherwise.	Supported for: RT Image
Rescale Slope	(0028,1053)	1C	m in the equation specified by Rescale Intercept (0028,1052). Required if Rescale Intercept is present.	Supported for: RT Image
Rescale Type	(0028,1054)	1C	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). See C.11.1.1.2 for further explanation. Required if Rescale Intercept is present.	Supported Export Defined Terms supported: HU = Hounsfield Units All other values are mapped to US.

B.2.15 VOI LUT – C.11.2

Attribute Name	Tag	Type	Description	Handling
VOI LUT Sequence	(0028,3010)	1C	Defines a sequence of VOI LUTs. One or more Items shall be present. Required if Window Center (0028,1050) is not present. May be present otherwise	Not supported
<i>> Content of not supported sequence is not listed</i>				

Attribute Name	Tag	Type	Description	Handling
Window Center	(0028,1050)	1C	Window Center for display. See C.11.2.1.2 for further explanation. Required if VOI LUT Sequence (0028,3010) is not present. May be present otherwise.	Supported
Window Width	(0028,1051)	1C	Window Width for display. See C.11.2.1.2 for further explanation. Required if Window Center (0028,1050) is sent	Supported

B.2.16 SOP Common – C.12.1

Attribute Name	Tag	Type	Description	Handling
SOP Class UID	(0008,0016)	1	Uniquely identifies the SOP Class. See C.12.1.1.1 for further explanation. See also PS 3.4.	Supported
SOP Instance UID	(0008,0018)	1	Uniquely identifies the SOP Instance. See C.12.1.1.1 for further explanation. See also PS 3.4.	Supported
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set. Required if an expanded or replacement character set is used. See C.12.1.1.2 for Defined Terms.	Not supported
Instance Creation Date	(0008,0012)	3	Date the SOP Instance was created.	Supported.
Instance Creation Time	(0008,0013)	3	Time the SOP Instance was created.	Supported

B.2.17 Common Instance Reference – C.12.2

Attribute Name	Tag	Type	Description	Handling
Referenced Series Sequence	(0008,1115)	1C	Sequence of Items each of which includes the Attributes of one Series. One or more Items shall be included in this sequence. Required if this Instance references Instances in this Study.	Supported
>Series Instance UID	(0020,000E)	1	Unique identifier of the Series containing the referenced Instances.	Supported

Attribute Name	Tag	Type	Description	Handling
>Referenced Instance Sequence	(0008,114A)	1	Sequence of Items each providing a reference to an Instance that is part of the Series defined by Series Instance UID (0020,000E) in the enclosing Item. One or more Items shall be included in this sequence.	Supported
>>Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Supported
>>Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Supported
Studies Containing Other Referenced Instances Sequence	(0008,1200)	1C	Sequence of items each identifying a Study other than the Study of which this Instance is a part, which Studies contain Instances that are referenced elsewhere in this Instance. One or more Items shall be included in this sequence. Required if this Instance references Instances in other Studies.	Not supported
>Study Instance UID	(0020,000D)	1	Unique identifier of the Study containing the referenced Instances.	Not supported
>Referenced Series Sequence	(0008,1115)	1	Sequence of Items each of which includes the Attributes of one Series. One or more Items shall be included in this sequence.	Not supported
>>Series Instance UID	(0020,000E)	1	Unique identifier of the Series containing the referenced Instances.	Not supported
>>Referenced Instance Sequence	(0008,114A)	1	Sequence of Items each providing a reference to an Instance that is part of the Series defined by Series Instance UID (0020,000E) in the enclosing Item. One or more Items shall be included in this sequence.	Not supported
>>Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Not supported
>>Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Not supported

B.2.18 Spatial Registration Series – C.20.1

Attribute Name	Tag	Type	Description	Handling
Modality	(0008.0060)	1	Modality type. Enumerated Values: REG	Supported

