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Digital Imaging and Communications in Medicine (DICOM)

Supplement 131: Implant Templates

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Scope and Field

155 This supplement describes storage, query and retrieval of implant templates (generally non-patient-specific) as they are used in implantation planning. The supplement contains a generic IOD for implants of an unspecified type and an IOD that describes assemblies of implant components for specific surgical use cases.

160 The Generic Implant Template IOD is used to encode the description of a specific surgical implant (vendor, type, serial number), its shape and planning landmarks used to register them with patient images. Together with the Implant Assembly Template IOD these IODs describe how multiple components are to be assembled.

The associated Service Classes support the storage (C-STORE), query (C-FIND), and retrieve (C-MOVE), (C-GET) of Implant Template Instances between servers and workstations.

165 3D templates are described using the Surface Mesh Module while 2D templates are described by encapsulated documents that comply with a subset of HPGL, which is specified within this Supplement.

The Generic Implant Template IOD supports the following features:

- 170 — An Implant IOD Instance contains information about one physical part of an implant. If implants consist of several components, each component will be represented in a separate Instance.
- Implant Template Instances (can) contain information about:
 - o Manufacturer, Name, Part Number, ...
 - o Shape
 - 175 o Indication
 - o Coordinate Systems that can be used to match one implant with another implant in an assembly
 - o Anatomical Landmarks
- 180 — Query for Implant Templates is possible by name, manufacturer, body part, and other Attributes.

The Implant Assembly Templates IOD supports the following features:

- It references several Implant Template Instances and provides a list of possible combinations between the represented implants.
- 185 — By referencing Mating Feature in the Implant Template Instances the spatial relation between compatible components after the assembly is described.
- Query for Implant Assembly Templates are possible by name, manufacturer, intervention type, target anatomy, and other Attributes.

The Implant Template Group IOD supports the following features:

- 190 — It references several Implant Template Instances and provides dimensions according to which the templates can be ordered.

- Defines a common coordinate system according to which all templates in a group can be roughly aligned.
- Query for Implant Template Groups are possible by name, issuer, intervention type, target anatomy, and other Attributes.

195 The associated Service Classes support the storage (C-STORE), query (C-FIND), and retrieve (C-MOVE), (C-GET) of Implant Assembly Template Instances between servers and workstations.

200

205

Changes to NEMA Standards Publication PS 3.2-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

Item: Add SOP Class to Table A.1-2

210

**Table A.1-2
UID VALUES**

UID Value	UID NAME	Category
...		
1.2.840.10008.5.1.4.43.1 Gener	ic Implant Template Storage	Transfer
1.2.840.10008.5.1.4.43.2 Gener	ic Implant Template Information Model – FIND	Query / Retrieve
1.2.840.10008.5.1.4.43.3 Gener	ic Implant Template Information Model – MOVE	Query / Retrieve
1.2.840.10008.5.1.4.43.4 Gener	ic Implant Template Information Model – GET	Query / Retrieve
1.2.840.10008.5.1.4.44.1 Implant	Assembly Template Storage	Transfer
1.2.840.10008.5.1.4.44.2 Implant	Assembly Template Information Model – FIND	Query / Retrieve
1.2.840.10008.5.1.4.44.3 Implant	Assembly Template Information Model – MOVE	Query / Retrieve
1.2.840.10008.5.1.4.44.4 Implant	Assembly Template Information Model – GET	Query / Retrieve
1.2.840.10008.5.1.4.45.1 Im	plant Template Group Storage	Transfer
1.2.840.10008.5.1.4.45.2 Im	plant Template Group Information Model – FIND	Query / Retrieve
1.2.840.10008.5.1.4.45.3 Im	plant Template Group Information Model – MOVE	Query / Retrieve
1.2.840.10008.5.1.4.45.4 Im	plant Template Group Information Model – GET	Query / Retrieve
...		

215

220

Changes to NEMA Standards Publication PS 3.3-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

225

Item: Add In Section 2

2 Normative references

230 HPGL HEWLETT PACKARD PCL/PJL Reference
PCL5 Printer Language Technical Reference Manual Part II
HP Part No. 5961-0509
URL: <http://h20000.www2.hp.com/bc/docs/support/SupportManual/bpl13211/bpl13211.pdf>.

Item: Add In Section 7

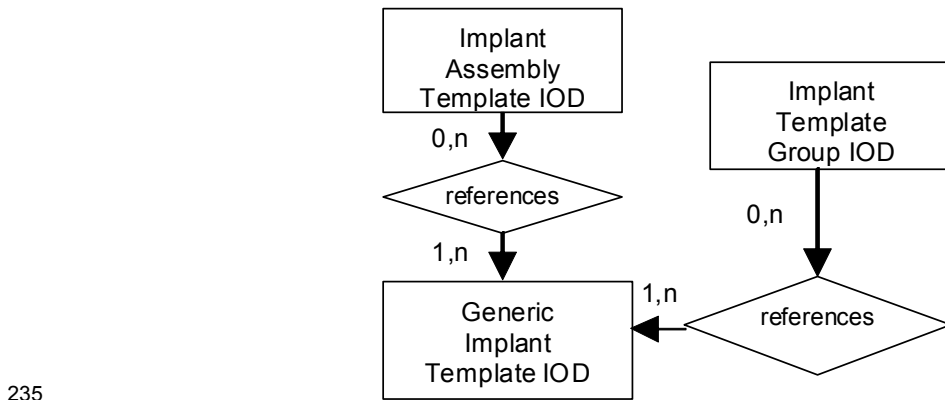


Figure 7-2z
DICOM INFORMATION MODEL - IMPLANT TEMPLATES

7.1 DICOM INFORMATION MODEL

240 The DICOM Information Model is derived from the DICOM Model of the Real-World. The DICOM
Information Model presented by Figures 7-2a, 7-2b, **and 7-2c, and 7-2z** identify the various IODs
specified by this Standard and their relationships. There is not always a one-to-one
correspondence between DICOM Information Object Definitions and Real-World Objects. For
245 example a Composite IOD contains Attributes of multiple real-world objects such as series,
equipment, frame of reference, study and patient.

The entities in Figures 7-2a, 7-2b, **and 7-2c, and 7-2z** correspond to IODs defined in Annexes A
through C.

Item: Add In Section 7.X

7.X EXTENSION OF DICOM MODEL OF THE REAL WORLD FOR IMPLANT TEMPLATES

250 For the purpose of Implant Template SOP Classes the DICOM Model of the Real-World is described in this section. This subset of the real-world model covers the requirements for the planning of surgical implantation of implants using 2D and/or 3D templates. In this context, a Manufacturer may be a company, an institution or a person that issues Implant Templates.

Figures 7.X-1 is an abstract description of the real world objects involved in Implant Templates.

255

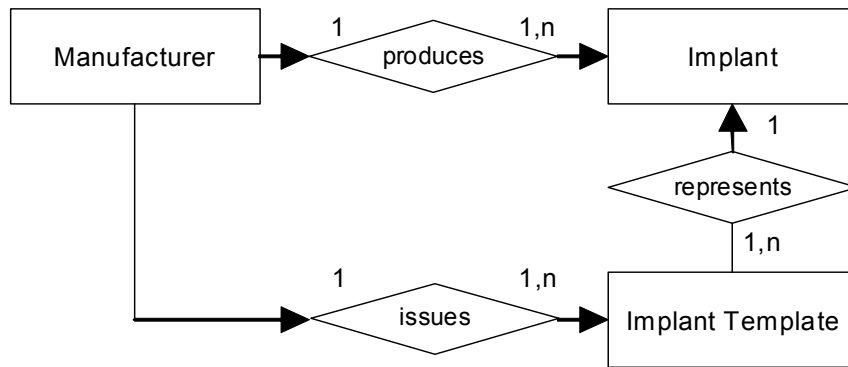
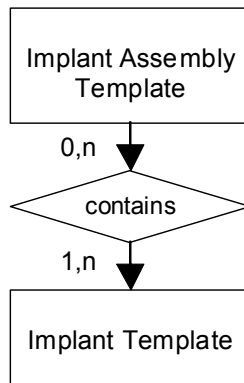
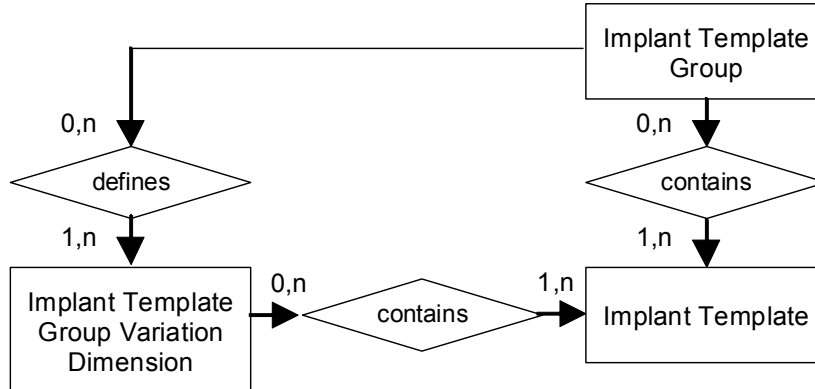


Figure 7.X-1
IMPLANT TEMPLATE MODEL OF THE REAL WORLD



260

**Figure 7.X-2
IMPLANT ASSEMBLY TEMPLATE MODEL OF THE REAL WORLD**



265

**Figure 7.X-3
IMPLANT TEMPLATE GROUP MODEL OF THE REAL WORLD**

Item: Add in Section A.1.4, rows and column to Table A.1-2

A.1.4 Overview of the Composite IOD Module Content

IODs Modules	<u>Generic Implant Template</u>	<u>Implant Assembly Template</u>	<u>Implant Template Group</u>
<u>Generic Implant Template Description</u>	<u>M</u>		
<u>Generic Implant Template 2D Drawings</u>	<u>C</u>		
<u>Generic Implant Template 3D Models</u>	<u>C</u>		
<u>Generic Implant Template Mating Features</u>	<u>U</u>		

<u>Generic Implant Template Planning Landmarks</u>	<u>U</u>		
<u>Implant Assembly Template</u>		<u>M</u>	
<u>Implant Template Group</u>			<u>M</u>
SOP Common	<u>M</u>	<u>M</u>	<u>M</u>
<u>Surface Mesh</u>	<u>U</u>		

270

Item: Add in the following new section in Annex A

A.X GENERIC IMPLANT TEMPLATE INFORMATION OBJECT DEFINITION

A.X.1 Generic Implant Template IOD Description

275

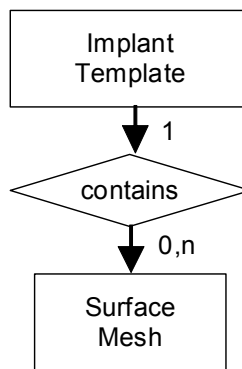
The Generic Implant Template Information Object Definition (IOD) specifies the description of a 2D- and/or 3D-template representing a rigid and passive implant. The specific properties of flexible implants, such as silicone implants, and active implants such as cardiac pacemakers are not reflected. The IOD contains mechanisms for implant assembly, i.e. the rigid connection of two or more implants and implant registration, i.e. the placement of an implant in relation to anatomical landmarks.

The Generic Implant Template is a kind of Implant Template (see Section 7.X).

280

A.X.2 Generic Implant Template IOD Entity-Relationship

The E-R Model in Figure A.X-1 depicts those entities of the DICOM Information Model that are used in the following IODs.



285

**Figure A.X-1
GENERIC IMPLANT TEMPLATE IOD INFORMATION MODEL**

Note: Implant templates are not referenced to a patient, a study or a series.

A.X.3 Generic Implant Module IOD Module Table

Implant Templates can contain 2D drawings as well as 3D models describing one implant. At least one of the two must be present in one Instance; both may be present in the same Instance.

