

# **DICOM Conformance Statement**

## **Vision Applications 6**

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Vision Applications, DICOM Conformance Statement

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# 1. Introduction

## 1.1 Purpose

This conformance statement specifies how the Vision applications conform to the DICOM V 3.0 standard. Vision applications use DICOM to receive and transmit objects that are used in the radiation therapy process. Further more images and image related data can be printed on a hard copy medium using the DICOM Print Management Service Class.

## 1.2 Scope

The scope and format of this document from chapter 2 on are defined by the part 2 of the DICOM V3.0 standard. Some sections defined in the standard that are not applicable to the software described herein are left out for clarity.

## 1.3 Definitions

This section provides the definitions of terms, acronyms, and abbreviations, which are used throughout the document.

AE	Application Entity
VDCM	Name of the Vision Applications DICOM program
VDCMPrint	Name of the Vision Applications DICOM Print Management program
DICOM	Digital Imaging and Communications in Medicine, a standard on image communications in medical applications
PDU	Protocol Data Unit
SCU	Service Class User
SCP	Service Class Provider
SOP	Service-Object-Pair, a definition of an information object (like an image) and of a service (like storage) that can be performed for the object
TCP/IP	Transmission Control Program / Internet Protocol, a widely used computer networking protocol
VR	Value Representation, a data encoding method in DICOM
Multi-frame Image	Image that contains multiple two-dimensional pixel planes

## 1.4 Related Documents

- [1] Digital Imaging and Communications in Medicine (DICOM), Parts 1-14 (1998), National Electrical Manufacturers Association

## 2. Implementation Model

### 2.1 Application data flow diagram

A diagram illustrating the application model is shown in Figure 1: Application Data Flow Diagram below.