B.2.19 Spatial Registration – C.20.2

Attribute Name	Tag	Type	Description	Handling
Content Date	(0008,0023)	1	The date the content creation started.	Supported
Content Time	(0008,0033)	1	The time the content creation started.	Supported
Instance Number	(0020,0013)	1	A number that identifies this instance	Supported
Content Label	(0070,0080)	1	A label that is used to identify this registration.	Supported
Content Description	(0070,0081)	2	A description of this registration.	Supported
Content Creator's Name	(0070,0084)	2	Name of operator performing the registration (such as a technologist or physician).	Not supported
Registration Sequence	(0070,0308)	1	A sequence of one or more registration items. Each item defines a spatial registration to the referenced images in that item. All referenced images are in the same spatial frame of reference or atlas.	Supported
> Frame of Reference UID	(0020,0052)	1C	Identifies a Frame of Reference that may or may not be an image set (e.g. atlas or physical space). See C.7.4.1.1.1 for further explanation. Required if Referenced Image Sequence (0008,1140) is absent. May be present otherwise.	Supported
> Referenced Image Sequence	(0008,1140)	1C	Identifies the set of images registered in this sequence item. One or more items shall be present. Required if Frame of Reference UID (0020,0052) is absent. May be present otherwise.	Supported
>> Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.	Supported
>> Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.	Supported
>> Referenced Frame Number	(0008,1160)	1	Identifies the frame numbers within the Referenced SOP Instance to which the reference applies. The first frame shall be denoted as frame number 1. Note: This Attribute may be multi-valued. Required if the Referenced SOP Instance is a multi-frame image and the reference does not apply to all frames.	Not supported
> Matrix Registration Sequence	(0070,0309)	1	A sequence that specifies one spatial registration. Exactly one item shall be present	Supported
>> Frame of Reference Transformation Comment	(3006,00C8)	3	User description or comments about the Transformation Comment registration.	Not supported

Attribute Name	Tag	Type	Description	Handling
>> Registration Type Code Sequence	(0070,030D)	2	Describes the information input into the registration process. Only one item may be present.	Supported
>>> Code Value	(0008,0100)	1C	See Section 8.1. Required if a sequence item is present.	Supported
>>> Coding Scheme Designator	(0008,0102)	1C	See Section 8.2. Required if a sequence item is present.	Supported
>>> Coding Scheme Version	(0008,0103)	1C	See Section 8.2. Required if a sequence item is present and the value of Coding Scheme Designator (0008,0102) is not sufficient to identify the Code Value (0008,0100) unambiguously.	Supported
>>> Code Meaning	(0008,0104)	1C	See Section 8.3. Required if a sequence item is present.	Supported
>> Matrix Sequence	(0070,030A)	1	One or more items shall be present. Each item specifies a transformation. The item order is significant and corresponds to matrix multiplication order. See C.20.2.1.1.	Supported Export Always one item is exported which incorporates the combination of all matrices of the original sequence.
>>> Frame of Reference Transformation Matrix	(3006,00C6)	1	A 4x4 homogeneous transformation matrix that registers the referenced images to the local RCS. Matrix elements shall be listed in row-major order. See C.20.2.1.1.	Supported
>>> Frame of Reference Transformation Matrix Type	(0070,030C)	1	Type of Frame of Reference Transformation Matrix (3006,00C6). Defined terms: RIGID RIGID_SCALE AFFINE See C.20.2.1.2	Supported Export Value set to RIGID

Attribute Name	Tag	Type	Description	Handling
>> Registration Sub Type	(3275,XX00)	3	Identifies the application or application context in which this registration object has been created.	Supported Export The value exported is one of the following: "Online3D", "Online-Marker", "Online2D3DPaired", "Online2DPaired"
> Used Fiducials Sequence	(0070,0314)	3	The fiducials used to determine the Frame of Reference Transformation Matrix. One or more Items may be present.	Not supported
>> <i>Content of not supported sequence is not listed</i>				

Appendix C - Extended Interface

The following IODs have private attributes containing an XML data structure for transporting structured non-DICOM data:

- RT Ion Plan
- CT/RT Image

For more information on the private attributes, see *Varian System Server DICOM Conformance Statement*.

Appendix D - Conversion between Table Top Representations

The position and orientation of the Table Top can be described in different representations, or underlying mechanical models. A representation of a position and orientation as numerical values assumes a certain order of rotations and translations. In one representation, a given table top position and orientation is described by a set of values, whereas in another representations the same position may be described with different values. The ProBeam Imaging application displays table top positions in "Isocentric Standard" representation while the DICOM data requires the numerical table top values in the "IEC 61217" representation. Reproducing 6 degree of freedom table top values displayed to the operator at the treatment device from DICOM IODs requires conversion of table top values from the "IEC 61217" representation to the "Isocentric Standard" representation.

