

# SIEMENS

## LANTIS DICOM Conformance Statement



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Revision C • 6/04

54 94 864    UPD 1975    English

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**LANTIS DICOM**

**Conformance Statement**

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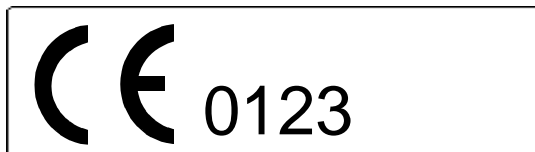
54 94 864  
Revision C

LANTIS Software version 6.1

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EC Declaration of Conformity

Application of Council Directive: 93/42/EEC

Manufacturer's name: Siemens Medical Solutions USA, Inc., Oncology Care Systems

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Type of equipment: Radiotherapy equipment option (LANTIS DICOM)

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# Introduction

## Purpose

This document is the DICOM Conformance Statement for the DICOM Communication Module 2.00. It describes compliance with the DICOM Version 3.0 standard including supported DICOM Services Classes, Information Objects and Communication Protocols. This document has been written in accordance with part PS 3.2 of the DICOM Version 3.0 standard. Familiarity with the DICOM standard is assumed.

This Conformance Statement is intended for use by software developers of DICOM interfaces, customers, and system integrators who wish to connect DICOM equipment with the DICOM Communication Module. This document specifies conformance with the DICOM standard, including limitations and restrictions on conformance. Careful review and comparison of this Conformance Statement with the Conformance Statements of other equipment must be done to determine whether integration will achieve a desired result. This document is essential to integrating DICOM-compliant applications and equipment, but does not guarantee system functionality by itself.

## Scope

This Conformance Statement covers the DICOM Communication Module (DCM) 2.00 application release.

Siemens believes that the information in this specification is accurate and reliable but accepts no responsibility for any consequences arising out of unforeseen events.

The information contained in this document is subject to change. Revisions and updates will be issued from time to time to document changes and/or additions.

## DOCUMENTATION CONVENTIONS

The following conventions are used throughout this document:

- Menu options and control buttons are indicated by **Bold Print**. Menu commands that are executed one directly after another are separated by vertical lines. Example: **File | Tools | Options**.
- Window and dialog box titles and icons are in SMALL CAPITAL LETTERS.
- Window elements (e.g. fields, radio buttons, check boxes, and tabs) and footnotes are in *italics*.
- File names, file paths, databases, and database fields are printed in mixed-case Courier typeface.
- Text that you need to type exactly as shown, such as commands or responses, is shaded.
- Words or phrases that are specifically defined and could potentially be misunderstood are initially in “quotes”.
- Function keys and booster keys appear in upper case bold print. Example: **F2** or **CTRL**. Multiple keys that you press simultaneously are separated by a plus sign. Example: **CTRL + F4**.
- The sword symbol (†) shall indicate deviations from Siemens labeling conventions.

## Definitions

Acronym, Abbreviation, Term	Definition
<b>AE</b>	Application Entity, a DICOM application.
<b>AE Title</b>	Application Entity Title, the publicly known name of a DICOM AE.
<b>association</b>	One entire communication session between two DICOM AEs. An association is initiated by an SCU. The association may be terminated by either the SCU or SCP.
<b>Asynchronous Window Operations Negotiation</b>	A “window” of opportunity in the association establishment phase, between two DICOM AEs, during which “asynchronous” (non-handshake) operations may be negotiated.

Acronym, Abbreviation, Term	Definition
<b>attribute</b>	A unit of data that has a value and is identified by a 4 byte number called a tag.
<b>DCM</b>	<b>DICOM Communications Module</b> - IMPACS implementation of DICOM
{ <b>DICM</b> }	A reference used in this document for DICOM
<b>DICOM</b>	<b>Digital Imaging and Communications in Medicine</b> . A standard developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) for the electronic transfer of digital images and associated information.
<b>DICOM file</b>	An instance of an IOD that is stored on a physical disk drive or file server. As used by DCM, a DICOM file conforms to the DICOM Version 3.0 standard file format, except it does not contain the file meta information. It consists of attributes with a tag of (0008,0000) and greater.
<b>DICOM message</b>	A combination of a DICOM command, request or response and its associated IOD instance.
<b>import area</b>	A directory where DCM writes DICOM files received from other DICOM AEs over a network.
<b>IOD</b>	Information Object Definition, a class of data defined in the DICOM standard.
<b>PDU</b>	<b>Protocol Data Unit</b>
<b>Real-World Activity</b>	A command given to a DICOM application by a user or the result of such a command (in the “Real World”).
<b>SCP</b>	Service Class Provider, a DICOM AE is an SCP when it provides DICOM services (like a server) over a network.
<b>SCU</b>	Service Class User, a DICOM AE is an SCU when it requests DICOM services (like a client) over a network.

<b>Acronym, Abbreviation, Term</b>	<b>Definition</b>
<b>SOP</b>	Service/Object Pair, an actual occurrence of an Information Object and a communication context.
<b>TCP/IP</b>	Transmission Control Protocol/Internet Protocol, the suite of network protocols developed and used by DARPA and US DOD.
<b>UID</b>	Unique Identifier.