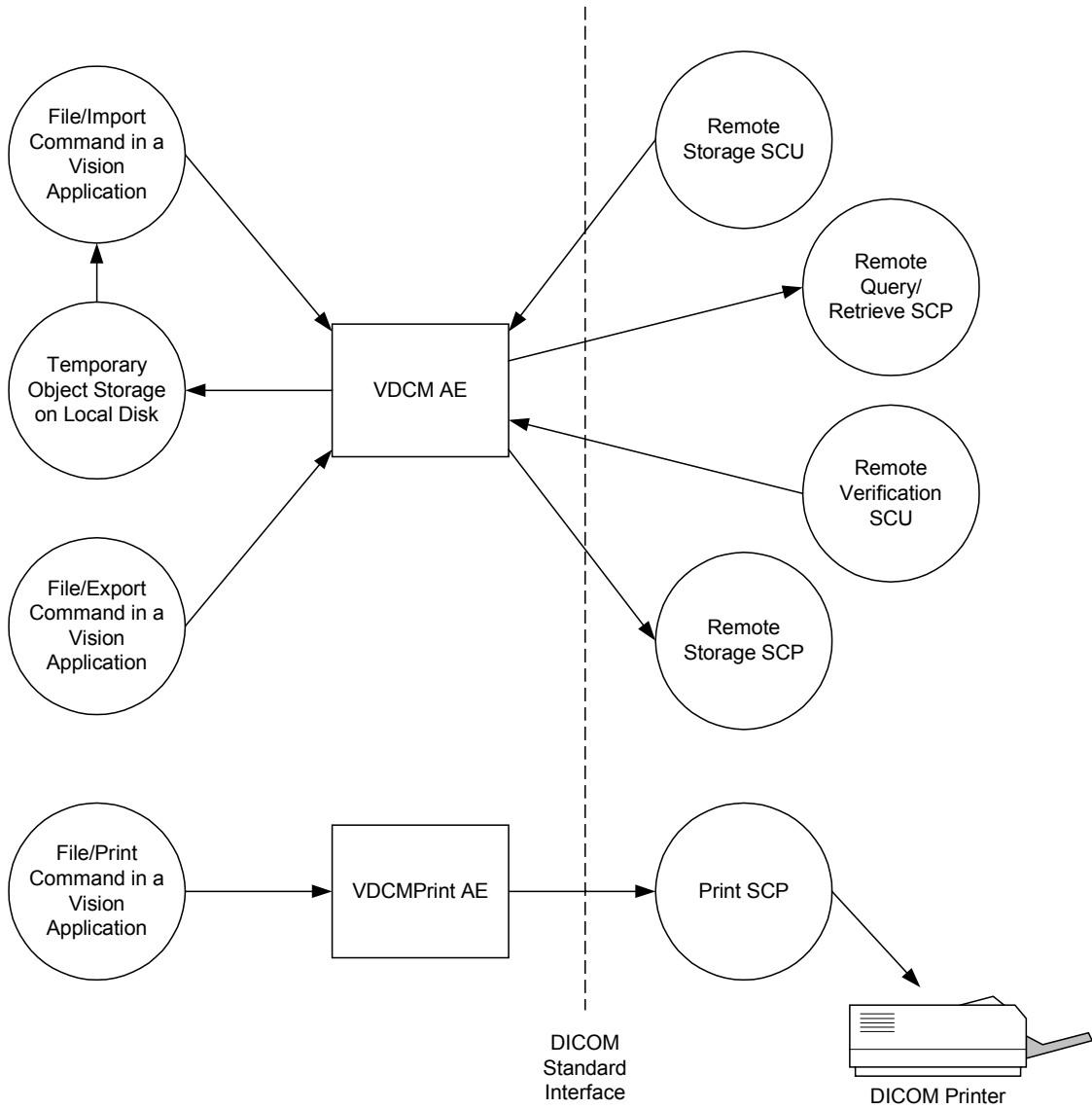


Figure 1: Application Data Flow Diagram

## **2.2 VDCM and VDCMPrint AE Functional Definition**

The VDCM application entity is responsible for all DICOM communications. Depending on the specific installation this application is running either all the time, or only when started by the user. It accepts storage requests of the service classes specified below. The objects are stored in separate intermediate files, from which they are read in and converted by Vision Applications when the user issues an appropriate command. The C-echo messages to the Verification SCP are automatically responded to with a C-echo response.

The VDCMPrint application entity contains the DICOM Print Management. VDCMPrint is responsible for acquiring all the information which is required to print a film session. The film session contains one or more films related in an user defined way (e.g. belonging to the same patient or to the same folder). Each film consists of one or more images.

## 3. AE Specifications

### 3.1 VDCM AE Specification

The VDCM Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes:

SOP Class Name	SCU/SCP Role	SOP Class UID
Verification (Echo)	SCP only	1.2.840.10008.1.1
CR Image Storage	Both	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	Both	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	Both	1.2.840.10008.5.1.4.1.1.4
Ultrasound Image Storage (*)	Both	1.2.840.10008.5.1.4.1.1.6 (retired) 1.2.840.10008.5.1.4.1.1.6.1
Secondary Capture Image Storage (*)	Both	1.2.840.10008.5.1.4.1.1.7
X-Ray Angiographic Image Storage (*)	Both	1.2.840.10008.5.1.4.1.1.12.1
RT Image Storage	Both	1.2.840.10008.5.1.4.1.1.481.1
RT Structure Set Storage	Both	1.2.840.10008.5.1.4.1.1.481.3
RT Plan Storage	Both	1.2.840.10008.5.1.4.1.1.481.5
Study Root Query/Retrieve information model- FIND	SCU	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve information model- MOVE	SCU	1.2.840.10008.5.1.4.1.2.2.2

**Note:** Query/Retrieve will be supported as a SCP in future releases of the software.

For (\*) see chapter SOP Specific conformance to the supported storage service classes, SCP role

#### 3.1.1 Association Establishment Policies

##### 3.1.1.1 General

The maximum PDU length of the AE is 32768 bytes.