D.1 Comparison

D.1.1 "IEC 61217" Representation

IEC 61217 defines the geometrical model as follows (axes notations according to IEC 61217 coordinate systems). In particular, pitch and roll are around the table top origin, which translates with Lat_{IEC} , Lng_{IEC} , Vrt_{IEC} :

- a) **Rotation** by γ (Patient Support Angle PSA) around the fixed room axis Z_f .
- b) **Translation** by Lat_{IEC} , Lng_{IEC} , Vrt_{IEC} along the PSA-rotated patient support axes X_s , Y_s , Z_s or X_f' , Y_f' , Z_f' .
- c) **Pitch** by α around the PSA-rotated and translated table top axis X_t or X_f'' (i.e. around the table top origin).
- d) **Roll** by β around the PSA-rotated, translated, and pitched table top axis Y_t' or Y_f''' (i.e. around the table top origin).

Lat_{IEC} , Lng_{IEC} , Vrt_{IEC} can be interpreted as a translation of the IEC table top origin away from the isocenter. The following figure illustrates the "IEC 61217" representations (the green arrows show Vrt_{IEC} , Lng_{IEC} , Pitch):

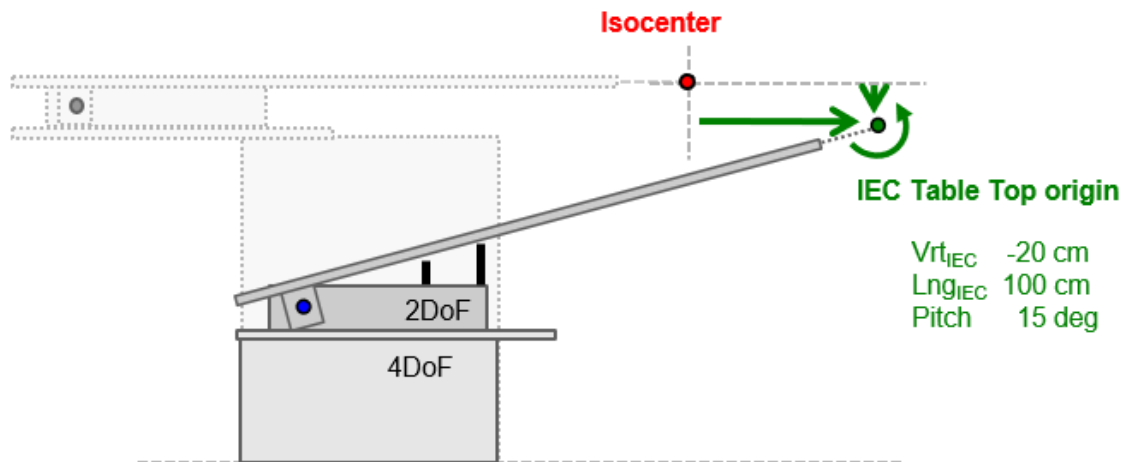


Fig. 3: "IEC61217" table top representations

D.1.2 "Isocentric Standard" Representation

The "Isocentric Standard" representation assumes that pitch and roll are always around the treatment machine's isocenter, irrespective of the translational components. The sequence of rotations is the same as in IEC:

- Rotation** by γ (Patient Support Angle PSA) around the fixed room axis Z_f (i.e., around the isocenter).
- Pitch** by α around the PSA-rotated patient support axis X_s or X_f' (i.e., around the isocenter).
- Roll** by β around the PSA-rotated and pitched axis Y_s' or Y_f'' (i.e., around the isocenter).
- Translation** by Lat_{ISO} , Lng_{ISO} , Vrt_{ISO} along the PSA-rotated, pitched, and rolled axes X_s'' , Y_s'' , Z_s'' or X_f''' , Y_f''' , Z_f''' .