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## Implementation Model

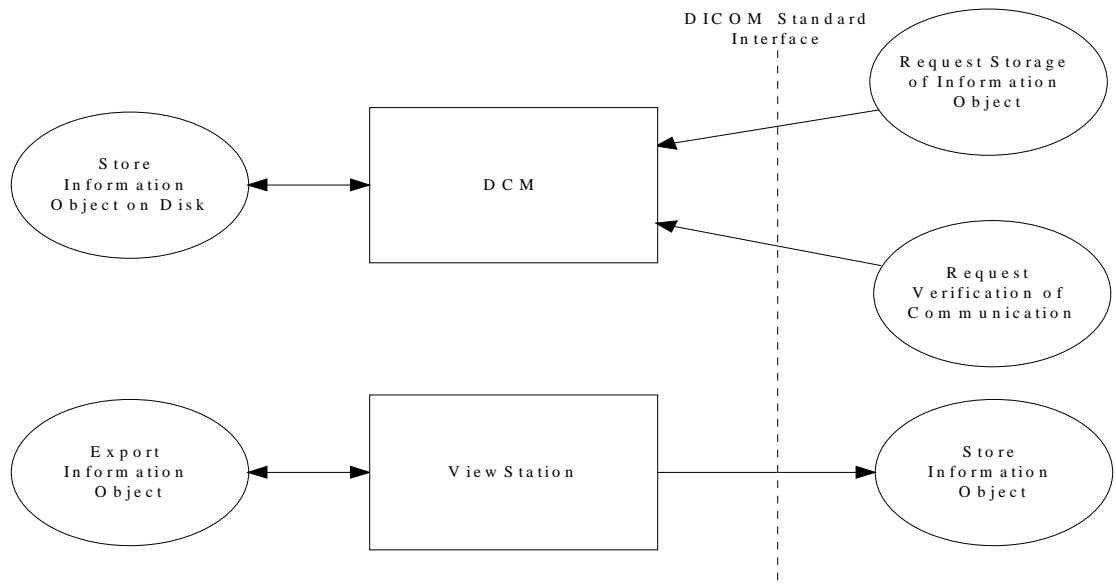
DCM is a 32-bit application designed to operate on Intel x86 based platforms running the Microsoft Windows NT/2000/XP operating system. Generally, this application is started automatically as part of the operating system initialization sequence. Once started, it runs as a background task, usually in a minimized state.

DCM incorporates the MergeCOM-3 implementation of DICOM provided by Merge Technologies, Inc.

Generally, DCM starts automatically on a workstation or server as part of the initialization sequence. Once started, it runs as a background task, usually in a minimized state.

### APPLICATION DATA FLOW DIAGRAM

The relationship of DCM to Real-World Activities is shown below:



DCM is invoked by the following Real-World Activities:

- Request Storage of Information Object
- Request Verification of Communication

### **Request Storage of Information Object**

When DCM accepts an association request from a remote AE, it processes the Information Objects and saves them to disk.

### **Request Verification of Communication**

When DCM receives an Echo request from a remote AE, it returns an Echo response.

## **Functional Definitions of AEs**

DCM is a single DICOM AE that is an SCP.

DCM will:

- wait for an association request from an SCU AE
- accept an association for a supported SOP Class
- receive DICOM messages sent from the SCU AE over the association
- process each DICOM message and store it to disk as a DICOM file  
abort the association if an error occurs
- send appropriate response messages to the SCU AE

### **Sequencing of Real-World Activities**

Not Applicable.

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## AE Specifications

### DCM Specifications

DCM provides Standard Conformance to the following DICOM v3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
CT (Computed Tomography) Image Storage	1.2.840.10008.5.1.4.1.1.1
MR (Magnetic Resonance) Image Storage	1.2.840.10008.5.1.4.1.1.2
SC (Secondary Capture) Image Storage	1.2.840.10008.5.1.4.1.1.4
RT (Radiotherapy) Image Storage	1.2.840.10008.5.1.4.1.1.7
RT (Radiotherapy) Plan Storage	1.2.840.10008.5.1.4.1.1.481.1
Verification (Echo)	1.2.840.10008.5.1.4.1.1.481.5
CR (Computed Radiography) Image Storage	1.2.840.10008.1.1

### Association Establishment Policies

#### General

The maximum Protocol Data Unit (PDU) size accepted by DCM is configurable within the range of 1K byte to 32K bytes, with a default size of 16K bytes.

#### Number of Associations

The maximum number of simultaneous associations supported by DCM as an SCP is configurable, with a default of 5. The total number of simultaneous associations may be limited by the resources of the server on which DCM is running.

### Asynchronous Nature

DCM does not support multiple outstanding transactions over an association; it will not perform asynchronous operations window negotiation.

### Implementation Identifying Information

Implementation Class UID	Implementation Version Name
1.2.840.113854.0.1	DCM_200

### Association Initiation Policy

DCM will not attempt to initiate an association.

### Association Acceptance Policy

DCM polls the TCP/IP port at specified intervals for association requests from SCUs. DCM only accepts associations pertaining to the specified SOP Classes.

### Request Storage of Information Object

#### Associated Real-World Activity

Once an association has been established, DCM responds to standard DICOM C-STORE requests for those presentation contexts listed below. DCM optionally validates the DICOM messages received for conformance with the related IOD outlined in DICOM Version 3.0 standard {DICM}. DCM creates uniquely named DICOM files within the specified import area for each of the DICOM messages. A standard C-STORE response is sent to the SCU for each request received by DCM indicating the success or failure of the storage request.

DCM generates an image series based on the Series Instance UID, Image Position and Image Orientation attributes. All DICOM messages received within a single open association that have a valid value for Image Position and have the same value for Series Instance UID are presented to Namer as an image series. DCM processes the Image Position and Image Orientation attributes to properly order the images in the series. Therefore, if a client SCU wishes to associate a collection of image objects as an image series, they must all be sent over the same association, have the same value for Series Instance UID and have a valid value for Image Position. Image objects that are truly unrelated should be sent over separate associations.

### Presentation Context Table

DCM accepts the following SOP Presentation Contexts:

PRESENTATION CONTEXT TABLE					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	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	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	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	1.2.840.10008.5.1.4.1.1.481.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	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

DCM provides Standard Conformance for the DICOM Storage Classes listed above. In the event of a successful C-STORE operation, the DICOM message is written to disk as a DICOM file. Otherwise, DCM returns one of the following status codes to the SCU:

- A700 (Out of Resources) - Indicates that the disk space is insufficient to store the Information Object or an error occurred while writing the Information Object to disk.

- A780 (Resources not configured) - Indicates that no disk location has been configured to store the Information Object.
- A900 (Data Set does not match SOP Class) - Indicates that the Information Object does not encode an instance of the SOP Class specified. This indicates a problem with the SCU of the Service Class.
- C000 (Cannot understand) - Indicates that DCM cannot parse the Information Object into elements. This indicates a problem with the SCU.

DCM supports the standard SOP Class for RT Plan Storage; refer to Appendix B - Specific Conformance for RT Plan IOD. For all other DICOM Storage Classes listed above, refer to Appendix A - Specific Conformance for Image IODs.