The AE does not support any SOP class extended negotiations. The user information item sent by this AE only contains the maximum PDU length and the Implementation UID.

### **3.1.1.2 Number of associations**

The VDCM AE accepts any number of simultaneous associations. Note however, that multiple associations at a time affect the response time of the system, and may thus cause time-outs on the association initiator side.

### **3.1.1.3 Asynchronous nature**

Asynchronous operation is not supported.

### **3.1.1.4 Implementation Identifying information**

The Implementation Class UID of the application entity is:

1.2.246.352.43077212.2

No implementation version information is given.

## **3.1.2 Association Initiation by Real-World Activity**

The VDCM application entity initiates associations in two different cases:

1. The user selects the File/Export command in a Vision application and then selects an export destination that is configured to use DICOM. The service class used depends on the type of the object that the user has selected before the File/Export command.
2. The user selects the File/Import command and an import source that has been configured to use the DICOM Query/Retrieve service class.

## **3.1.3 Association Acceptance Policy**

The VDCM accepts all association requests that request one of the supported service classes. It does not place any limits on the number of concurrent associations or on who may connect to it.

### **3.1.3.1 Associated real world activity**

When objects are sent to VDCM, it stores them to temporary files. The user may then use the File/Import command to read the objects into the database.

In case of Query/Retrieve, the objects that are received by VDCM are read into the database as they are received.

### 3.1.3.2 Presentation Context Table

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	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/ SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.1 2.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
RT Plan Storage	1.2.840.10008.5.1.4.1.1.4 81.5	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.4 81.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
RT Image Storage	1.2.840.10008.5.1.4.1.1.4 81.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None

Study Root Query/Retrieve information model- FIND	1.2.840.10008.5.1.4.1.2.2.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
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

### **SOP Specific conformance to the verification service class**

VDCM provides standard conformance to the DICOM Verification Service Class.

### **SOP Specific conformance to the supported image storage service classes**

#### **SCP role**

VDCM conforms to the image storage service classes at level 0 (local) for CT, CR and MR. This means that only the attributes of the images that can be saved in the Vision database are stored by VDCM and all others are discarded. However, it is guaranteed that at least all type 1 attributes are stored. For other image modalities even type 1 attributes may be discarded.

A successful C-STORE operation means that the image has been received, and saved to a temporary file, which can then be read in to the Vision database by the user. The successful termination of the association does not imply that the image data is either syntactically or semantically correct.

#### **SCU Role**

In a case of successful C-STORE operation, the program does not display the user any information but returns to its normal state. All C-STORE-responses with a warning or unsuccessful status cause the program to display warning messages to the user.

### **SOP Specific conformance to the Query/Retrieve service class**

Priority processing is not used.

Mainly unique and required keys are supported. On study level the two optional keys Patient Name and Patient Id can be specified. Wild card matching (\*) is used.

No relational queries are allowed.

For the C-STORE sub-operations generated in the C-MOVE all SOP classes as listed in VDCM AE Specification are supported.

## **SOP Specific conformance to the RT Structure Set storage service class**

### **Conformance as a SCP**

VDCM conforms to the RT Structure Set storage service classes at level 0 (local). This means that only the attributes of the structure sets that can be converted to meaningful information for Vision Applications are utilized.

A successful C-STORE operation means that the structure set has been received, and saved to a temporary file. The successful termination does not imply that the data is either syntactically or semantically correct.

The system can only use ROI contours which lie on the slice planes of the CT or MR image set that is referenced by the structure set module.

Before the structure set can be imported in Vision Applications, the corresponding CT or MR image set has to be sent to the system and it has to be read in to the program. A volume image shall be constructed in advance by the user. The structure set can be imported and added to the appropriate volume image. A ROI contour is discarded if it's referencing an image which can not be found in the system.

### **Conformance as a SCU**

In case of a failure or warning status responded by the structure set receiver, an error message is displayed to the user. Otherwise no messages are displayed.