290

**Table A.X-1
GENERIC IMPLANT TEMPLATE IOD MODULES**

IE	Module	Reference	Usage
Implant Template	Generic Implant Template Description	C.X.1 M	
	Generic Implant Template 2D Drawings	C.X.2 U	
	Generic Implant Template 3D Models	C.X.3 U	
	Generic Implant Template Mating Features	C.X.4 U	
	Generic Implant Template Planning Landmarks	C.X.5 U	
	SOP Common	C.12.1	M
Surface Mesh	Surface Mesh	C.27.1	C - Required if Generic Implant Template 3D Models Module is present.

A.Y IMPLANT ASSEMBLY TEMPLATE INFORMATION OBJECT DEFINITION

A.Y.1 Implant Assembly Template IOD Description

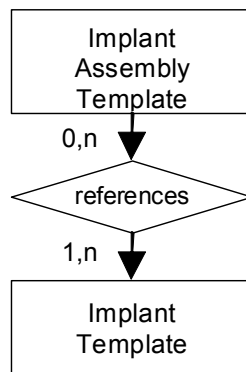
295

Implant Assembly Templates describe how to combine several implants to fulfill a certain purpose. The Implant Assembly Templates describe the aspects of component assembly that are relevant to planning only. Implants that are made out of several parts but are treated as a single piece may be described as single Implant Template.

A.Y.2 Implant Assembly Template IOD Entity Relationship

300

The E-R Model in Figure A.Y-1 depicts those entities of the DICOM Information Model that are used in the following IODs.



305

**Figure A.Y-1
IMPLANT ASSEMBLY TEMPLATE IOD INFORMATION MODEL**

A.Y.3 Implant Assembly Template IOD Module Table

**Table A.Y-1
IMPLANT ASSEMBLY TEMPLATE IOD MODULES**

IE	Module	Reference	Usage
Implant Assembly	Implant Assembly Template	C.Y M	
	SOP Common	C.12.1	M

310

A.Z IMPLANT TEMPLATE GROUP INFORMATION OBJECT DEFINITION

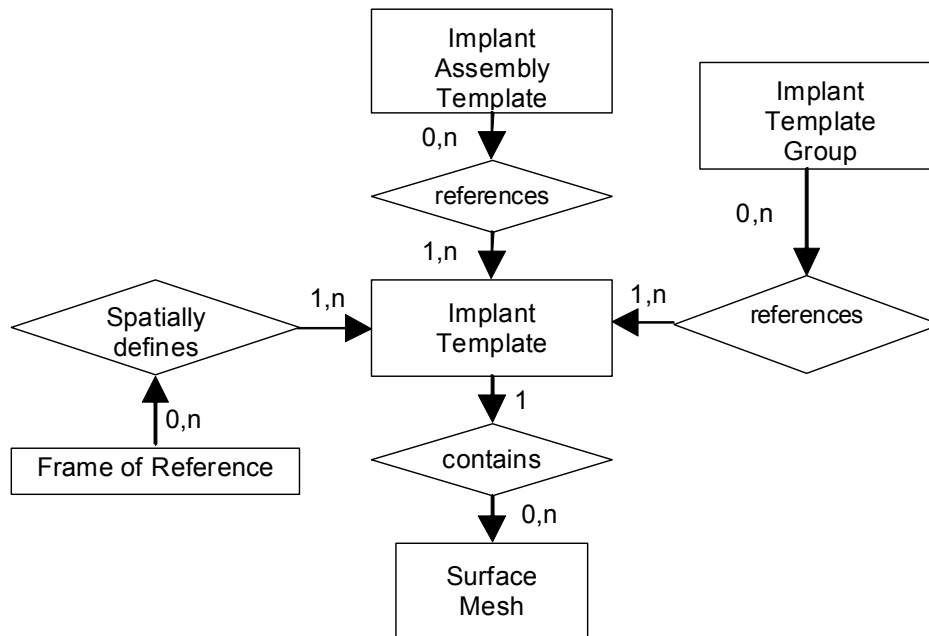
A.Z.1 Implant Template Group IOD Description

The Implant Template Group IOD facilitates the aggregation of a set of Implant Template Instances in an ordered set.

315

A.Z.2 Implant template Group IOD Entity Relationship

The E-R Model in Figure A.Z-1 depicts those entities of the DICOM Information Model that are used in the following IODs.



320

**Figure A.Z-1
IMPLANT TEMPLATE GROUP IOD INFORMATION MODEL**

A.Z.3 Implant Template Group IOD Module Table

**Table A.Z-1
IMPLANT TEMPLATE GROUP IOD MODULES**

325

IE	Module	Reference	Usage
Implant Template Group	Implant Template Group	C.Z M	
	SOP Common	C.12.1	M

Item: Add in the following new sections in C

C.X GENERIC IMPLANT TEMPLATE

This section describes the specific modules for the Generic Implant Template IOD.

330

C.X.1 Generic Implant Template Description Module

Table C.X.1-1 defines the general Attributes of the Generic Implant Template Description Module.

**Table C.X.1-1
GENERIC IMPLANT TEMPLATE DESCRIPTION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Manufacturer (0008,0070)		1	Name of the manufacturer that produces the implant.
Frame of Reference UID	(0020,0052)	1	Defines a 3D Frame of Reference for this component.
Implant Name	(0022,1095)	1	The (product) name of the implant.
Implant Size	(0068,6210)	1C	The size descriptor of the component. Required if the component exists in different sizes and the size number is not part of the name or identifier. May be present otherwise. See C.X.1.1.1 for details.
Implant Part Number	(0022,1097)	1	The (product) identifier of the implant.
Implant Template Version	(0068,6221)	1	The version code of the implant template. If Implant Type (0068,6223) is DERIVED, this shall have the same value as the Implant Template Version (0068,6221) of the manufacturer's implant template from which this instance was derived.
Replaced Implant Template Sequence	(0068,6222)	1C	Reference to the Implant Template which is replaced by this template. Required if this Instance replaces another Instance. Only one Item shall be present.

>Include 'SOP Instance Reference Macro' Table 10-11

Implant Type	(0068,6223)	1	Indicates whether the Implant Template is derived from another Implant Template. Enumerated Values: ORIGINAL DERIVED
Original Implant Template Sequence	(0068,6225)	1C	Reference to the Implant Template Instance with Implant Type (0068,6223) ORIGINAL from which this Instance was ultimately derived. Required if Implant Type (0068,6223) is DERIVED. Only one Item shall be present.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Derivation Implant Template Sequence	(0068,6224)	1C	Reference to Implant Template Instance from which this Instance was directly derived. Required if Implant Type (0068,6223) is DERIVED. Only one Item shall be present.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Effective DateTime	(0068,6226)	1	Date and time from which this Instance is or will be valid.
Implant Target Anatomy Sequence	(0068,6230)	3	Sequence that identifies the anatomical region the implant is to be implanted to. One or more Items shall be present.
>Anatomic Region Sequence	(0008,2218)	1	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.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Defined Context ID 7304 Implant Target Anatomy</i>	
Notification From Manufacturer Sequence	(0068,6265)	1C	Information from the manufacturer concerning a critical notification, recall, or discontinuation of the implant or implant template. Required if such information has been issued. One or more Items shall be present.
>Information Issue DateTime	(0068,6270)	1	Date and Time the information was issued.
>Information Summary	(0068,6280)	1	Summary of the information.
>Encapsulated Document	(0042,0011)	3	The complete manufacturer notification describing the template. Encapsulated Document stream, containing a document encoded according to the MIME Type.

>MIME Type of Encapsulated Document	(0042,0012)	1C	The type of the encapsulated document stream described using the MIME Media Type (see RFC 2046). Required if Encapsulated Document (0042,0011) is present in this Sequence item. Enumerated Value shall be "application/pdf".
Information From Manufacturer Sequence	(0068,6260)	3	Information from Manufacturer other than described in Notification From Manufacturer Sequence (0068,6265). One or more Items shall be present in the sequence.
>Information Issue DateTime	(0068,6270)	1	Date and Time the information was issued.
>Information Summary	(0068,6280)	1	Summary of the information.
>Encapsulated Document	(0042,0011)	3	Encapsulated Document stream, containing a document encoded according to the MIME Type. The complete manufacturer information.
>MIME Type of Encapsulated Document	(0042,0012)	1C	The type of the encapsulated document stream described using the MIME Media Type (see RFC 2046). Required if Encapsulated Document (0042,0011) is present in this Sequence item. Enumerated Value shall be "application/pdf".
Implant Regulatory Disapproval Code Sequence	(0068,62A0)	1C	Sequence containing countries and regions in which the implant is not approved for usage. Required if the implant has been disapproved in a country or a region. If present, one or more Items shall be present in the sequence.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Defined Context ID is 5001.</i>	
Overall Template Spatial Tolerance	(0068,62A5)	2	Tolerance in mm applying to all distance measurements and spatial locations in this Implant Template.
Materials Code Sequence	(0068,63A0)	1	A code sequence specifying the materials the implant was built from. One or more Items shall be present in the Sequence.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7300.</i>	

Coating Materials Code Sequence	(0068,63A4)	1C	Required if the implant is coated. A code sequence specifying the materials the implant is coated with. One or more Items shall be present in the Sequence.
>Include 'Code Sequence Macro' Table 8.8-1		Baseline Context ID is 7300.	
Implant Type Code Sequence	(0068,63A8)	1	Sequence containing a coded description of the type of implant the template reflects.
>Include 'Code Sequence Macro' Table 8.8-1		Baseline Context ID is 7307.	
Fixation Method Code Sequence	(0068,63AC)	1	The method which will be used to fixate the implant in the body. Only a single Item shall be permitted in this sequence.
>Include 'Code Sequence Macro' Table 8.8.1		Baseline Context ID 7310	

335

C.X.1.1 Generic Implant Template Description Attribute Descriptions

C.X.1.1.1 Implant Size

The Implant Size (0068,6210) is the descriptor defined by the manufacturer to distinguish between different sizes of one kind of implant, e.g. size S/M/L/XL.

340

C.X.1.1.2 Frame of Reference

The Frame of Reference UID (0020,0052) Attribute is used as an identifier for spatial registration in 3D. The Frame Of Reference UID uniquely identifies the spatial frame of reference of all 3D models contained in an Implant Template UID Instance.

345

If the Frame Of Reference UIDs in two instances are identical, the contained 3D Models are defined in the same 3D space, i.e. require no additional registration.

C.X.2 Generic Implant Template 2D Drawings Module

350

Table C.X.2-1 defines the general Attributes of the Generic Implant Template 2D Drawings Module. This module contains all Attributes required for the inclusion of technical 2D drawings in an IOD, e.g. the Implant Template IOD. The module specification contains the definition of a subset of the HPGL plotter language which is used for the graphical definition of the drawings.

**Table C.X.2-1
GENERIC IMPLANT TEMPLATE 2D DRAWINGS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
HPGL Document Sequence	(0068,62C0)	1	The 2D template representations of this implant. One or more Items shall be present in the sequence.
>HPGL Document ID	(0068,62D0)	1	Identification number of the HPGL Document. Uniquely identifies an HPGL Document within this SOP instance. The value shall start at 1, and increase monotonically by 1.

>HPGL Document Label	(0068,62D5)	3	Label describing the document.
>View Orientation Code Sequence	(0068,62E0)	1	Coded description of the direction of view represented by this 2D template. This sequence shall contain one item.
>>Include 'Code Sequence Macro' Table 8.8-1		Baseline Context ID is 7302.	
>View Orientation Modifier Code Sequence	(0068,62F0)	3	View Orientation Modifier. Only one Item shall be present in the Sequence.
>>Include 'Code Sequence Macro' Table 8.8-1		Baseline Context ID is 7303.	
>HPGL Document Scaling	(0068,62F2)	1	Conversion factor (real world mm/printed mm) See C.X.2.1.1.
>HPGL Document	(0068,6300)	1	The HPGL document as a byte stream. See C.X.2.1.2.
>HPGL Contour Pen Number	(0068,6310)	1	Numeric ID of the pen used in the encapsulated HPGL document for outlines.
>HPGL Pen Sequence	(0068,6320)	1	Labels for each pen used in the encapsulated HPGL Document. Shall contain one item per pen used in the HPGL document.
>>HPGL Pen Number	(0068,6330)	1	Numeric ID of the pen in the HPGL document
>>HPGL Pen Label	(0068,6340)	1	Label of the pen.
>>HPGL Pen Description	(0068,6345)	3	Description of the kind of information drawn with the pen.
>Recommended Rotation Point	(0068,6346)	1	Point around which the 2D template is rotated in manual planning, in HPGL coordinates.
>Bounding Rectangle	(0068,6347)	1	HPGL coordinates of the smallest rectangle parallel to the paper axes that contains the whole drawing.