### Presentation Context Acceptance Criterion

DCM supports the Presentation Contexts for the SOP Classes listed in the table above. Any other Presentation Context will be rejected.

### Transfer Syntax Selection Policies

If DCM is offered a choice of Transfer Syntaxes in a Presentation Context, it applies the following priority to the choice of Transfer Syntax:

- Explicit Little Endian Syntax.
- Implicit Little Endian Syntax.
- Explicit Big Endian Syntax.

## Request Verification of Communication

### Associated Real-World Activity

DCM responds to echo requests with a DICOM C-Echo response.

### Presentation Context Table

DCM accepts the following Verification Service Presentation Contexts:

PRESENTATION CONTEXT TABLE					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List	Negotiation	
Verification Service Class	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

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# Communication Profiles

## Supported Communication Stacks

### TCP/IP Stack

#### API

DCM uses the Windows Sockets API inherent to the Microsoft Windows NT/2000 operating system.

#### Physical Media Support

All physical media supported by the TCP/IP stack may be used with DCM. This includes, but is not limited to, 10-Base-2, 10-Base-T, 100-Base-T, fiber optic, and Internet.



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## Extensions/Specializations /Privatizations

### **Standard Extended/Specialized/Private SOPs**

None supported.

### **Private Transfer Syntaxes**

None supported.



# Configuration

## Configuration Files

The DCM application references the merge.ini file, which is located in the applications directory.

**merge.ini** Specifies the configurable parameters for DCM, and the names and locations of the other three (3) standard configuration files.

DCM references three standard configuration files. These files specify the parameters for the MergeCOM-3 implementation of DICOM provided by Merge Technologies, Inc. They are as follows:

**mergecom.pro** Specifies run-time parameters for the MergeCOM-3 implementation.

**mergecom.app** Specifies the services supported by the MergeCOM-3 implementation.

**mergecom.srv** Service definitions for the MergeCOM-3 implementation.

## AE Title/Presentation Address Mapping

Siemens recommended AE Title for DCM is the host name.

**Note** underscores do not work with syngo

## Configurable Parameters

None



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## Support of Extended Character Sets

Not supported.



# A

## Specific Conformance for Image IODs

### Image Object Import and Storage (SCP)

DICOM files created by DCM that contain an image object are processed by the Namer application. Namer performs an import process that extracts information from the DICOM file and stores the digital image and associated information in the Image Management System database. DCM and Namer work together as an SCP of the Storage Service Class for the following Composite Image IODs (depending on purchased configuration): CR, CT, MR, SC and RT Image.

All attributes of an image object are stored; none are discarded or modified. This provides Level 2 (Full) conformance as an SCP.

**Note** - See “Limitations on Extracting and Storing Image Pixel Data” on page 31, for an important statement regarding the limitations of the import process on extracting and storing image pixel data.

Images stored in the database are accessed by the ViewStation application for display, annotation, etc. Images are stored indefinitely, but may be deleted from the database using ViewStation.

## Image IOD Modules

The following table identifies the modules used when importing an image object into the Image Management System database. A module is shown with a reference of Not Used if none of its attributes are accessed during import.

Usage by IOD						
Module Name	Reference	CR	CT	MR	SC	RT Image
Patient	Patient Module on page 22	M	M	M	M	M
General Study	“General Study Module” on page 23	M	M	M	M	M
Patient Study	Not Used	U	U	U	U	U
General Series	“General Series Module” on page 23	M	M	M	M	
CR Series	Not Used	M				
RT Series	“RT Series Module” on page 24					M
Frame Of Reference	Not Used		M	M		U
General Equipment	“General Equipment Module” on page 24	M	M	M	U	M
SC Equipment	“SC Equipment Module” on page 25				M	
General Image	“General Image Module” on page 25	M	M	M	M	M
Image Plane	“Image Plane Module” on page 26		M	M		
Image Pixel	“Image Pixel Module” on page 26	M	M	M	M	M
Contrast / Bolus	Not Used	C	C	C		C
Cine	Not Used					C
Multi-frame	Not Used					C
CR Image	Not Used	M				
CT Image	Not Used		M			
MR Image	Not Used			M		

Usage by IOD						
Module Name	Reference	CR	CT	MR	SC	RT Image
SC Image	Not Used				M	
RT Image	“RT Image Module” on page 29					M
Approval	Not Used					U
Overlay Plane	Not Used	U	U	U	U	
Curve	Not Used	U				U
Audio	Not Used					U
Modality LUT	Not Used	U			U	U
VOI LUT	Not Used	U	U	U	U	U
SOP Common	“SOP Common Module” on page 30	M	M	M	M	M

Refer to {DICM} for a complete definition of the Usage notation, summarized as follows:

- M mandatory Module
- C conditional Module
- U user option Module

## Module Attributes

This section lists the attributes of each module that are used by the import process; attributes that are not accessed during import are not shown. Restrictions on attribute values and usage are also listed. Refer to {DICM} for a complete definition of the Type notation, summarized as follows:

- 1 The attribute must be included and have a valid value.
- 1C The attribute must be included under certain conditions. If included, it must have a valid value.
- 2 The attribute must be included. If the value is unknown, it can be null

(empty).

- 3 The attribute is optional. It may or may not be included in the module. If included, the attribute may or may not have a null value.

## Patient Module

The following table lists the attributes that are used to match the image object with a patient in the database. If the patient in the image object cannot be identified and uniquely matched with an existing patient in the database, the image object will not be imported.

Once the patient is identified and matched, the Image Management System uses none of the patient information contained in the image object. The patient information, already stored in the database, is used for further reference and is not affected by patient information contained in the image object.

Tag	Name	Type	Description
(0010,0010)	Patient's Name	2	Patient's full legal name. The import process may be configured to use this attribute, in addition to Patient ID, to match the image object with a patient in the Image Management System database. Only the first 40 characters of the last name in this attribute are used.
(0010,0020)	Patient ID	2	Primary hospital identification number or code for the patient. The image object will only be imported if the Patient ID can be uniquely matched with an existing patient's Primary ID in the database. Only the first 20 characters of this attribute are used.