## **SOP Specific conformance to the RT Plan storage service class**

### **Conformance as a SCP**

VDCM conforms to the RT Plan storage service classes at level 0 (local). This means that only the attributes of the plan that can be converted to meaningful information for Vision Applications are utilized.

A successful C-STORE operation means that the plan has been received, and saved to a temporary file. The successful termination does not imply that the data is either syntactically or semantically correct.

All information in the RT Prescription, RT Tolerance Tables, RT Patient Setup and RT Fraction Scheme modules is discarded. Compensator and Bolus will be supported in future releases. BeamLimitingDevice data will be only stored in case of successful verification of the imported treatment machine together with the BeamLimitingDevice (verification criteria see Appendix). The same applies for the imported Wedge, Block and Applicator data. The Data is discarded if verification fails.

Treatment beams with multiple control points can be read in to Vision Applications only if they represent static or arc fields, and contain a maximum of 2 control points.

### **Conformance as a SCU**

In case of a failure or warning status responded by the plan receiver, an error message is displayed to the user. Otherwise no messages are displayed.

## **SOP Specific conformance to the RT Image storage service class**

### **Conformance as a SCP**

VDCM conforms to the RT Image storage service classes at level 0 (local). This means that only the attributes of the RT image that can be converted to meaningful information for Vision Applications are utilized.

A successful C-STORE operation means that the RT image has been received, and saved to a

temporary file. The successful termination does not imply that the data is either syntactically or semantically correct.

If the RT image references the RT Plan and RT Beam, the referenced RT Plan has to be imported before the image to be able to preserve the association. On import of the RT Image no plans and fields are created.

#### **Conformance as a SCU**

In case of a failure or warning status responded by the RT Image receiver, an error message is displayed to the user. Otherwise no messages are displayed.

### **3.1.3.3 Presentation context and acceptance criterion**

VDCM will accept the presentation contexts mentioned in the Presentation Context Table above.

### **3.1.3.4 Transfer syntax selection policies**

VDCM will only accept the DICOM default transfer syntax.

## 3.2 VDCMPrint AE Specifications

VDCMPrint AE provides standard conformance as a Print Management SCU to the following SOP classes:

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
>Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
>Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
>Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
>Printer SOP Class	1.2.840.10008.5.1.1.16

### 3.2.1 Association Establishment Policies

#### 3.2.1.1 General

The maximum PDU length of the AE is 32768 bytes. The user information item sent by this AE only contains the maximum PDU length and the Implementation UID.

#### 3.2.1.2 Number of associations

The VDCMPrint AE acts as an Association-requester i.e. VDCMPrint establishes one single association to any remote AE at any time.

#### 3.2.1.3 Asynchronous nature

Asynchronous operation is not supported.

#### 3.2.1.4 Implementation Identifying information

The Implementation Class UID of the Print Management application entity (VDCMPrint) is:

1.2.246.352.43077212.3

No implementation version information is given.

### 3.2.2 Association Initiation by Real-World Activity

The VDCMPrint application entity initiates associations when the user selects the File/Print command in a Vision application and then selects a printer which is capable to use DICOM. The VDCMPrint AE allows the user to set print parameters and to transmit images for printing. Presentation Context Table.

### 3.2.2.1 Presentation Context Table

The VDCMPrint AE supports the listed Abstract Syntaxes and Transfer Syntaxes as a Print Management SCU.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Printer SOP Class	1.2.840.10008.5.1.1.16	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

### SOP Specific conformance for Meta SOP Class: Basic Grayscale Print Management

The Meta SOP Class is defined by the following set of supported SOP Classes.