355 **C.X.2.1 Generic Implant Template 2D Drawings Attribute Descriptions**

C.X.2.1.1 HPGL Document Scaling and Coordinate System

360 HPGL Documents use integer coordinates based on a 25µm grid in the printing space – i.e. the paper to print on – rather than the object space. HPGL Document Scaling (0068,62F2) is used to scale the printed dimensions measured in millimeters to match the real dimensions of the implant measured in millimeters.

- Notes:
1. For example, if HPGL Document Scaling is 2.5, then a line in HPGL that goes from (0,0) to (0,500) which is 12.5 mm long when printed represents 31.25 mm in the real world.
 2. In HPGL, the origin of the printing space is placed in the lower left corner with the x-axis pointing to the right. No negative coordinates are allowed.

365

This Attribute does not compensate for any radiographic geometric magnification effect caused by the diverging X-ray beam in the projection patient images used for planning. Such compensation is the responsibility of the application based on calibration of the imaging process.

C.X.2.1.2 HPGL Document

370 The HPGL files encapsulated in the Attribute HPGL Document (0068,6300) is restricted to a subset of HPGL commands called DICOM-HPGL specified in this section.

C.X.2.1.2.1 Scope

375 The aim of DICOM-HPGL is to facilitate the storage of 2D template graphics in DICOM implant objects. DICOM-HPGL is a subset of HPGL-2 that is kept as minimal as possible to comply with the needs of 2D implant templates.

C.X.2.1.2.2 Syntax

380 DICOM-HPGL documents consist of valid HPGL commands terminated by a semicolon. Commands consist of a two-letter mnemonic and zero or more numeric parameters separated by commas. To separate between commands, line breaks (x0D, x0A or x0Dx0A) or whitespaces (x20) may be used but are not mandatory.

Only the following commands shall be used in a DICOM-HPGL document

Command	Parameter	Meaning
IN -		Initialize.
PA	[X,Y]	Plot Absolute. The optional parameter assigns an initial position for the pen.
PC Pen	Number, Red, Green, Blue	Set Color of Pen with the given Pen Number. Colors are in RGB, intensities are encoded 0..255. The colors for pen number 0 shall be white and the color for pen number 1 shall be black. It is recommended to use only the pen numbers up to 255 to ensure compatibility with older HPGL-Viewers.
SP	Pen Number	Select Pen It is recommended to use only the pen numbers up to 255 to ensure compatibility with older HPGL-Viewers. Only pen numbers shall be used to which a color has been specified in a precedent PC command.
PU	[X,Y,...[,X,Y]]	Pen Up. The optional sequence of paired parameters describe subsequent pen motions after lifting the pen.
PD	[X,Y,...[,X,Y]]	Pen Down. The optional sequence of paired parameters describe subsequent pen motions after lowering the pen.

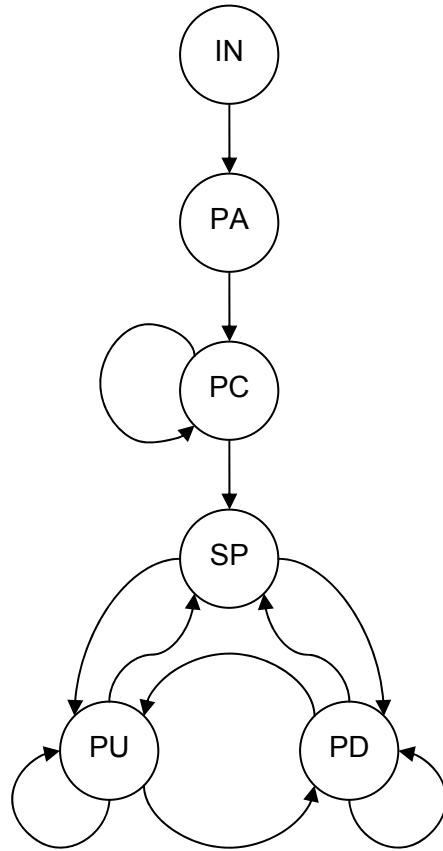
385 According to the parameter definition in HPGL, [] indicate optional parameters. The expression [X,Y,...[,X,Y]] indicates a sequence of arbitrary length of paired parameters X and Y. The commands and their parameters shall be interpreted as specified in the HP PCL/PJL Reference.

Note: This document can be obtained from
URL: <http://h20000.www2.hp.com/bc/docs/support/SupportManual/bpl13211/bpl13211.pdf>

390 The coordinates in a DICOM-HPGL document are absolute values with respect to the lower left corner of the drawing space. The units of length within HPGL are 25 µm with respect to pen movements in the drawing space.

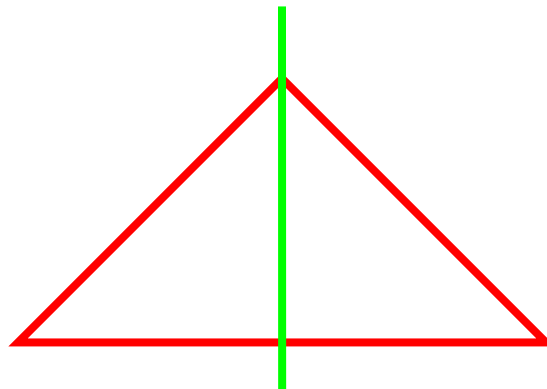
The DICOM-HPGL Document shall be structured as shown in Figure C.X.2-1.

395 Figure X-1.2 shows an example for a DICOM-HPGL Document in plain text, (as byte stream) and plotted.



**Figure C.X.2-1
DICOM-HPGL Document**

```
IN;  
PA;  
PC2,255,0,0;  
PC255,0,255,0;  
SP2;  
PU500,500;  
PD745,255,255,255;  
PD500,500;  
SP255;  
PU500,600;  
PD500,100;
```



**Figure C.X.2-2
DICOM-HPGL Document – Example**

C.X.3 Generic Implant Template 3D Models Module

405 Table C.X.3-1 defines the general Attributes of the Generic Implant Template 3D Models Module. This module contains Attributes that add context and scaling information to surfaces specified in the Surface Mesh Module (C.27.1), for 3D Models in an Implant Template Instance.

**Table C.X.3-1
GENERIC IMPLANT TEMPLATE 3D MODELS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Implant Template 3D Model Surface Number	(0068,6350)	1	Surface Number (0066,0003) of the surface that represents the shape of the entire implant.
Surface Model Description Sequence	(0068,6360)	1	The description of the Surface Model. Shall contain one Item per Item in the Surface Sequence (0066,0002).
>Referenced Surface Number	(0066,002C)	1	Reference to a Surface Number (0066,0003) present in the Surface Sequence (0066,0002).
>Surface Model Label	(0068,6380)	1	Label for this surface.
Surface Model Scaling Factor	(0068,6390)	1	Scaling factor (mm/Surface unit) See C.X.3.1.1.

410 C.X.3.1 Generic Implant Template 3D Models Attribute Descriptions

C.X.3.1.1 Surface Model Scaling Factor

Surface Model Scaling Factor (0068,6390) is used to scale dimensions of the surface mesh representation to match the real dimensions of the implant measured in millimeters.

415 This Attribute does not compensate for any radiographic geometric magnification effect caused by the diverging X-ray beam in the projection patient images used for planning. Such compensation is the responsibility of the application based on calibration of the imaging process.

C.X.4 Generic Implant Template Mating Features Module

420 Table C.X.4-1 defines the general Attributes of the Generic Implant Template Mating Features Module. This module adds coordinate systems which can be utilized to geometrically constrain mating of Implant Templates when planning the implantation of a modular implant.

Note: An Implant Template may contain 2D drawings of the described implant, 3D surface models of the described implant, or both. In this module mating features which constrain the geometric matching of implants in multi-component assemblies are specified. These geometric features (points and axes) can be specified in the 2D drawings as well as the 3D models. Mating features are grouped into mating feature sets (see PS3.17 X.1). Based on the existence of 2D drawings and/or 3D models in the Instance, either or both is possible. In this module, there are a number of conditions on attribute use to support the following cases:

- 425 • Specification of 2D mating features is only possible if at least one 2D drawing is present in the instance.
- 430 • Specification of 3D mating features is only possible if at least one 3D model is present in the instance.

**Table C.X.4-1
GENERIC IMPLANT TEMPLATE MATING FEATURES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
----------------	-----	------	-----------------------

Mating Feature Sets Sequence	(0068,63B0)	3	Mating feature sets used to combine the implant with other implants. One or more Items shall be present in the Sequence.
>Mating Feature Set ID	(0068,63C0)	1	Identification number of the set. Uniquely identifies a mating feature set within this SOP instance. The value shall start at 1, and increase monotonically by 1 for each Item.
>Mating Feature Set Label	(0068,63D0)	1	Label of the set.
>Mating Feature Sequence	(0068,63E0)	1	The mating features of the set. One or more Items shall be present in the Sequence.
>>Mating Feature ID	(0068,63F0)	1	Numeric ID of the mating feature. Uniquely identifies a mating feature within this Sequence Item.
>>3D Mating Point	(0068,64C0)	1C	Origin of the contact system. Required if 2D Mating Feature Coordinates Sequence (0068,6430) is not present and Implant Template 3D Model Surface Number (0068,6350) is present. May be present if 2D Mating Feature Coordinates Sequence (0068,6430) is present and Implant Template 3D Model Surface Number (0068,6350) is present. See C.X.4.1.1
>>3D Mating Axes	(0068,64D0)	1C	The Axes of contact described as direction cosines in the 3D coordinate system defined by the Frame Of Reference UID. Required if 3D Mating Point (0068,64C0) is present. See C.X.4.1.1
>>2D Mating Feature Coordinates Sequence	(0068,6430)	1C	Coordinates of the mating feature in the HPGL documents. Required if 3D Mating Point (0068,64C0) is not present and HPGL Document Sequence (0068,62C0) is present. May be present if 3D Mating Point (0068,64C0) is present and HPGL Document Sequence (0068,62C0) is present. One or more Items shall be present in the sequence.

>>>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) which contains the 2D Drawing including the Mating Feature. Shall be unique within the sequence.
>>>2D Mating Point	(0068,6450)	1	Origin of the contact system, in HPGL coordinates. See C.X.4.1.1
>>>2D Mating Axes	(0068,6460)	1	Direction cosines of the contact system. See C.X.4.1.1
>>Mating Feature Degree of Freedom Sequence	(0068,6400)	3	Degrees of freedom in this mating feature. One or more Items shall be present in the Sequence. See C.X.4.1.2.
>>>Degree of Freedom ID	(0068,6410)	1	Numeric ID of the degree of freedom. Uniquely identifies a degree of freedom within this Sequence Item. The value shall start at 1, and increase monotonically by 1 for each Item.
>>>Degree of Freedom Type	(0068,6420)	1	Indicates the type of the degree of freedom. Enumerated Values: TRANSLATION ROTATION See C.X.4.1.2.
>>>2D Degree of Freedom Sequence	(0068,6470) 1C		Geometric specifications of the degrees of freedom for this HPGL Document. Required if 2D Mating Feature Coordinates Sequence (0068,6430) is present. One or more Items shall be present in the sequence. See C.X.4.1.2.
>>>>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) which contains the 2D Drawing including the Mating Feature. See C.X.4.1.2. Shall be unique within the sequence.
>>>>2D Degree Of Freedom Axis	(0068,64F0) 1		Direction cosines of the axis of the degree of freedom. See C.X.4.1.2.