### General Study Module

Tag	Name	Type	Description
(0008,0020)	Study Date	2	Date the Study started. If the value is unknown, the import process defaults to the current date of import.
(0008,0030)	Study Time	2	Time the Study started. If the value is unknown, the import process defaults to the current time of import, or optionally at midnight.
(0008,1030)	Study Description	3	Institution generated description or classification of the Study. This attribute may be used instead of Image Comments. Only the first 60 characters of this attribute are used. If the attribute is absent or the value is unknown, the import process defaults to blank.

### General Series Module

The following Modality attribute table lists the attribute in this module that is used to identify the source of the image object. In addition to matching the image object with a patient, the image source must be identified. Otherwise the image object will not be imported. Identification of the image source also allows the import process to apply image enhancements that are customized for that source. For an RT Image IOD, the RT Series Module is used instead. For an SC Image IOD, the SC Equipment Module takes precedence.

Tag	Name	Type	Description								
(0008,0060)	Modality	1	Type of equipment that originally acquired the data used to create the image. It must have the corresponding value for the following Image IODs: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>IOD</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>CR</td> <td>CR</td> </tr> <tr> <td>CT</td> <td>CT</td> </tr> <tr> <td>MR</td> <td>MR</td> </tr> </tbody> </table>	IOD	Value	CR	CR	CT	CT	MR	MR
IOD	Value										
CR	CR										
CT	CT										
MR	MR										
(0020,000E)	Series Instance UID	1	Unique identifier of the Series. DCM uses this to generate an image series for the import process. For more information see the section, “Associated Real-World Activity” on page 8.”								

### RT Series Module

The following Modality attribute table lists the attribute in this module that is used to identify the image source for an RT Image IOD.

Tag	Name	Type	Description
(0008,0060)	Modality	1	Type of equipment that originally acquired the data used to create the image. It must have the following value: RTIMAGE

### General Equipment Module

The following table lists the attributes in this module that are used to identify the image source. For an SC Image IOD, the SC Equipment Module takes precedence.

Tag	Name	Type	Description
(0008,0070)	Manufacturer	2	Manufacturer of the equipment that produced the image. This attribute may be used, in addition to Modality, to identify the image source. This allows the import process to differentiate image objects with the same Modality. Only the first 40 characters of this attribute are used.
(0008,1010)	Station Name	3	User defined name identifying the machine that produced the image. This attribute may be used, in addition to Modality, to identify the image source. This allows the import process to differentiate image objects with the same Modality and Manufacturer.
(0008,1090)	Manufacturer's Model Name	3	Manufacturer's model number of the equipment that produced the image. This attribute may be used, in addition to Modality, to identify the image source. This allows the import process to differentiate image objects with the same Modality. Only the first 40 characters of this attribute are used.

### SC Equipment Module

The following Conversion Type attribute table lists the attributes in this module that are used to identify the image source for an SC Image IOD.

Tag	Name	Type	Description
(0008,0064)	Conversion Type	1	Describes the kind of image conversion. It must have one of the following values: DF, DI, DV or WSD

### General Image Module

Tag	Name	Type	Description
(0020,4000)	Image Comments	3	User defined comments about the image. This attribute may be used instead of Study Description. Only the first 60 characters of this attribute are used. If the attribute is absent or the value is unknown, the import process defaults to blank.

## Image Plane Module

Tag	Name	Type	Description
(0018,0050)	Slice Thickness	2	Normal slice thickness, in mm. If the value is unknown, the import process will default to 0.
(0020,0032)	Image Position (Patient)	1	The x, y, and z coordinates of the upper left hand corner of the image. DCM uses this to generate an image series for the import process. For more information see the section, “Associated Real-World Activity” on page 8.
(0020,0037)	Image Orientation (Patient)	1	The direction cosines of the first row and the first column with respect to the patient. DCM uses this to generate an image series for the import process. For more information see the section, “Associated Real-World Activity” on page 8.”
(0020,1041)	Slice Location	3	Relative position of exposure expressed in mm. If the attribute is absent or the value is unknown, the import process will default to 0.
(0028,0030)	Pixel Spacing	1	Physical distance in the patient between the center of each pixel in mm. If the row and column spacing values are not equal (pixels are not square), the image appears distorted when displayed and measurements made on the image are inaccurate.

## Image Pixel Module

**Note** - See “Limitations on Extracting and Storing Image Pixel Data” on page 31, for an important statement regarding the limitations of the import process on extracting and storing image pixel data.

Tag	Name	Type	Description
(0028,0002)	Samples per Pixel	1	Number of samples (planes) in this image. This attribute is not explicitly used; the value is assumed to be 1. Otherwise, the image object is not imported.

Tag	Name	Type	Description
(0028,0004)	Photometric Interpretation	1	Specifies the intended interpretation of the pixel data. This attribute is not explicitly used; the value is assumed to be MONOCHROME2. Otherwise, if the value is MONOCHROME1, the image will be displayed with an inverted grayscale; if the value is anything else, the import process will not properly interpret the image.
(0028,0010)	Rows	1	Number of rows in the image. The value must be in the range 16 to 4096. Otherwise the image object is not imported.
(0028,0011)	Columns	1	Number of columns in the image. The value must be in the range 16 to 4096. Otherwise the image object is not imported.
(0028,0034)	Pixel Aspect Ratio	1C	Ratio of the real world spacing of the pixels in the image. This attribute is not explicitly used; pixel aspect ratio is assumed to be 1\1. Otherwise, the image will appear distorted when displayed, and measurements made on the image will not be accurate.
(0028,0100)	Bits Allocated	1	Number of bits allocated for each pixel sample. The value must be 8 or 16. Otherwise the image object will not be imported.
(0028,0101)	Bits Stored	1	Number of bits stored for each pixel sample. The value must be in the range 1 to Bits Allocated. Otherwise the import process will default to Bits Allocated.
(0028,0102)	High Bit	1	Most significant bit for pixel sample data. This attribute is not explicitly used; the value is assumed to be Bits Stored - 1. Otherwise, the import process will not properly interpret the image.
(0028,0103)	Pixel Representation	1	Data representation of the pixel samples. The value must be 1 or 0. A value of 1 indicates that the pixel values are signed, and 0 unsigned.
(7FE0,0010)	Pixel Data	1	A data stream of the pixel samples that comprise the image.