- Basic Film Session SOP Class
- Basic Film Box SOP Class
- Basic Grayscale Image Box SOP Class
- Printer SOP Class

### SOP Specific conformance for SOP Class: Basic Film Session

VDCMPrint AE supports the following Attributes of the N-CREATE DIMSE Service:

Attribute Name	Tag
Number of Copies	(2000, 0010)
Medium Type	(2000, 0030)
Film Session Label	(2000, 0050)

### SOP Specific conformance for SOP Class: Basic Film Box

VDCMPrint AE supports the following Attributes of the N-CREATE DIMSE Service:

Attribute Name	Tag
Image Display Format	(2010, 0010)
Referenced Film Session Sequence	(2010, 0500)
Film Orientation	(2010, 0040)
Film Size ID	(2010, 0050)
Magnification Type	(2010, 0060)

### SOP Specific conformance for SOP Class: Basic Grayscale Image Box

VDCMPrint AE supports the following Attributes of the N-SET DIMSE Service:

Attribute Name	Tag	Range
Image Position	(2020,0010)	
Preformatted Grayscale Image Sequence	(2020,0110)	
>Samples Per Pixel	(0028,0002)	1
>Photometric Interpretation	(0028,0004)	MONOCHROME1 or 2
>Rows	(0028,0010)	Depending on image
>Columns	(0028,0011)	Depending on image
>Pixel Aspect Ratio	(0028,0034)	Depending on image
>Bits Allocated	(0028,0100)	16 / 8
>Bits Stored	(0028,0101)	12 / 8
>High Bit	(0028,0102)	11 / 7

>Pixel Representation	(0028,0103)	unsigned integer
>Pixel Data	(7FE0,0010)	
Magnification Type	(2010,0060)	

**SOP Specific conformance for SOP Class: Printer**

VDCMPrint AE supports the mandatory service element N-EVENT-REPORT.

The N-GET DIMSE Service Attributes supported are:

<b>Attribute name</b>	<b>Tag</b>
Printer Status	(2110, 0010)
Printer Status Info	(2110,0020)

### 3.2.3 Association Acceptance Policy

The VDCMPrint AE does not accept any association from a remote AE.

## **4. Communication profiles**

### **4.1 Supported communications stacks**

VDCM and VDCMPrint provide DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 (part 8 of the DICOM V3.0 standard).

#### **4.1.1 TCP/IP stack**

VDCM and VDCMPrint uses the TCP/IP stack of Windows NT (Winsock) which is the operating system of the Vision application system.

##### **4.1.1.1 Physical media support**

VDCM and VDCMPrint can run on any physical network media that is supported by the underlying hardware and operating system (i.e. standard PCs and Windows NT). These include, but are not limited to: thin, thick, and twisted-pair Ethernet, token ring network and FDDI.

## 5. Configuration

The configurable parameters of VDCM are:

- For the storage and Query/Retrieve service class SCUs the TCP/IP address, calling and called AE title and port number of the destination are configurable. Multiple configurations can exist in the system at the same time.
- The TCP/IP port number.  
The port number defaults to 104 (decimal), but it can be configured to be any number that is acceptable for TCP/IP.
- Whether or not a debug log is produced.  
By default no debug log is produced by VDCM. It can be configured to produce an ASCII log of its actions in a file called 'dicom.log'

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# Appendix A

## Limitations

### General

The following sub-modules of the module RT Beams are currently not supported:

- RT Compensator
- RT Bolus
- References to RT Dose module and RT Dose

Modules of the RT Plan IOD which are currently not supported

- RT Tolerance Table
- RT Patient Setup (only used for verification)
- RT Prescription
- RT Fraction Scheme

RT Image Module

- Multiframe images are not supported and the RT Image Module which contains only a single item in the Exposure sequence are supported.

### RT Beams Module

The RTCompensator and RTBolus shall be supported in future releases.

Dynamic Treatment currently not supported i.e. only static fields or standard arc therapy with 2 control points can be imported/exported.

Attribute Name	Tag	Supported
Beam Type	(300A,00C3)	STATIC = all beam parameters remain unchanged during delivery  DYNAMIC = two Control Points allowed where only the Gantry Angle (300A,011E) may change
Radiation Type	(300A, 00C6)	PHOTON, ELECTRON
Number of Wedges	(300A, 00D0)	Only one wedge per beam is supported
Number of Compensators	(300A,00E0)	Only value 0 is supported i.e. data sent in the compensator sequence will be discarded on import.