>>>>Range of Freedom	(0068,64A0)	1	Interval of freedom for this degree of freedom. See C.X.4.1.2.
>>>3D Degree Of Freedom Axis	(0068,6490) 1C		Direction cosines of the axis of the degree of freedom in the Frame of Reference of the template. See C.X.4.1.2. Required if 3D Mating Point (0068,64C0) is present.
>>>Range of Freedom	(0068,64A0)	1C	Two floating point numbers defining a value range for this degree of freedom. See C.X.4.1.2. Required if 3D Mating Point (0068,64C0) is present.

435

C.X.4.1 Generic Implant Template 2D Drawings Attribute Descriptions

C.X.4.1.1 Mating Features

440 These Attributes establish a Cartesian coordinate system relative to the Frame of Reference of the implant. When two implants are assembled using a pair of mating features, a rigid spatial registration can be established, that transforms one Frame of Reference so that the mating features align.

C.X.4.1.2 Degrees of Freedom

445 Mating Feature Degree of Freedom Sequence (0068,6400) is used to specify that a mating feature allows mating with another implant not only in one defined pose, but within a certain range of freedom. One sequence item specifies one degree of freedom which may be a rotation around or a translation along an arbitrary axis. The Degree of Freedom Type (0068,6420) specifies whether the degree of freedom describes a rotation or a translation.

450 The 3D coordinates of the axis of translation or rotation is specified by 3D Degree Of Freedom Axis (0068,6490) with respect to the Implant Template's Frame of Reference as three dimensional vector in x-y-z order. Range Of Freedom (0068,64A0) specifies an interval, in millimeters or degrees, by which this 3D coordinate system mating feature may be moved along or around the axis.

455 For each HPGL Document, the 2D Degree Of Freedom Axis (0068,64F0) may be specified as a 3D vector encoded in x-y-z order, where the z-coordinate is equal to the direction of projection, i.e., equal to the cross product of the x- and y-axis of the printing space. Range Of Freedom (0068,64A0) specifies an interval, in millimeters or degrees, by which the 3D coordinate system of this mating feature may be moved along or around the axis.

C.X.5 Generic Implant Template Planning Landmarks Module

460 Table C.X.5-1 defines the general Attributes of the Generic Implant Template Planning Landmarks Module. This module adds planning landmarks, i.e., geometric annotations which constrain implant template registration to anatomical features, to the Implant Template IOD.

465 **Note:** An Implant Template may contain 2D drawings from several viewpoints, 3D surface models, or both. The planning landmarks which are specified with this module may occur in all of these, but may also only occur in some of these (due to their invisibility or irrelevance in some drawings or the 3D representation). Each 2D drawing specifies its own 2D drawing space, which requires a separate geometric description for each drawing. The 3D models share one Frame of Reference. Thus, each landmark needs only one 3D representation which then applies to all 3D models contained in one Instance. The Attribute Descriptions of the Attributes

- 470 which geometrically define landmarks (in Table C.X.5-2 – C.X.5-4) contain complicated
Conditions which express the following constraints:
- If 2D drawings are present in an Implant Template Instance, there may be 2D specifications of landmarks present in this Implant Template Instance.
 - 2D specifications of landmarks will refer to HPGL Document Numbers (0068,62D0) which are present in an Implant Template Instance.
 - 475 ▪ Landmarks are not required to be geometrically defined in all existing HPGL documents.
 - If 3D models are present in a Implant Template Instance, there may be 3D specifications of landmarks present in this Implant Template Instance
 - 2D and 3D specifications may be present for one landmark in an Instance if both, 2D drawings and 3D models, are contained in the Instance.

480

**Table C.X.5-1
GENERIC IMPLANT TEMPLATE PLANNING LANDMARKS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Planning Landmark Point Sequence	(0068,6500)	3	Point landmarks for planning. One or more Items shall be present in the Sequence.
<i>>Include 'Planning Landmark Point Macro' Table C.X.5-2</i>			
>Planning Landmark ID	(0068,6530)	1	Numeric ID of the planning landmark. Uniquely identifies a planning landmark within the SOP instance. The value shall start at 1, and increase monotonically by 1 for each Item.
>Planning Landmark Description	(0068,6540)	3	Purpose or intended use of the landmark.
>Planning Landmark Identification Code Sequence	(0068,6545)	2	Coded Description of the real-world point which is represented by the landmark. One or more Items shall be present in the Sequence.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7305</i>	
Planning Landmark Line Sequence	(0068,6510)	3	Line landmarks for planning. One or more Items shall be present in the Sequence.
<i>>Include 'Planning Landmark Line Macro' Table C.X.5-3</i>			
>Planning Landmark ID	(0068,6530)	1	Numeric ID of the planning landmark. Uniquely identifies the planning landmark within the SOP instance. The value shall start at 1, and increase monotonically by 1 for each Item.
>Planning Landmark Description	(0068,6540)	3	Purpose or intended use of this landmark.
>Planning Landmark Identification Code Sequence	(0068,6545)	2	Coded Description of the real-world line which is represented by this landmark. One or more Items shall be present in the Sequence.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7305</i>	

Planning Landmark Plane Sequence	(0068,6520)	3	Plane landmarks for planning. One or more Items shall be present in the Sequence.
<i>>Include 'Planning Landmark Plane Macro' Table C.X.5-4</i>			
>Planning Landmark ID	(0068,6530)	1	Numeric ID of the planning landmark. Uniquely identifies the planning landmark within the SOP instance. The value shall start at 1, and increase monotonically by 1 for each Item.
>Planning Landmark Description	(0068,6540)	3	Purpose or intended use of the landmark.
>Planning Landmark Identification Code Sequence	(0068,6545)	2	Coded Description of the real-world plane which is represented by this landmark. One or more Items shall be present in the Sequence.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7305</i>	

C.X.5.1 Planning Landmark Macros

485 Tables C.X.5-2 – C.X.5-4 contain macros for the definition of landmarks which can be used during planning to align an implant template with patient geometry.

All attributes within these Macros that contain 3D points or vectors are in x, y, z order. If multiple elements are encoded, the ordering is $x_1 y_1 z_1, \dots, x_n y_n z_n$. The points are in the coordinate system identified by the Frame of Reference UID 0020,0052.

490

**Table C.X.5-2
PLANNING LANDMARK POINT MACRO**

Attribute Name	Tag	Type	Attribute Description
2D Point Coordinates Sequence	(0068,6550)	1C	2D coordinates of the point in the HPGL documents. Required if 3D Point Coordinates (0068,6590) is not present and HPGL Document Sequence (0068,62C0) is present. May be present if 3D Point Coordinates (0068,6590) is present and HPGL Document Sequence (0068,62C0) is present. One or more Items shall be present in the Sequence.
>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) which contains the 2D Drawing including the planning landmark. Shall be unique within the sequence.

>2D Point Coordinates	(0068,6560)	1	Coordinates of the point in the HPGL document. Coordinates are measured in millimeters of the printing space. See C.X.2.1.1.
3D Point Coordinates	(0068,6590)	1C	3D Coordinates of the point. Required if 2D Point Coordinates Sequence (0068,6550) is not present and Implant Template 3D Model Surface Number (0068,6350) is present. May be present if 2D Point Coordinates Sequence (0068,6550) is present and Implant Template 3D Model Surface Number (0068,6350) is present.

**Table C.X.5-3
PLANNING LANDMARK LINE MACRO**

Attribute Name	Tag	Type	Attribute Description
2D Line Coordinates Sequence	(0068,65A0)	1C	2D coordinates of the line in the HPGL documents. Required if 3D Line Coordinates (0068,65D0) is not present and HPGL Document Sequence (0068,62C0) is present. May be present if 3D Line Coordinates (0068,65D0) is present and HPGL Document Sequence (0068,62C0) is present. One or more Items shall be present in the Sequence.
>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) which contains the 2D Drawing including the planning landmark. Shall be unique within the sequence.
>2D Line Coordinates	(0068,65B0)	1	Coordinates of the line in the HPGL document. Coordinates are measured in millimeters of the printing space. See C.X.2.1.1.
3D Line Coordinates	(0068,65D0)	1C	3D Coordinates of the line. Required if 2D Line Coordinates Sequence (0068,65A0) is not present and Implant Template 3D Model Surface Number (0068,6350) is present. May be present, if 2D Line Coordinates Sequence (0068,65A0) is present and Implant Template 3D Model Surface Number (0068,6350) is present.

**Table C.X.5-4
PLANNING LANDMARK PLANE MACRO**

Attribute Name	Tag	Type	Attribute Description
2D Plane Coordinates Sequence	(0068,65E0)	1C	2D coordinates of the plane's intersection with the HPGL documents. Required if 3D Plane Origin (0068,6610) is not present and HPGL Document Sequence (0068,62C0) is present. May be present if 3D Plane Origin (0068,6610) is present and HPGL Document Sequence (0068,62C0) is present. One or more Items shall be present in the Sequence.
>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) which contains the 2D Drawing including the planning landmark. Shall be unique within the sequence.
>2D Plane Intersection	(0068,65F0)	1	2D Coordinates of the intersection of the plane with the projection plane. Coordinates are measured in Millimeters of the printing space. See C.X.2.1.1.
3D Plane Origin	(0068,6610)	1C	3D Coordinates of the plane origin. Required if 2D Plane Coordinates Sequence (0068,65E0) is not present and Implant Template 3D Model Surface Number (0068,6350) is present. May be present if 2D Plane Coordinates Sequence (0068,65E0) is present and Implant Template 3D Model Surface Number (0068,6350) is present.
3D Plane Normal	(0068,6620)	1C	3D Coordinates of the plane normal. Required if 3D Plane Origin (0068,6610) is present.

C.X.5.1.1 Planning Landmark Macros Attribute Descriptions

500 **C.X.5.1.1.1 2D Coordinates Sequences**

The 2D Point Coordinates Sequence (0068,6550) and 2D Line Coordinates Sequence (0068,65A0) contain the positions of point, line or plane landmarks in 2D templates. Each sequence item consists of a reference to one of the 2D templates and the point coordinates of the landmark with respect to that template. The Coordinates are with respect to the origin of the HPGL Document and are specified in Millimeters of the printing space.

505

C.Y IMPLANT ASSEMBLY TEMPLATE

This section describes the specific modules for the Implant Assembly Template IOD. This IOD references Instances of the Implant Template IOD.

C.Y.1 Implant Assembly Template Module

510 Table C.Y.1-1 defines the general Attributes of the Implant Assembly Template Module.

**Table C.Y-1
IMPLANT ASSEMBLY TEMPLATE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Effective DateTime	(0068,6226)	1	Date and time from which on this Instance is valid.
Implant Assembly Template Name	(0076,0001)	2	A name given to the assembly described in this instance.
Implant Assembly Template Issuer	(0076,0003)	1	The person or organization who issued the assembly template.
Implant Assembly Template Version	(0076,0006)	2	The version code of the Implant Assembly Template.
Replaced Implant Assembly Template Sequence	(0076,0008)	1C	Reference to the Implant Assembly Template which is replaced by this Instance. Required if the Instance replaces another Instance. Only one Item shall be present in the Sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Implant Assembly Template Type	(0076,000A) 1		Indicates whether the Implant Assembly Template is derived from another Instance. Enumerated Values: ORIGINAL DERIVED
Original Implant Assembly Template Sequence	(0076,000C)	1C	Reference to the Implant Assembly Template Instance with Implant Assembly Template Type (0076,000A) ORIGINAL from which this Instance was ultimately derived. Required if Implant Assembly Template Type (0076,000A) is DERIVED. Only one Item shall be present in the Sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			

Derivation Implant Assembly Template Sequence	(0076,000E)	1C	Reference to the Implant Template Instance from which this Instance was directly derived. Required if Implant Assembly Template Type (0076,000A) is DERIVED. Only one Item shall be present in the Sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Implant Assembly Template Target Anatomy Sequence	(0076,0010) 1		Identifies the anatomical region the implant assembly is to be implanted to. One or more Items shall be present in the Sequence.
>Anatomic Region Sequence	(0008,2218)	1	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.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Defined Context ID 7304 Implant Target Anatomy</i>	
Procedure Type Code Sequence	(0076,0020) 1		Coded description of the procedure by which the assembly is implanted. One or more Items shall be present in the Sequence.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7301.</i>	
Surgical Technique	(0076,0030) 3		The surgical technique associated with this assembly template.
MIME Type of Encapsulated Document	(0042,0012)	2	The type of the encapsulated document stream described using the MIME Media Type (see RFC 2046). Mime Type shall be "application/pdf".
Encapsulated Document	(0042,0011)	2	Encapsulated Document stream, containing a document encoded according to the MIME Type. PDF description of the surgical technique.
Component Types Sequence	(0076,0032)	1	Sets of components of which the assembly is constructed. One or more Items shall be present in the Sequence.
>Component Type Code Sequence	(0076,0034)	1	Label assigned to that type of component.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Baseline Context ID is 7307.</i>	