CR Image Module

Tag	Name	Type	Description
(0018,1164)	Imager Pixel Spacing	3	Physical distance between the center of each pixel in mm. If the row and column spacing values are not equal (pixels are not square), the image appears distorted when displayed and measurements made on the image are inaccurate..

## RT Image Module

Tag	Name	Type	Description
(0008,0008)	Image Type	1	Image identification characteristics. Only the third value of this attribute is used.
(3002,0003)	RT Image Name	3	User-defined name for RT Image. This is used to match the image with a radiotherapy treatment Field ID for the patient in the database. Only the first 5 characters of this attribute are used. If the attribute is absent or the value is unknown, the import process does not associate the image with a treatment field.
(3002,0004)	RT Image Description	3	User-defined description of RT Image. Only the first 20 characters of this attribute are used. If the attribute is absent or the value is unknown, the import process defaults to blank.
(3002,0011)	Image Plane Pixel Spacing	2	Physical distance (in mm) between the center of each image pixel. If the row and column spacing values are not equal (pixels are not square), the image appears distorted when displayed and measurements made on the image are inaccurate.
(3002,0020)	Radiation Machine Name	2	User-defined name identifying radiation machine used in acquiring or computing image. If the value is unknown, the import process defaults to 'Unknown'.
(3002,0022)	Radiation Machine SAD	2	Radiation source to Gantry rotation axis distance of radiation machine used in acquiring or computing image (mm). If the value is unknown, the import process defaults to 0.
(3002,0024)	Radiation Machine SSD	3	Source to patient surface distance (in mm) of radiation machine used in acquiring or computing image. If the attribute is absent or the value is unknown, the import process defaults to 0.
(3002,0026)	RT Image SID	2	Distance from radiation machine source to image plane (in mm) along radiation beam axis. If the value is unknown, the import process defaults to 0.

### VOI LUT Module

The Window Center and Window Width attributes in this module are used by the import process to produce the display image in the database. The import process assumes no Modality LUT transformation is required and applies the VOI LUT transformation (using Window Center and Window Width) directly to the stored pixel values. If a Modality LUT transformation is required, the application of the VOI LUT transformation directly to the stored pixel values results in incorrect image display.

Tag	Name	Type	Description
(0028,1050)	Window Center	3	Window Center for display. If multiple values are present, only the first value is used. If the attribute is absent or the value is unknown, the import process does not apply the VOI LUT transformation.
(0028,1051)	Window Width	1C	Window Width for display. If multiple values are present, only the first value is used. If the attribute is absent or the value is unknown, the import process does not apply the VOI LUT transformation.

### SOP Common Module

Tag	Name	Type	Description
(0008,0005)	Specific Character Set	1C	Character Set that expands or replaces the Basic Graphic Set. This attribute is not explicitly used; all characters in strings are assumed to be from the Default Character Repertoire as defined in {DICM}. Otherwise string comparisons with data from the database may fail, and applications that access the imported character strings may not print or display them correctly.

## Limitations on Extracting and Storing Image Pixel Data

The import process makes assumptions about the value of certain attributes that it does not explicitly use, but are nonetheless important for proper interpretation of the image pixel data. All assumptions and restrictions are listed in the tables in the preceding section, and cases that result in a failure to import an image object are described. Assumptions about Pixel Spacing, Photometric Interpretation and Pixel Aspect Ratio may result in incorrect image display, but do not otherwise affect the stored pixel data.

Certain assumptions may result in undesired modification of image pixel data, however, even though the image object is otherwise successfully imported. The following two cases constitute these limitations:

### Bits Stored less than Bits Allocated, High Bit equal to Bits Stored-1

In this case, the import process masks off any extra-pixel data (e.g. an overlay encoded in the bits above the High Bit). The stored pixel data will have 0 for all such bits, but the original pixel sample values are stored and will be displayed properly.

### Bits Stored less than Bits Allocated, High Bit *not* equal to Bits Stored-1

Since the import process assumes High Bit equal to Bits Stored - 1, this case will result in incorrect extraction of the pixel data. As in the case above, data above the assumed High Bit (Bits Stored - 1) is masked off. This data may contain pixel sample as well as extra-pixel data. The effect on image display will vary depending on how many bits of the actual pixel sample are lost, and whether there is extra-pixel data encoded in the least significant bits of each pixel. Regardless, the stored pixel data is an incorrect representation of the original pixel sample, and the image will not be properly displayed.



# B

## Specific Conformance for RT Plan IOD

The Radiotherapy Plan Information Object Definition (RT Plan IOD) is used to transfer treatment plans generated by manual entry, a virtual simulation system or a treatment planning system before or during a course of treatment.

RT Plans received by DCM are translated to RTPlink files that the LANTIS application imports. The LANTIS application performs an import process that extracts information from the RTPlink file and stores the information in the database. DCM and the LANTIS application work together, acting as an SCP of the Storage Service Class for the RT Plan IOD.

DCM provides Standard Conformance to the standard extended DICOM RT Plan Storage Class at Level 0 (Local) as an SCP. Information stored in the database is accessed by the LANTIS application for display, editing, etc. Information may be stored indefinitely or deleted from the database using LANTIS.

### RT Plan IOD Modules

The following table identifies the modules used when translating an RT Plan object to the RTPlink file and importing the file into the database. A module is shown with a reference of Not Used if none of its attributes are accessed during translation or import.