Number of Boli	(300A,00ED)	Only value 0 is supported i.e. references sent in the Referenced Bolus Sequence will be discarded on import.
Beam Limiting Device Position Sequence	(300A,011A)	Sequence is only supported for the first Control Point, i.e. dynamic treatments besides arc therapy are not supported.
Beam Limiting Device Rotation Direction	(300A,0121)	Only type NONE is supported
Patient Support Rotation Direction	(300A,0123)	Only type NONE is supported
Table Top Eccentric Rotation Direction	(300A,0126)	Only type NONE is supported

### RT Image Module

Attribute Name	Tag	Supported
RT Image Plane	(3002,0000C)	NORMAL = image plane normal to beam axis
Image Type	(0028,0008)	BLANK are not supported

### RT ROI Contour Module

The system can only use ROI contours of the type mentioned in the table and the contours have to be on the slice planes of the CT or MR images which are referenced by one of the frames of reference in the Referenced Frame of Reference Sequence.

Attribute Name	Tag	Supported
Contour Geometric Type	(3006,0042)	POINT, OPEN_PLANAR, CLOSED_PLANAR

### RT Structure Set

Tag (3006, 0016) referenced images must be present, i.e. a structure set which was created without referencing images will not be imported by Vision Applications.

## Appendix B

# Requirements

For a successful exchange of RT data certain DICOM tags must map with attributes of the corresponding data in Vision Applications. Data may be discarded or rejected otherwise.

In case of the RT Plan for example the beam can be imported even though the treatment device can not be verified. Wedges or Applicators on the other hand will be discarded.

### Treatment Machine

The mapping will be successful

- if the DICOM Treatment Machine Name (tag (300A, 00B2)) is the same as the Radiation Device ID in Vision
- or if the DICOM Treatment Machine Name is the same as the Radiation Device Name in Vision
- or if the DICOM Device Serial Number (tag (0018, 1000)) is the same as the Radiation Device Manufacturer Serial No. in Vision

Further more the Source Axis Distance (tag (300A,00B4)), if present, must be equal to the SAD of the Radiation Device in Vision and the Table Top Eccentric Axis Distance (tag (300A, 0124)), if present, must be equal to the Table Top Eccentric of the Vision Machine.

### Wedge

A wedge is successfully verified if wedge angle (tag (300A, 00D5)), wedge orientation (tag (3000A, 00D8)) and wedge type (tag (300A, 00D3)) are equal to a wedge of the specific treatment machine in the Vision Application. If multiple wedges are fulfilling the criteria the wedge ID in Vision must be the same as the wedge number (tag (300A, 00D2)).

### Applicator

The applicator Id (tag (300A,0108)) must be the same as the Applicator ID in Vision.

### MLC

Number of Leaf/Jaw pairs (tag (300A, 00BC)) must be the same as the number of leaves in the Vision Application MLC

### Block

In Vision Applications one single Block may contain multiple block edges (closed polygons). DICOM blocks which have the same thickness (tag (300A,0100)) and block type (tag (300A,00F8)) are combined into one block on import.

### Field (Beam)

For the static beam the second control point shall not contain any values besides the Control Point Index (tag (300A,0112)) and Cumulative Meterset Weight (tag (300A,0134)).

In case of a dynamic beam also the Gantry Angle (tag (300A,011E)) shall be present in the second control point.

## **Patient Setup**

Although Vision applications do not support the patient setup module certain verifications have to be done on import of a RT Plan. If the plan is referencing a Structure Set which has been imported before, the patient position of the connected 3D image is checked. If no Structure Set is referenced by the Plan, the user may choose a 3D image. The same check is performed. A warning is given if the Patient position of any referenced patient setup (tag (0018, 5100)) is not equal to the patient position of the 3D image.