>Exclusive Component Type	(0076,0036)	1	Indicates that only one component of this Component Type shall be used in an assembly. Defined Terms: YES NO
>Mandatory Component Type	(0076,0038)	1	Indicates that at least one component of this Component Type has to be used in an assembly. Defined Terms: YES NO
>Component Sequence	(0076,0040)	1	References to implant template components used in the assembly. One or more Items shall be present in the Sequence.
<i>>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
>>Component ID	(0076,0055)	1	Numeric ID of the Implant Template. Uniquely identifies the Implant Template within the SOP instance. The value shall start at 1, and increase monotonically by 1 for each Item.
Component Assembly Sequence	(0076,0060)	3	Information about how to connect the implants from the component groups. One or more Items shall be present in the Sequence. See C.Y.1.1.1.1 for details.
>Component 1 Referenced ID	(0076,0070)	1	Value of the Component ID (0076,0055) present in the Component Sequence (0076,0040) which contains the assembly implant components. The ID selects the first component of the connection.
>Component 1 Referenced Mating Feature Set ID	(0076,0080)	1	Value of the Mating Feature Set ID (0068,63C0) present in the Mating Feature Set Sequence (0068,63B0) which contains the Mating Feature Sets. The ID selects the Mating Feature Set of the first component of the connection.

>Component 1 Referenced Mating Feature ID	(0076,0090)	1	Value of the Mating Feature ID (0068,63F0) present in the Mating Feature Sequence (0068,63E0) which contains the Mating Features. The ID selects the Mating Feature of the Mating Feature Set of the first component of the connection.
>Component 2 Referenced ID	(0076,00A0)	1	Value of the Component ID (0076,0055) present in the Component Sequence (0076,0040) which contains the assembly implant components. The ID selects the second component of the connection.
>Component 2 Referenced Mating Feature Set ID	(0076,00B0)	1	Value of the Mating Feature Set ID (0068,63C0) present in the Mating Feature Set Sequence (0068,63B0) which contains the Mating Feature Sets. The ID selects the Mating Feature Set of the second component of the connection.
>Component 2 Referenced Mating Feature ID	(0076,00C0)	1	Value of the Mating Feature ID (0068,63F0) present in the Mating Feature Sequence (0068,63E0) which contains the Mating Features. The ID selects the Mating Feature of the Mating Feature Set of the second component of the connection.

C.Y.1.1 Implant Assembly Template Module Attribute Description

515 **C.Y.1.1.1 Component Assembly Sequence**

This Sequence defines a table that establishes relations between Mating Features in Implant Templates. This table contains possible connections for the surgical technique described in an instance.

C.Z IMPLANT TEMPLATE GROUP MODULE

520 This section describes the specific modules for the Implant Template Group IOD.

C.Z.1 Implant Template Group Module

Table C.Z.1-1 contains the Attributes of the Implant Template Group Module.

**Table C.Z-1
IMPLANT TEMPLATE GROUP MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Effective DateTime	(0068,6226)	1	Date and time from which on this Instance is valid.
Implant Template Group Name	(0078,0001)	1	Name of this group

Implant Template Group Description	(0078,0010)	3	Purpose or intent of this group.
Implant Template Group Issuer	(0078,0020)	1	Person or Organization which issued this group.
Implant Template Group Version	(0078,0024)	2	The version code of the Implant Template Group.
Replaced Implant Template Group Sequence	(0078,0026)	1C	Reference to the Implant Template Group which is replaced by this Instance. Required if this Instance replaces another Instance. Only one Item shall be present in the Sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
Implant Template Group Target Anatomy Sequence	(0078,0028) 3		Identifies the anatomical region the implant is to be implanted to. One or more Items shall be present in the Sequence.
>Anatomic Region Sequence	(0008,2218)	1	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.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>Defined Context ID 7304 Implant Target Anatomy</i>	
Implant Template Group Members Sequence	(0078,002A) 1		Contains references to all Implant Template SOP instances which are part of this group. One or more Items shall be present in the Sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
>Implant Template Group Member ID	(0078,002E)	1	Numeric ID of the Implant Template. Uniquely identifies the Implant Template within the Implant Template Group. The value shall start at 1, and increase monotonically by 1 for each Item.
>3D Implant Template Group Member Matching Point	(0078,0050)	1C	3D inter-component Matching Point. May be present if Number of Surfaces (0066,0001) is present in the Instance referenced in the Implant Template Group Members Sequence Item. See C.Z.1.1.1
>3D Implant Template Group Member Matching Axes	(0078,0060)	1C	Direction cosines of the Matching Point. Required if 3D Implant Template Group Matching Point (0078,0050) is present.

> Implant Template Group Member Matching 2D Coordinates Sequence	(0078,0070)	1C	May be present if HPGL Document Sequence (0068,62C0) is present in the Instance referenced in the Implant Template Group Members Sequence Item. One or more Items shall be present in the Sequence. See C.Z.1.1.1
>>Referenced HPGL Document ID	(0068,6440)	1	Value of the HPGL Document ID (0068,62D0) present in the HPGL Document Sequence (0068,62C0) of the Instance that is referenced in the Implant Template Group Members Sequence Item. Shall be unique within the sequence.
>>2D Implant Template Group Member Matching Point	(0078,0090)	1	2D inter-component Matching Point. See C.Z.1.1.1.
>>2D Implant Template Group Member Matching Axes	(0078,00A0)	1	Direction cosines of the Matching Point. See C.Z.1.1.1.
Implant Template Group Variation Dimension Sequence	(0078,00B0)	1	List of all Variation Dimensions that are covered by this group. One or more Items shall be present in the Sequence. See C.Z.1.1.2.
>Implant Template Group Variation Dimension Name	(0078,00B2)	1	Descriptive name of the variation dimension.
>Implant Template Group Variation Dimension Rank Sequence	(0078,00B4)	1	Order in which the implant group members are sorted according to this dimension.
>> Referenced Implant Template Group Member ID	(0078,00B6)	1	Value of the Implant Template Group Member ID (0078,002E) present in the Implant Template Group Member Sequence (0078,002A) which contains the Implant Template Group Member Items. Shall be unique within the sequence.
>>Implant Template Group Variation Dimension Rank	(0078,00B8)	1	The rank of this Implant Template in the Variation Dimension. In one Implant Template Group Variation Dimension Rank Sequence there may be more than one Implant Templates with the same rank.

525

C.Z.1.1 Implant Template Group Module Attribute Description

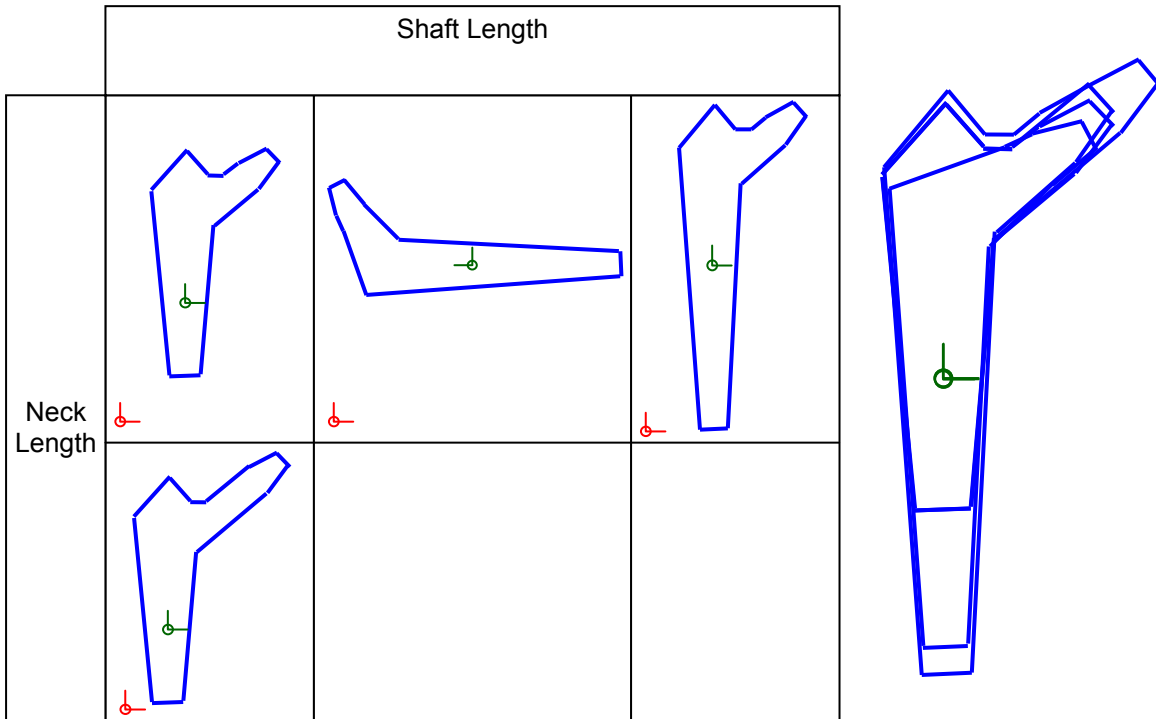
C.Z.1.1.1 Implant Template Group Member Matching Coordinates

Template Groups are used to facilitate browsing through a set of similar implants. The Template Group Member Matching Coordinates is a coordinate system in the Frame of Reference of every member of the group which is used to place and orient the members of the group in a similar

530

way: When a user or a system positioned one member of the group within the Frame of Reference of the patient, then all other members of the family are placed and oriented so that their Template Group Member Matching Coordinates coincide.

535 The matching coordinates are applied similar to the mating features during implant template mating. An example is found in part 17, Figure C.Z.1.1.1-1.

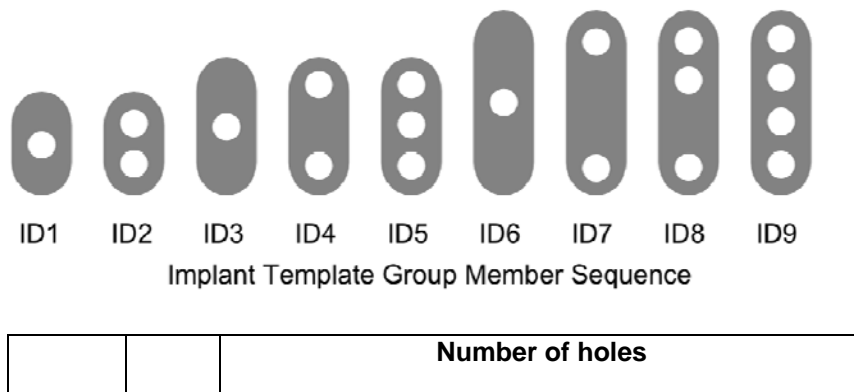


**Figure C.Z.1.1.1-1
Implant Template Groups Example.**

540 **C.Z.1.1.2 Implant Template Groups**

Implant templates in the group can be ordered according to several orthogonal dimensions, e.g., width and length. This is intended to facilitate scrolling through the implant template repository by offering references to the next bigger and smaller templates according to multiple criteria. Figure C.Z.1.1.2-1 shows how the Variation Dimensions may be used for plates that differ in two dimensions: length and number of holes.