Module Name	Reference	Usage*
Patient	“Patient Module” on page 35	M
General Study	“RT Series Module” on page 36	M
Patient Study	Not Used	U
RT Series	“RT Series Module” on page 36	M
General Equipment	“General Equipment Module” on page 36	M
RT General Plan	“RT General Plan Module” on page 37	M
RT Prescription	“RT Prescription Module” on page 37	U
RT Tolerance Tables	“RT Tolerance Tables Module” on page 39	U

Module Name	Reference	Usage*
RT Patient Setup	Not Used	U
RT Fraction Scheme	“RT Fraction Scheme Module” on page 40	U
RT Beams	“RT Beams Module” on page 41	C - Required if RT Fraction Scheme Module exists and Number of Beams is greater than zero for one or more fraction groups.
RT Brachy Application Setups	Not Used	C - Required if RT Fraction Scheme Module exists and Number of Brachy Application Setups is greater than zero for one or more fraction groups.
Approval	“Approval Module” on page 46	U
Audio	Not Used	U
SOP Common	“SOP Common Module” on page 46	M

Usage\*

Refer to {DICM} for a complete definition of the Usage notation, summarized as follows:

M mandatory Module

C conditional Module

U user option Module

## Module Attributes

This section lists the attributes of each module that are used by the translation and import process; **attributes that are not accessed are not shown**. Restrictions on attribute values and usage are also listed. Refer to {DICM} for a complete definition of the Type notation, summarized as follows:

- 1 The attribute must be included and have a valid value.
- 1C The attribute must be included under certain conditions. If included, it must have a valid value.
- 2 The attribute must be included. If the value is unknown, it can be null (empty).
- 3 The attribute is optional. It may or may not be included in the module. If included, the attribute may or may not have a null value.

## Patient Module

The following table lists the attributes that are used to match the RT Plan with a patient in the database. If the patient in the RT Plan cannot be identified and uniquely matched with an existing patient in the database, the RT Plan is not imported.

Once the patient is identified and matched, the Information Management System uses none of the patient information contained in the RT Plan. The patient information already stored in the database is used for further reference and is not affected by patient information contained in the RT Plan.

Tag	Name	Type	Description
(0010,0010)	Patient's Name	2	Patient's full legal name. The import process is configured to use the last name in this attribute, in addition to Patient ID, to match the RT Plan with a patient in the database. The first 40 characters of the last name and the first 20 characters of the first name in this attribute are used.
(0010,0020)	Patient ID	2	Primary hospital identification number or code for the patient. The RT Plan will only be imported if this attribute and Patient's Name can be uniquely matched with an existing patient in the database. Only the first 20 characters of this attribute are used.

### RT Series Module

Tag	Name	Type	Description
(0008,0060)	Modality	1	Type of equipment that originally acquired the data. Enumerated value must be RTPLAN.

### General Equipment Module

Tag	Name	Type	Description
(0008,0070)	Manufacturer	2	This attribute is translated to RTP_Mfg. Only the first 20 characters of this attribute are used.
(0008,1090)	Manufacturer's Model Name	3	This attribute is translated to RTP_Model. Only the first 20 characters of this attribute are used.
(0018,1020)	Software Version	3	This attribute is translated to RTP_Version. Only the first 10 characters of this attribute are used.

### RT General Plan Module

Tag	Name	Type	Description
(0008,1070)	Operator's Name	2	Name of operator creating treatment plan. This attribute is translated to Author_Last_Name (20 characters), Author_First_Name (20 characters) and Author_Initial (1 character).
(300A,0002)	RT Plan Label	1	This attribute is translated to Plan_ID (first 15 characters only). If this attribute consists of numbers, the first 2 digits are translated to Course_ID (1-99).
(300A,0006)	RT Plan Date	2	This attribute is translated to Plan_Date (yyyymmdd).
(300A,0007)	RT Plan Time	2	This attribute is translated to Plan_Time (hhmmss).
(300A,0009)	Treatment Protocols	3	This attribute is translated to Technique and only the first 20 characters are used.

### RT Prescription Module

The following table lists the attributes that are used to create primary and secondary treatment sites for the patient. If Dose Reference Description conflicts with an existing Primary Treatment Site Name or Secondary Treatment Region Name in the database, the dose reference is not imported.

Tag	Name	Type	Description
(300A,000E)	Prescription Description	3	This attribute is translated to RX_Note. Only the first 60 characters are used.
(300A,0010)	Dose Reference Sequence	3	Introduces sequence of Dose References.
(300A,0012)	> Dose Reference Number	1C	Identification number of the Dose Reference. This attribute is translated to Rx_Site_Name or Region_Name (see description below) if Dose Reference Description does not exist or is NULL.

Tag	Name	Type	Description
(300A,0016)	> Dose Reference Description	3	This attribute is translated to Rx_Site_Name if Dose Reference Type (300A,0020) is TARGET, or Region_Name if Dose Reference Type is ORGAN_AT_RISK. Only the first 20 characters of this attribute are used.
(300A,001A)	> Nominal Prior Dose	3	Dose (in Gy) from prior treatment to this Dose Reference. This attribute is translate to Region Prior Dose (Gy to cGy) and ranges from 1 to 99999 cGy.
(300A,0020)	> Dose Reference Type	1C	Enumerated values are TARGET or ORGAN_AT_RISK.
(300A,0022)	> Delivery Warning Dose	3	The dose which when reached or exceeded should cause some action to be taken. This attribute is translated to Action Dose (Gy to cGy) and ranges from 1 to 99999 cGy.
(300A,0026)	> Target Prescription Dose	3	Prescribed dose to Dose Reference if Dose Reference Type (300A,0020) is TARGET. This attribute is translated to Dose_TTL (Gy to cGy) and ranges from 1 to 99999; and is used in calculating Dose_TX (Gy to cGy), i.e. Dose_Tx is equal to Target Prescription Dose divided by Number of Fractions Planned (300A,0078). It ranges from 1 to 9999 cGy.

### RT Tolerance Tables Module

The following table lists the attributes that are used to match the RT Plan with an existing Tolerance Table in the database. If the Tolerance Table Label does not match an existing Tolerance Table ID in the database, the attributes in this module are not imported.

Tag	Name	Type	Description
(300A,0040)	Tolerance Table Sequence	3	Introduces sequence of tolerance tables.
(300A,0043)	> Tolerance Table Label	3	Tolerance Table ID. Valid values are 1-9 inclusive and must match an existing ID in the database.