Lat_{ISO} , Lng_{ISO} , Vrt_{ISO} can be interpreted as a translation of the table top origin away from the isocenter measured along the axes of the potentially pitched and rolled table top. The following figure illustrates the "Isocentric Standard" representation (the red arrows show Vrt_{ISO} , Lng_{ISO} , Pitch):

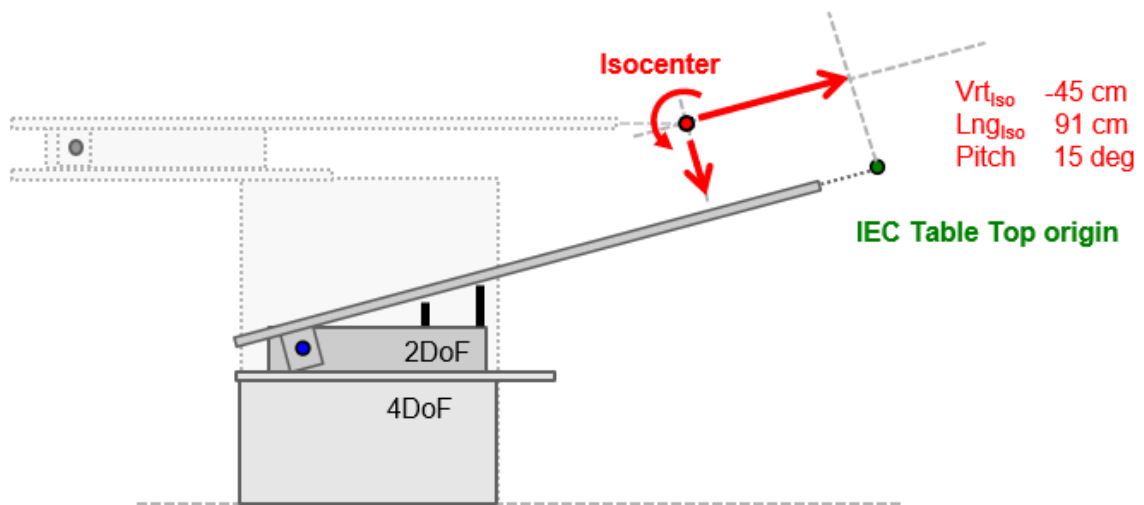


Fig. 4: "Isocentric Standard" table top representations

D.2 Conversion Formulas between "Isocentric Standard" and "IEC 61217" Table Top Representation

The formulas below describe the conversion between table top parameters in "IEC61217" representation, which is used in DICOM IODs, and "Isocentric Standard" representation, which is used on the ProBeam Imaging application's user interface.

The three angles--Table Top Pitch, Table Top Roll, and Patient Support Angle--are exactly the same in both representations.

The Lateral, Longitudinal, and Vertical translations can be converted according to the formulas below.

"IEC 61217" to "Isocentric Standard":

$$Lat_{ISO} = \cos(Roll) \cdot Lat_{IEC} + \sin(Pitch) \cdot \sin(Roll) \cdot Lng_{IEC} - \cos(Pitch) \cdot \sin(Roll) \cdot Vrt_{IEC}$$

$$Lng_{ISO} = \cos(Pitch) \cdot Lng_{IEC} + \sin(Pitch) \cdot Vrt_{IEC}$$

$$Vrt_{ISO} = \sin(Roll) \cdot Lat_{IEC} - \sin(Pitch) \cdot \cos(Roll) \cdot Lng_{IEC} + \cos(Pitch) \cdot \cos(Roll) \cdot Vrt_{IEC}$$

"Isocentric Standard" to "IEC 61217":

$$Lat_{IEC} = \cos(Roll) \cdot Lat_{ISO} + \sin(Roll) \cdot Vrt_{ISO}$$

$$Lng_{IEC} = \sin(Pitch) \cdot \sin(Roll) \cdot Lat_{ISO} + \cos(Pitch) \cdot Lng_{ISO} - \sin(Pitch) \cdot \cos(Roll) \cdot Vrt_{ISO}$$

$$Vrt_{IEC} = -\cos(Pitch) \cdot \sin(Roll) \cdot Lat_{ISO} + \sin(Pitch) \cdot Lng_{ISO} + \cos(Pitch) \cdot \cos(Roll) \cdot Vrt_{ISO}$$