545












	Rank	1	2	3	4
Length	1	 ID1	 ID2		
	2	 ID3	 ID4	 ID5	
	3	 ID6	 ID7	 ID8	 ID9

Figure C.Z.1.1.2
Implant Template Group for 2 Dimensions Example

Add to PS 3.3 Annex F:

550

Table F.3-3
DIRECTORY INFORMATION MODULE

Attribute Name	Tag	Type	Attribute Description
>Directory Record Type	(0004,1430)	1C	... Enumerated Values (see Section F.5): ... <u>IMPLANT</u> <u>IMPLANT GROUP</u> <u>IMPLANT ASSY</u>

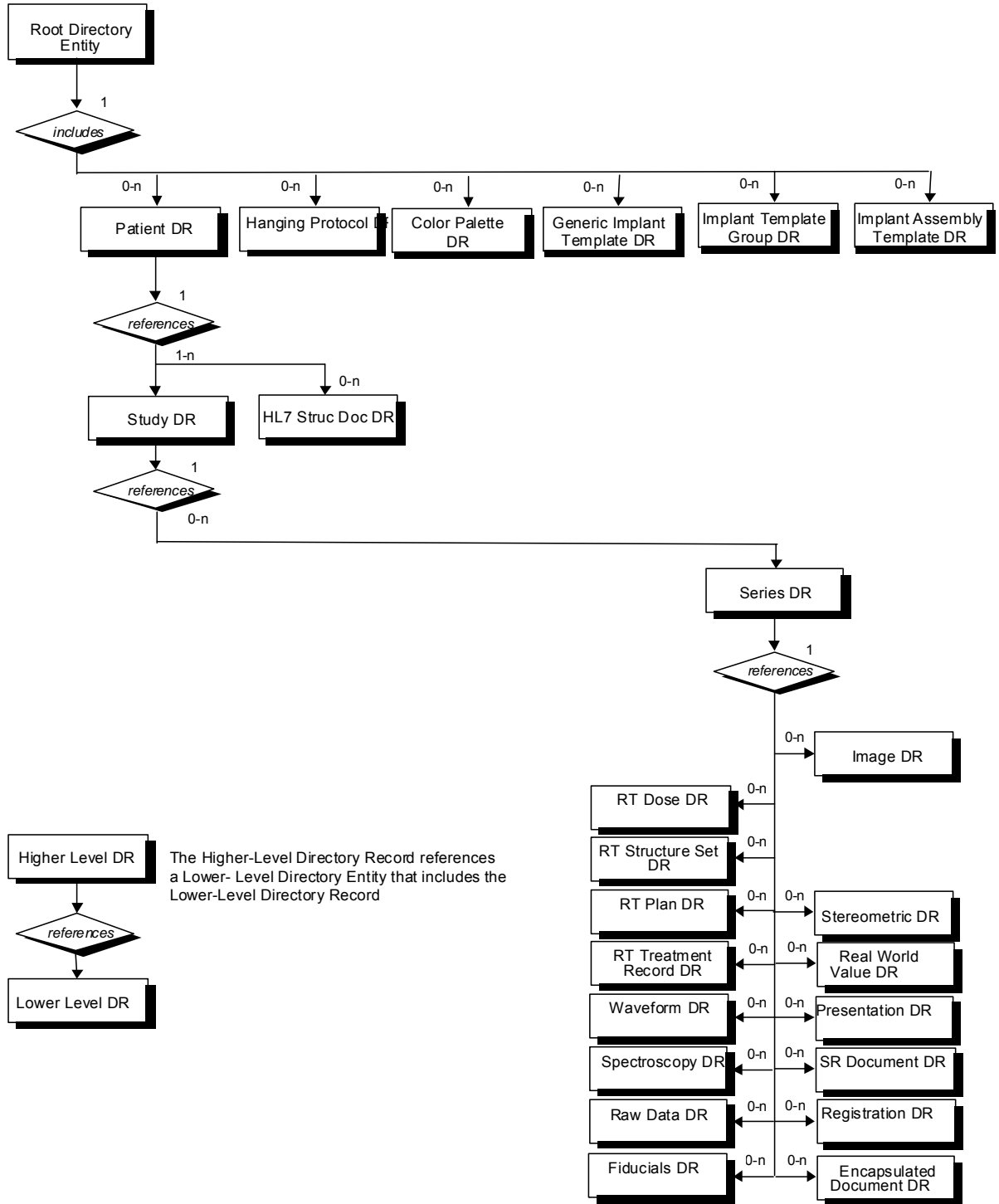
555

Table F.4-1
RELATIONSHIP BETWEEN DIRECTORY RECORDS

Directory Record Type	Section	Directory Record Types which may be included in the next lower-level directory Entity
(root directory entity)	-	PATIENT, HANGING PROTOCOL, PALETTE, <u>IMPLANT</u> , <u>IMPLANT ASSY</u> , <u>IMPLANT GROUP</u> , PRIVATE

...
<u>IMPLANT</u>	<u>F.5.X</u>	<u>PRIVATE</u>
<u>IMPLANT ASSY</u>	<u>F.5.Y</u>	<u>PRIVATE</u>
<u>IMPLANT GROUP</u>	<u>F.5.Z</u>	<u>PRIVATE</u>

Update Figure F.4-1 Basic Directory IOD Information Model: add Generic Implant Template DR, Implant Template Group DR and Implant Assembly Template DR next to the Hanging Protocol DR



Add Directory Record to F.5:

F.5.X Implant directory record definition

565 The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "IMPLANT". Table F.5-x lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Generic Implant Template IOD. This Directory Record shall be used to reference a Generic Implant Template SOP Instance.

570 **Table F.5-x
IMPLANT KEYS**

Key	Tag	Type	Attribute Description
Manufacturer (0008,0070)		1	Name of the manufacturer that produces the implant.
Implant Name	(0022,1095)	1	The (product) name of the implant.
Implant Size	(0068,6210)	1C	The size descriptor of the component. Required if present in the referenced instance.
Implant Part Number	(0022,1097)	1	The (product) identifier of the implant.

Note: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table F.3-3), it is not duplicated in this list of keys.

575 **F.5.Y Implant Assembly directory record definition**

The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value „IMPLANT ASSY". Table F.5-y lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Implant Assembly Template IOD. This Directory Record shall be used to reference an Implant Assembly Template SOP Instance.

580 **Table F.5-y
IMPLANT ASSEMBLY KEYS**

Key	Tag	Type	Attribute Description
Implant Assembly Template Name	(0076,0001)	1	A name given to the assembly described in this instance.
Implant Assembly Template Issuer	(0076,0003)	1	The person or organization who issued the assembly template.
Procedure Type Code Sequence	(0076,0020)	1	A code describing the Intervention in which the implant is used. One or more Items shall be present in the Sequence.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>			

Note: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table F.3-3), it is not duplicated in this list of keys.

585 **F.5.Z Implant Group directory record definition**

590 The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "IMPLANT GROUP". Table F.5-z lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the

Implant Template Group IOD. This Directory Record shall be used to reference an Implant Template Group SOP Instance.

Table F.5-Z
IMPLANT GROUP KEYS

Key	Tag	Type	Attribute Description
Implant Template Group Name	(0078,0001)	1	Name of this group
Implant Template Group Description	(0078,0010)	3	Purpose or intent of this group.
Implant Template Group Issuer	(0078,0020)	1	Person or Organization which issued this group.

595

Note: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table F.3-3), it is not duplicated in this list of keys.

600

605

Changes to NEMA Standards Publication PS 3.4-2009

Digital Imaging and Communications in Medicine (DICOM)

610

Part 4: Service Class Specifications

Item: Add the following to Table B.5-1

B.5 STANDARD SOP CLASSES

**Table B.5-1
STANDARD SOP CLASSES**

615

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
...		
<u>Generic Implant Template Storage</u>	<u>1.2.840.10008.5.1.4.43.1</u>	<u>Generic Implant Template</u>
<u>Implant Assembly Template Storage</u>	<u>1.2.840.10008.5.1.4.44.1</u>	<u>Implant Assembly Template</u>
<u>Implant Template Group Storage</u>	<u>1.2.840.10008.5.1.4.45.1</u>	<u>Implant Template Group</u>
...		

Item: Add the following to PS 3.4 Section B.5.1

B.5.1.x Implant Template Storage SOP Classes

620

A device that is a Generic Implant Template Storage, Implant Assembly Template Storage, or Implant Template Group Storage SOP Class SCU may modify information in a SOP Instance that it has previously sent or received. When this SOP Instance is modified and sent to an SCP, it shall be assigned a new SOP Instance UID if there is addition, removal or update of any attribute within:

625

- Generic Implant Template Description Module
- Generic Implant Template 2D Drawings Module
- Generic Implant Template 3D Models Module
- Generic Implant Template Mating Features Module
- Generic Implant Template Planning Landmarks Module

630

- Implant Assembly Template Module
- Implant Template Group Module
- Surface Mesh Module

Referential integrity between sets of related SOP instances shall be maintained.

635

Item: Add the following to Table I.4-1

I.4

MEDIA STORAGE STANDARD SOP CLASSES

**Table I.4-1
Media Storage Standard SOP Classes**

SOP Class Name	SOP Class UID	IOD Specification
...		
<u>Generic Implant Template Storage</u>	<u>1.2.840.10008.5.1.4.43.1</u>	<u>Generic Implant Template</u>
<u>Implant Assembly Template Storage</u>	<u>1.2.840.10008.5.1.4.44.1</u>	<u>Implant Assembly Template</u>
<u>Implant Template Group Storage</u>	<u>1.2.840.10008.5.1.4.45.1</u>	<u>Implant Template Group</u>
...		

Item: Add the following Annex

Annex Y IMPLANT TEMPLATE QUERY/RETRIEVE SERVICE CLASSES

Y.1 OVERVIEW

Y.1.1 Scope

645 The Implant Template Query/Retrieve Service Classes define application-level classes-of-service that facilitate access to Implant Template and Implant Assembly Template composite objects.

Y.1.2 Conventions

650 Key Attributes serve two purposes; they may be used as Matching Key Attributes or as Return Key Attributes. Matching Key Attributes may be used for matching (criteria to be used in the C-FIND request to determine whether an entity matches the query). Return Key Attributes may be used to specify desired return attributes (what elements in addition to the Matching Key Attributes have to be returned in the C-FIND response).

Note: Matching Keys are typically used in an SQL 'where' clause. Return Keys are typically used in an SQL 'select' clause to convey the Attribute values.

655

Matching Key Attributes may be of Type "required" (R) or "optional" (O). Return Key Attributes may be of Type 1, 1C, 2, 2C, 3 as defined in PS 3.5.

Y.1.3 Query/Retrieve Information Model

660 In order to serve as an SCP of the Implant Template Query/Retrieve Service Class, a DICOM AE possesses information about the Attributes of a number of Implant Template or Implant Assembly Template composite SOP Instances. The information is organized into an Information Model. The Information Models for the different SOP Classes specified in this Annex are defined in Y.6.

Y.1.4 Service Definition

665 Two peer DICOM AEs implement a SOP Class of an Implant Template or Implant Assembly Template Query/Retrieve Service Class with one serving in the SCU role and one serving in the SCP role. SOP Classes of the Implant Template and Implant Assembly Template Query/Retrieve Service Classes are implemented using the DIMSE-C C-FIND, C-MOVE and C-GET services as defined in PS 3.7.

670 An SCP of this SOP Class shall support Level-2 conformance as defined in Section B.4.1.

The semantics of the C-FIND service are the same as those defined in the Service Definition of the Basic Worklist Management Service Class.

The semantics of the C-MOVE service are the same as those defined in the Service Definition of the Query/Retrieve Service Class, with the exception that there is only one level of retrieval.

675 The semantics of the C-GET service are the same as those defined in the Service Definition of the Query/Retrieve Service Class, with the exception that there is only one level of retrieval.

Y.2 IMPLANT TEMPLATE INFORMATION MODELS DEFINITIONS

680 The Implant Template, Implant Assembly Template, and Implant Template Group Information Models are identified by the SOP Class negotiated at Association establishment time. Each SOP Class is composed of both an Information Model and a DIMSE-C Service Group.

The Implant Template, Implant Assembly Template, and Implant Template Group Information Models are defined in Y.6, with the Entity-Relationship Model Definition and Key Attributes Definition analogous to those defined in the Worklist Information Model Definition of the Basic Worklist Management Service.