RT Fraction Scheme Module

Tag	Name	Type	Description
(300A,0070)	Fraction Group Sequence	1	Introduces sequence of Fraction Groups in current Fraction Scheme. Each Fraction Group is translated to a Prescription Site.
(300A,0078)	> Number of Fractions Planned	2	This attribute, together with Target Prescription Dose (300A,0026), is used to calculate Dose_Tx.
(300A,0080)	> Number of Beams	1	Number of Beams in current Fraction Group. This attribute is translated to Number of Fields (1-999) for the current Prescription Site.
(300C,0004)	> Referenced Beam Sequence	1C	Introduces sequence of treatment beams in current Fraction Group. Required if Number of Beams is greater than zero. Each Beam is translated to a Treatment Field within the current Prescription Site.
(300A,0084)	>> Beam Dose	3	This attribute is translated to Field Dose (Gy to cGy) and ranges from 0.01 to 9999.99 cGy.
(300A,0086)	>> Beam Meterset	3	If the Primary Dosimeter Unit (300A, 00B3) is MU, this attribute is translated to Field_Monitor_Units (0.01-9999.99) if Treatment Delivery Type (300A, 00CE) is TREATMENT; and Wedge_Monitor_Units (0-9999.99) if Wedge Position (300A,0118) is IN and Wedge Type (300A,00D3) is MOTORIZED.
(300C,0006)	>> Referenced Beam Number	1C	Uniquely identifies Beam specified by Beam Number within Beam Sequence in RT Beams module.
(300C,0050)	> Referenced Dose Reference Sequence	3	Introduces sequence of Dose References for the current Fraction Group.
(300C,0051)	>> Referenced Dose Reference Number	1C	Uniquely identifies Dose Reference specified by Dose Reference Number within Dose Reference Sequence in RT Prescription module.

## RT Beams Module

The following table lists the attributes that are used to create a new treatment field for the patient. Only Beams with a Treatment Delivery Type of TREATMENT are translated to treatment fields. Beams that do not have the Treatment Delivery Type attribute are considered to be TREATMENT beams. If Beam Number conflicts with an existing Treatment Field ID for the patient in the database, the existing treatment field’s revision is incremented and the imported field is imported as the current revision. Otherwise a new treatment field is created. If the Treatment Machine Name does not match an existing Treatment Machine in the database, this attribute is not used and the Treatment Machine for this treatment field is set to blank.

Tag	Name	Type	Description
(300A,00B0)	Beam Sequence	1	Introduces sequence of treatment beams for current RT Plan.
(0008,0070)	> Manufacturer	2	This attribute is translated to MLC_Type. If this attribute is “GE”, set to 1; “PHILIPS” or “ELEKTA”, set to 2; “SCANDATRONICS”, set to 3; “SIEMENS”, set to 4; “VARIAN”, set to 5; “BRAINLAB”, set to 6; “RADIONICS”, set to 7; “LIEBINGER-FISHER”, set to 8; “WELLHOFER”, set to 9; “MITSUBISHI”, set to 10; Otherwise, set to 11.
(300A,00B2)	> Treatment Machine Name	2	This attribute is translated to Treatment_Machine and only the first 20 characters of this attribute are used. This attribute is used to match with an existing machine in the database so that conversion of treatment geometry attributes from IEC-based coordinate system to machine-based native coordinate system can be performed.
(300A,00B3)	> Primary Dosimeter Unit	3	Measurement unit of machine dosimeter. Enumerated values are MU or MINUTE.

Tag	Name	Type	Description
(300A,00B4)	> Source to Axis Distance	3	Radiation source to Gantry rotation axis distance. This attribute is translated to SAD and ranges from 30.0 to 999.9 centimeters.
(300A,00B6)	> Beam Limiting Device Sequence	1	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) sets.
(300A,00B8)	>> Beam Limiting Device Type	1	X = symmetric jaw pair in X direction Y = symmetric jaw pair in Y direction ASYMX = asymmetric jaw pair in X direction ASYMY = asymmetric jaw pair in Y direction MLCX = multileaf jaw pair in X direction MLCY = multileaf jaw pair in Y direction
(300A,00BC)	>> Number of Leaf/Jaw Pairs	1	Number of leaf (element) or jaw pairs (equal to 1 for standard beam limiting device jaws). This attribute is translated to MLC Leaves (20-100) if Beam Limiting Device Type (300A,00B8) is either MLCX or MLCY.
(300A,00C0)	> Beam Number	1	Identification number of the Beam. This attribute is translated to Field_ID if Beam Name (300A,00C2) does not exist or is NULL. Only the first 5 characters of this attribute are used.
(300A,00C2)	> Beam Name	3	This attribute is translated to the Field_ID (first 5 characters).
(300A,00C3)	> Beam Description	3	This attribute is translated to Field_Name (first 20 characters).
(300A,00C4)	> Beam Type	1	Motion characteristic of Beam. Enumerated values are STATIC or DYNAMIC.
(300A,00C6)	> Radiation Type	2	Particle type of Beam. This attribute is translated to Modality. An enumerated value of PHOTON is translated to Xrays, a value of ELECTRON to Elect, and all other enumerated values are translated to NULL.
(300A,00CE)	> Treatment Delivery Type	3	Only Beams with Treatment Delivery Type of TREATMENT are translated to treatment fields. If this attribute is missing, the Beam is considered to be a TREATMENT beam.
(300A,00D0)	> Number of Wedges	1	Number of wedges associated with current Beam. Only a value of 1 is supported.