Y.3 IMPLANT TEMPLATE INFORMATION MODELS

The Implant Template Information Models are based upon a one level entity:

- Implant Template object instance.

The Implant Template object instance contains Attributes associated with the Implant Template object IE of the Composite IODs as defined in PS 3.3.

690 The Implant Assembly Template Information Model is based upon a one level entity:

- Implant Assembly Template object instance.

The Implant Assembly Template object instance contains Attributes associated with the Implant Assembly Template object IE of the Composite IODs as defined in PS 3.3.

The Implant Assembly Group Information Model is based upon a one level entity:

695 — Implant Template Group object instance.

The Implant Template Group object instance contains Attributes associated with the Implant Template Group object IE of the Composite IODs as defined in PS 3.3.

Y.4 DIMSE-C SERVICE GROUPS

Y.4.1 C-FIND Operation

700 See the C-FIND Operation definition for the Basic Worklist Management Service Class (K.4.1), and substitute “Implant Template” for “Worklist”. The “Worklist” Search Method shall be used.

705 The SOP Class UID identifies the Implant Template or Implant Assembly Template, respectively Information Model against which the C-FIND is to be performed. The Key Attributes and values allowable for the query are defined in the SOP Class definitions for the Implant Template and Implant Assembly Template Information Model.

Y.4.1.1 Service Class User Behavior

When receiving several Implant Template Instances with the same Implant Part Number, the receiving application shall use Effective DateTime (0068,6226) to determine the appropriate Instance.

Y.4.1.2 Service Class Provider Behavior

710 An SCP of this SOP Class shall support Level-2 conformance as defined in Section B.4.1.

Y.4.2 C-MOVE Operation

715 See the C-MOVE Operation definition for the Query/Retrieve Service Class (C.4.2). No Extended Behavior or Relational-Retrieve is defined for the Implant Template and Implant Assembly Template Query/Retrieve Service Classes.

Query/Retrieve Level (0008,0052) is not relevant to the Implant Template and Implant Assembly Template Query/Retrieve Service Classes, and therefore shall not be present in the Identifier. The only Unique Key Attribute of the Identifier shall be SOP Instance UID (0008,0018). The SCU shall supply one UID or a list of UIDs.

720 Note: More than one entity may be retrieved, using List of UID matching.

Y.4.3 C-GET Operation

725 See the C-GET Operation definition for the Query/Retrieve Service Class (C.4.2). No Extended Behavior or Relational-Retrieve is defined for the Implant Template and Implant Assembly Template Query/Retrieve Service Classes.

Note: More than one entity may be retrieved, using List of UID matching.

Y.5 ASSOCIATION NEGOTIATION

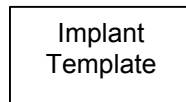
730 See the Association Negotiation definition for the Basic Worklist Management Service Class (K.5).

Y.6 SOP CLASS DEFINITIONS

Y.6.1 Implant Template Information Model

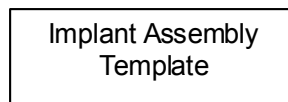
Y.6.1.1 E/R Models

735 The Implant Template Information Model consists of a single entity. In response to a given C-FIND request, the SCP shall send one C-FIND response per matching Implant Template Instance.



**Figure Y.6-1
IMPLANT TEMPLATE INFORMATION MODEL E/R DIAGRAM**

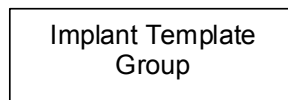
740 The Implant Assembly Template Information Model consists of a single entity. In response to a given C-FIND request, the SCP shall send one C-FIND response per matching Implant Assembly Template Instance.



**Figure Y.6-2
IMPLANT ASSEMBLY TEMPLATE INFORMATION MODEL E/R DIAGRAM**

745

The Implant Template Group Information Model consists of a single entity. In response to a given C-FIND request, the SCP shall send one C-FIND response per matching Implant Template Group Instance.



750

**Figure Y.6-3
IMPLANT TEMPLATE GROUP INFORMATION MODEL E/R DIAGRAM**

Y.6.1.2 Implant Template Attributes

Y.6.1.2.1 Generic Implant Template Attributes

Table Y.6-1 defines the Attributes of the Generic Implant Template Information Model:

755

**Table Y.6-1
Attributes for the Implant Template Information Model**

Description / Module	Tag	Match -ing Key Type	Return Key Type	Remark / Matching Type
SOP Common				
Specific Character Set	(0008,0005)	-	1C	This Attribute is required if expanded or replacement character sets are used. See C.2.2.2 and C.4.1.1.
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
Implant Template				
Manufacturer (0008,0070)		R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Implant Name	(0022,1095)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Implant Size	(0068,6210)	R	2	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Implant Part Number	(0022,1097)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Replaced Implant Template Sequence	(0068,6222)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Derivation Implant Template Sequence	(0068,6224)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Effective DateTime	(0068,6226)	R	1	Shall be retrieved with Single Value or Range Matching.
Original Implant Template Sequence	(0068,6225)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP	(0008,1155)	R	1	Shall be retrieved with List of UID

Description / Module	Tag	Match-ing Key Type	Return Key Type	Remark / Matching Type
Instance UID				Matching.
Implant Target Anatomy Sequence	(0068,6230)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Anatomic Region Sequence	(0008,2218)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>>Code Meaning	(0008,0104)	-	1	
Implant Regulatory Disapproval Code Sequence	(0068,62A0)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Material Code Sequence	(0068,63A0)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Coating Materials Code Sequence	(0068,63A4)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	

Y.6.1.2.2 Implant Assembly Template Attributes

Table Y.6-2 defines the Attributes of the Implant Assembly Template Information Model:

760

**Table Y.6-2
Attributes for the Implant Assembly Template Information Model**

Description / Module	Tag	Match-ing Key Type	Return Key Type	Remark / Matching Type
SOP Common				

Description / Module	Tag	Match- ing Key Type	Return Key Type	Remark / Matching Type
Specific Character Set	(0008,0005)	-	1C	This Attribute is required if expanded or replacement character sets are used. See C.2.2.2 and C.4.1.1.
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
Implant Assembly Template				
Implant Assembly Template Name		R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Implant Assembly Template Issuer	(0076,0003)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Procedure Type Code Sequence	(0076,0020)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Replaced Implant Assembly Template Sequence	(0076,0008)	R	1	Shall be retrieved with Sequence or Universal Matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Original Implant Assembly Template Sequence	(0076,000C)	R	1	Shall be retrieved with Sequence or Universal Matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Derivation Implant Assembly Template Sequence	(0076,000E)	R	1	Shall be retrieved with Sequence or Universal Matching.
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Surgical Technique	(0076,0030)	R	2	Shall be retrieved with Single Value, Wild Card, or Universal Matching.

Y.6.1.2.3 Implant Template Group Attributes

Table Y.6-3 defines the Attributes of the Implant Template Group Information Model:

765

Table Y.6-3
Attributes for the Implant Template Group Information Model

Description / Module	Tag	Match- ing Key Type	Return Key Type	Remark / Matching Type
SOP Common				
Specific Character Set	(0008,0005)	-	1C	This Attribute is required if expanded or replacement character sets are used. See C.2.2.2 and C.4.1.1.
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
Implant Template Group				
Implant Template Group Name	(0078,0001)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Implant Template Group Description	(0078,0010)	-	2	
Implant Template Group Issuer	(0078,0020)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Effective DateTime	(0068,6226)	R	1	Shall be retrieved with Single Value or Range Matching.
Replaced Implant Template Group Sequence	(0078,0026)	R	2	Shall be retrieved with Sequence or Universal Matching
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.

Y.6.1.3 Conformance Requirements

770 An implementation may conform to one of the Implant Template, Implant Assembly Template, or Implant Template Group Information Model SOP Classes as an SCU, SCP, any combination of two of these, or all three. The Conformance Statement shall be in the format defined in PS 3.2.

Y.6.1.3.1 SCU Conformance

Y.6.1.3.1.1 C-FIND SCU Conformance

775 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or Implant Template Group Information Model SOP Classes shall support queries against the appropriate Information Model using the C-FIND SCU Behavior described for the Basic Worklist Management Service Class (see K.4.1.2 and Y.4.1).

780 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or Implant Template Group Information Model SOP Classes as an SCU shall state in its Conformance Statement whether it requests Type 3 Return Key Attributes, and shall list these Optional Return Key Attributes.

785 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or Implant Template Group Information Model SOP Classes as an SCU shall state in its Conformance Statement how it makes use of Specific Character Set (0008,0005) when encoding queries and interpreting responses.

Y.6.1.3.1.2 C-MOVE SCU Conformance

790 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCU shall support transfers
against the appropriate Information Model, using the C-MOVE SCU baseline behavior described
for the Query/Retrieve Service Class (see C.4.2.2.1 and Y.4.2).

Y.6.1.3.1.3 C-GET SCU Conformance

795 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCU shall support transfers
against the appropriate Information Model, using the C-GET SCU baseline behavior described for
the Query/Retrieve Service Class (see C.4.3.2).

Y.6.1.3.2 SCP Conformance

Y.6.1.3.2.1 C-FIND SCP Conformance

800 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCP shall support queries
against the appropriate Template Information Model, using the C-FIND SCP Behavior described
for the Basic Worklist Management Service Class (see K.4.1.3).

805 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCP shall state in its
Conformance Statement whether it supports Type 3 Return Key Attributes, and shall list these
Optional Return Key Attributes.

An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCP shall state in its
Conformance Statement how it makes use of Specific Character Set (0008,0005) when
interpreting queries, performing matching and encoding responses.

Y.6.1.3.2.2 C-MOVE SCP Conformance

810 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCP shall support transfers
against the appropriate Information Model, using the C-MOVE SCP baseline behavior described
for the Query/Retrieve Service Class (see C.4.2.3.1).

815 An implementation that conforms to one of the Implant Template, Implant Assembly Template, or
Implant Template Group Information Model SOP Classes as an SCP, which generates transfers
using the C-MOVE operation, shall state in its Conformance Statement appropriate Storage
Service Class, under which it shall support the C-STORE sub-operations generated by the C-
MOVE.

Y.6.1.3.2.3 C-GET SCP Conformance

820 An implementation which conforms to one of the SOP Classes of the Implant Template, Implant
Assembly Template, or Implant Template Group Information Model SOP Class Group as an SCP
shall support retrievals against the Query/Retrieve Information Model described in Section
C.6.1.1 using the C-GET SCP Behavior described in Section C.4.3.3.