Tag	Name	Type	Description
(300A,00D1)	> Wedge Sequence	1C	Introduces sequence of treatment wedges. Required if Number of Wedges is non-zero.
(300A,00D3)	>> Wedge Type	2C	STANDARD = standard (static) wedge DYNAMIC = moving beam limiting device jaw simulating wedge MOTORIZED = single wedge that can be remotely removed from the beam
(300A,00D4)	>> Wedge ID	3	This attribute is translated to Wedge and Dynamic_Wedge if Wedge Type (300A,00D3) is MOTORIZED. Only the first 10 characters of this attribute are used.
(300A,00E0)	> Number of Compensators	1	Number of Compensators associated with current Beam.
(300A,00E3)	> Compensator Sequence	1C	Introduces sequence of treatment compensators. Required if Number of Compensators is non-zero.
(300A,00E5)	>> Compensator ID	3	This attribute is translated to Compensator if Radiation Type (300A, 00C6) is PHOTON, or eField Def Aperture if Radiation Type is ELECTRON. Only the first 10 characters of this attribute are used.
(300A,00F0)	> Number of Blocks	1	Number of shielding blocks associated with Beam.
(300A,00F4)	> Block Sequence	1C	Introduces sequence of blocks associated with Beam. Required if Number of Blocks is non-zero.
(300A,00F5)	>> Block Tray ID	3	This attribute is translated to Block. Only the first 10 characters of this attribute are used.
(300A,0107)	> Applicator Sequence	3	Introduces sequence of Applicators. Only a single item shall be permitted in this sequence.
(300A,0108)	>> Applicator ID	1C	This attribute is translated to eApplicator if Radiation Type (300A, 00C6) is ELECTRON. Only the first 10 characters of this attribute are used.
(300A,010E)	> Final Cumulative Meterset Weight	1C	Value of Cumulative Meterset Weight (300A, 0134) for final Control Point. This attribute is used to calculate Monitor_Units (= Cumulative Meterset Weight divided by Final Cumulative Meterset Weight).

Tag	Name	Type	Description
(300A,0110)	> Number of Control Points	1	This attribute is translated to Total_Control_Points and ranges in value from 1 to 999. If Beam Type (300A,00C4) is STATIC, Total_Control_Points is set to 1.
(300A,0111)	> Control Point Sequence	1C	Introduces sequence of machine configurations describing treatment beam. Two or more items may be included in this sequence.
(300A,0112)	>> Control Point Index	1C	Index of current Control Point, starting at 0 for first Control Point. This attribute is translated to Control_Pt_Number and ranges in value from 0 to 999.
(300A,0114)	>> Nominal Beam Energy	3	Nominal Beam Energy at control point (MV/MeV). This attribute is translated to Energy and ranges from 0 to 99.99 MeV.
(300A,0115)	>> Dose Rate Set	3	This attribute is translated to Doserate (MU/min) and ranges from 1 to 9999.
(300A,0116)	>> Wedge Position Sequence	3	Introduces sequence of Wedge positions.
(300A,0118)	>>> Wedge Position	1C	Position of Wedge at current control point. Enumerated values are IN or OUT.
(300A,011A)	>> Beam Limiting Device Position Sequence	1C	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) positions.
(300A,00B8)	>>> Beam Limiting Device Type	1C	X = symmetric jaw pair in X direction Y = symmetric jaw pair in Y direction ASYMX = asymmetric jaw pair in X direction ASYMY = asymmetric jaw pair in Y direction MLCX = multileaf jaw pair in X direction MLCY = multileaf jaw pair in Y direction.
(300A,011C)	>>> Leaf/Jaw Positions	1C	Positions (mm) of beam limiting device leaf or jaw pairs. This attribute is translated to Field_X (00.0-50.0 cm), Field_Y (00.0-50.0 cm), Collimator_X1 (-20.0-25.0 cm), Collimator_X2 (-20.0-25.0 cm), Collimator_Y1 (-20.0-25.0 cm), Collimator_Y2 (-20.0-25.0 cm), and MLC_LPn (-25.00-25.00 cm) depending on Beam Limiting Device Type (300A, 00B8).

Tag	Name	Type	Description
(300A,011E)	>> Gantry Angle	1C	This attribute translates to Arc_Start_Angle, Arc_Stop_Angle and Gantry_Angle, and ranges from –360.0 to 360.0 degrees.
(300A,011F)	>> Gantry Rotation Direction	1C	Direction of gantry rotation when viewing gantry from isocenter. CW = clockwise CC = counter-clockwise NONE = no rotation. This attribute is translated to Arc_Direction and Gantry_Dir.
(300A,0120)	>> Beam Limiting Device Angle	1C	This attribute is translated to Collimator_Angle and ranges from –360.0 to 360.0 degrees.
(300A,0121)	>> Beam Limiting Device Rotation Direction	1C	Direction of beam limiting device rotation when viewing beam limiting device from radiation source. CW = clockwise CC = counter-clockwise NONE = no rotation. This attribute is translated to Collimator_Dir.
(300A,0130)	>> Source to Surface Distance	3	Source to Patient Surface distance (mm). This attribute is translated to SSD and ranges from 10.0 to 999.9 cm.
(300A,0134)	>> Cumulative Meter-set Weight	2C	Cumulative Weight to current control point. This attribute is used for calculating Monitor_Units (= Cumulative Meterset Weight divided by Final Cumulative Meterset Weight).
(300C,0050)	>> Referenced Dose Reference Sequence	3	Introduces sequence of Dose References for current Beam. Each Dose Reference translates to either a Primary Site (if Dose Reference Type is TARGET) or Secondary Site (if Dose Reference Type is ORGAN_AT_RISK) for the current Beam.
(300A,010C)	>>> Cumulative Dose Reference Coefficient	2C	Coefficient used to calculate cumulative dose contribution from this Beam to the referenced Dose Reference. This attribute is translated to Reg_Coeff and ranges from 0 to 9.99999.
(300C,0051)	>>> Referenced Dose Reference Number	1C	Uniquely identifies Dose Reference specified by Dose Reference Number in Dose Reference Sequence in RT Prescription module.

### Approval Module

Tag	Name	Type	Description
(300E,0002)	Approval Status	1	Approval status at the time the SOP Instance was created. 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.
(300E,0008)	Reviewer's Name	2C	Name of person who reviewed object. Required if Approval Status (300E, 0002) is APPROVED or REJECTED. This attribute is translated to MD_Approve_LName (20 characters), MD_Approve_FName (20 characters) and MD_Approve_Minial (1 character).

### SOP Common Module

Tag	Name	Type	Description
(0008,0005)	Specific Character Set	IC	Character Set that expands or replaces the Basic Graphic Set. This attribute is not explicitly used; all characters in strings are assumed to be from the Default Character Repertoire defined in {DICM}. Otherwise string comparisons with data from the database may fail, and applications that access the imported character strings may not print or display them correctly.