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Y.6.1.4 SOP Classes

830 The SOP Classes of the Implant Template Information Models in the Implant Template
Query/Retrieve Service Class identify the Implant Template Information Models, and the DIMSE-
C operations supported. The SOP Classes of the Implant Assembly Template Information Models
in the Implant Assembly Template Query/Retrieve Service Class identify the Implant Assembly
Template Information Models, and the DIMSE-C operations supported. The SOP Classes of the
Implant Template Group Information Models in the Implant Template Group Query/Retrieve

Service Class identify the Implant Template Group Information Models, and the DIMSE-C operations supported. The following Standard SOP Classes are identified:

SOP Class Name	SOP Class UID
Generic Implant Template Information Model – FIND	1.2.840.10008.5.1.4.43.2
Generic Implant Template Information Model - MOVE	1.2.840.10008.5.1.4.43.3
Generic Implant Template Information Model – GET	1.2.840.10008.5.1.4.43.4
Implant Assembly Template Information Model – FIND	1.2.840.10008.5.1.4.44.2
Implant Assembly Template Information Model - MOVE	1.2.840.10008.5.1.4.44.3
Implant Assembly Template Information Model – GET	1.2.840.10008.5.1.4.44.4
Implant Template Group Information Model – FIND	1.2.840.10008.5.1.4.45.2
Implant Template Group Information Model - MOVE	1.2.840.10008.5.1.4.45.3
Implant Template Group Information Model – GET	1.2.840.10008.5.1.4.45.4

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845

Changes to NEMA Standards Publication PS 3.6-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

Item: Add or the following Data Elements to Part 6 Section 6:

850

6 Registry of DICOM data elements

Tag	Name	Keyword	VR	VM
(0068,6210)	Implant Size	ImplantSize	LO	1
(0068,6221)	Implant Template Version	ImplantTemplateVersion	LO	1
(0068,6222)	Replaced Implant Template Sequence	ReplacedImplantTemplateSequence	SQ	1
(0068,6223)	Implant Type	ImplantType	CS	1
(0068,6224)	Derivation Implant Template Sequence	DerivationImplantTemplateSequence	SQ	1
(0068,6225)	Original Implant Template Sequence	OriginalImplantTemplateSequence	SQ	1
(0068,6226)	Effective DateTime	EffectiveDateTime	DT	1
(0068,6230)	Implant Target Anatomy Sequence	ImplantTargetAnatomySequence	SQ	1
(0068,6260)	Information From Manufacturer Sequence	InformationFromManufacturerSequence	SQ	1
(0068,6265)	Notification From Manufacturer Sequence	NotificationFromManufacturerSequence	SQ	1
(0068,6270)	Information Issue DateTime	InformationIssueDateTime	DT	1
(0068,6280)	Information Summary	InformationSummary	ST	1
(0068,62A0)	Implant Regulatory Disapproval Code Sequence	ImplantRegulatoryDisapprovalCodeSequence	SQ	1
(0068,62A5)	Overall Template Spatial Tolerance	OverallTemplateSpatialTolerance	FD	1
(0068,62C0)	HPGL Document Sequence	HPGLDocumentSequence	SQ	1
(0068,62D0)	HPGL Document ID	HPGLDocumentID	US	1
(0068,62D5)	HPGL Document Label	HPGLDocumentLabel	LO	1
(0068,62E0)	View Orientation Code Sequence	ViewOrientationCodeSequence	SQ	1
(0068,62F0)	View Orientation Modifier	ViewOrientationModifier	FD	9
(0068,62F2)	HPGL Document Scaling	HPGLDocumentScaling	FD	1
(0068,6300)	HPGL Document	HPGLDocument	OB	1
(0068,6310)	HPGL Contour Pen Number	HPGLContourPenNumber	US	1
(0068,6320)	HPGL Pen Sequence	HPGLPenSequence	SQ	1
(0068,6330)	HPGL Pen Number	HPGLPenNumber	US	1
(0068,6340)	HPGL Pen Label	HPGLPenLabel	LO	1
(0068,6345)	HPGL Pen Description	HPGLPenDescription	ST	1
(0068,6346)	Recommended Rotation Point	RecommendedRotationPoint	FD	2
(0068,6347)	Bounding Rectangle	BoundingRectangle	FD	4
(0068,6350)	Implant Template 3D Model Surface Number	ImplantTemplate3DModelSurfaceNumber	US	1-n
(0068,6360)	Surface Model Description Sequence	SurfaceModelDescriptionSequence	SQ	1

Tag	Name	Keyword	VR	VM
(0068,6380)	Surface Model Label	SurfaceModelLabel	LO	1
(0068,6390)	Surface Model Scaling Factor	SurfaceModelScalingFactor	FD	1
(0068,63A0)	Materials Code Sequence	MaterialsCodeSequence	SQ	1
(0068,63A4)	Coating Materials Code Sequence	CoatingMaterialsCodeSequence	SQ	1
(0068,63A8)	Implant Type Code Sequence	ImplantTypeCodeSequence	SQ	1
(0068,63AC)	Fixation Method Code Sequence	FixationMethodCodeSequence	SQ	1
(0068,63B0)	Mating Feature Sets Sequence	MatingFeatureSetsSequence	SQ	1
(0068,63C0)	Mating Feature Set ID	MatingFeatureSetID	US	1
(0068,63D0)	Mating Feature Set Label	MatingFeatureSetLabel	LO	1
(0068,63E0)	Mating Feature Sequence	MatingFeatureSequence	SQ	1
(0068,63F0)	Mating Feature ID	MatingFeatureID	US	1
(0068,6400)	Mating Feature Degree Of Freedom Sequence	MatingFeatureDegreeOfFreedomSequence	SQ	1
(0068,6410)	Degree Of Freedom ID	DegreeOfFreedomID	US	1
(0068,6420)	Degree Of Freedom Type	DegreeOfFreedomType	CS	1
(0068,6430)	2D Mating Feature Coordinates Sequence	TwoDMatingFeatureCoordinatesSequence	SQ	1
(0068,6440)	Referenced HPGL Document ID	ReferencedHPGLDocumentID	US	1
(0068,6450)	2D Mating Point	TwoDMatingPoint	FD	2
(0068,6460)	2D Mating Axes	TwoDMatingAxes	FD	4
(0068,6470)	2D Degree Of Freedom Sequence	TwoDDegreeOfFreedomSequence	SQ	1
(0068,6490)	3D Degree Of Freedom Axis	ThreeDDegreeOfFreedomAxis	FD	3
(0068,64A0)	Range Of Freedom	RangeOfFreedom	FD	2
(0068,64C0)	3D Mating Point	ThreeDMatingPoint	FD	3
(0068,64D0)	3D Mating Axes	ThreeDMatingAxes	FD	9
(0068,64F0)	2D Degree Of Freedom Axis	TwoDDegreeOfFreedomAxis	FD	3
(0068,6500)	Planning Landmark Point Sequence	PlanningLandmarkPointSequence	SQ	1
(0068,6510)	Planning Landmark Line Sequence	PlanningLandmarkLineSequence	SQ	1
(0068,6520)	Planning Landmark Plane Sequence	PlanningLandmarkPlaneSequence	SQ	1
(0068,6530)	Planning Landmark ID	PlanningLandmarkID	US	1
(0068,6540)	Planning Landmark Description	PlanningLandmarkDescription	LO	1
(0068,6545)	Planning Landmark Identification Code Sequence	PlanningLandmarkIdentificationCodeSequence	SQ	1
(0068,6550)	2D Point Coordinates Sequence	TwoDPointCoordinatesSequence	SQ	1
(0068,6560)	2D Point Coordinates	TwoDPointCoordinates	FD	2
(0068,6590)	3D Point Coordinates	ThreeDPointCoordinates	FD	3
(0068,65A0)	2D Line Coordinates Sequence	TwoDLineCoordinatesSequence	SQ	1
(0068,65B0)	2D Line Coordinates	TwoDLineCoordinates	FD	4
(0068,65D0)	3D Line Coordinates	ThreeDLineCoordinates	FD	6
(0068,65E0)	2D Plane Coordinates Sequence	TwoDPlaneCoordinatesSequence	SQ	1
(0068,65F0)	2D Plane Intersection	TwoDPlaneIntersection	FD	4

(0068,6610)	3D Plane Origin	ThreeDPlaneOrigin	FD	3
(0068,6620)	3D Plane Normal	ThreeDPlaneNormal	FD	3
(0076,0001)	Implant Assembly Template Name	ImplantAssemblyTemplateName	LO	1
(0076,0003)	Implant Assembly Template Issuer	ImplantAssemblyTemplateIssuer	LO	1
(0076,0006)	Implant Assembly Template Version	ImplantAssemblyTemplateVersion	LO	1
(0076,0008)	Replaced Implant Assembly Template Sequence	ReplacedImplantAssemblyTemplateSequence	SQ	1
(0076,000A)	Implant Assembly Template Type	ImplantAssemblyTemplateType	CS	1
(0076,000C)	Original Implant Assembly Template Sequence	OriginalImplantAssemblyTemplateSequence	SQ	1
(0076,000E)	Derivation Implant Assembly Template Sequence	DerivationImplantAssemblyTemplateSequence	SQ	1
(0076,0010)	Implant Assembly Template Target Anatomy Sequence	ImplantAssemblyTemplateTargetAnatomySequence	SQ	1
(0076,0020)	Procedure Type Code Sequence	ProcedureTypeCodeSequence	SQ	1
(0076,0030)	Surgical Technique	SurgicalTechnique	LO	1
(0076,0032)	Component Types Sequence	ComponentTypesSequence	SQ	1
(0076,0034)	Component Type Code Sequence	ComponentTypeCodeSequence	CS	1
(0076,0036)	Exclusive Component Type	ExclusiveComponentType	CS	1
(0076,0038)	Mandatory Component Type	MandatoryComponentType	CS	1
(0076,0040)	Component Sequence	ComponentSequence	SQ	1
(0076,0055)	Component ID	ComponentID	US	1
(0076,0060)	Component Assembly Sequence	ComponentAssemblySequence	SQ	1
(0076,0070)	Component 1 Referenced ID	Component1ReferencedID	US	1
(0076,0080)	Component 1 Referenced Mating Feature Set ID	Component1ReferencedMatingFeatureSetID	US	1
(0076,0090)	Component 1 Referenced Mating Feature ID	Component1ReferencedMatingFeatureID	US	1
(0076,00A0)	Component 2 Referenced ID	Component2ReferencedID	US	1
(0076,00B0)	Component 2 Referenced Mating Feature Set ID	Component2ReferencedMatingFeatureSetID	US	1
(0076,00C0)	Component 2 Referenced Mating Feature ID	Component2ReferencedMatingFeatureID	US	1
(0078,0001)	Implant Template Group Name	ImplantTemplateGroupName	LO	1
(0078,0010)	Implant Template Group Description	ImplantTemplateGroupDescription	ST	1
(0078,0020)	Implant Template Group Issuer	ImplantTemplateGroupIssuer	LO	1
(0078,0024)	Implant Template Group Version	ImplantTemplateGroupVersion	LO	1
(0078,0026)	Replaced Implant Template Group Sequence	ReplacedImplantTemplateGroupSequence	SQ	1
(0078,0028)	Implant Template Group Target Anatomy Sequence	ImplantTemplateGroupTargetAnatomySequence	SQ	1
(0078,002A)	Implant Template Group Members Sequence	ImplantTemplateGroupMembersSequence	SQ	1
(0078,002E)	Implant Template Group Member ID	ImplantTemplateGroupMemberID	US	1

(0078,0050)	3D Implant Template Group Member Matching Point	ThreeDImplantTemplateGroupMemberMatchingPoint	FD	3
(0078,0060)	3D Implant Template Group Member Matching Axes	ThreeDImplantTemplateGroupMemberMatchingAxes	FD	9
(0078,0070)	Implant Template Group Member Matching 2D Coordinates Sequence	ImplantTemplateGroupMemberMatching2DCoordinatesSequence	SQ	1
(0078,0090)	2D Implant Template Group Member Matching Point	TwoDImplantTemplateGroupMemberMatchingPoint	FD	2
(0078,00A0)	2D Implant Template Group Member Matching Axes	TwoDImplantTemplateGroupMemberMatchingAxes	FD	4
(0078,00B0)	Implant Template Group Variation Dimension Sequence	ImplantTemplateGroupVariationDimensionSequence	SQ	1
(0078,00B2)	Implant Template Group Variation Dimension Name	ImplantTemplateGroupVariationDimensionName	LO	1
(0078,00B4)	Implant Template Group Variation Dimension Rank Sequence	ImplantTemplateGroupVariationDimensionRankSequence	SQ	1
(0078,00B6)	Referenced Implant Template Group Member ID	ReferencedImplantTemplateGroupMemberID	US	1
(0078,00B8)	Implant Template Group Variation Dimension Rank	ImplantTemplateGroupVariationDimensionRank	US	1

Item: Add the following UIDs to Part 6 Annex A:

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

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Table A-1
UID VALUES

UID Value	UID NAME	UID TYPE	Part
...			
<u>1.2.840.10008.5.1.4.43.1</u>	<u>Generic Implant Template Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.43.2</u>	<u>Generic Implant Template Information Model – FIND</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.43.3</u>	<u>Generic Implant Template Information Model – MOVE</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.43.4</u>	<u>Generic Implant Template Information Model – GET</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.44.1</u>	<u>Implant Assembly Template Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>

<u>1.2.840.10008.5.1.4.44.2</u>	<u>Implant Assembly Template Information Model – FIND</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.44.3</u>	<u>Implant Assembly Template Information Model – MOVE</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.44.4</u>	<u>Implant Assembly Template Information Model – GET</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.45.1</u>	<u>Implant Template Group Storage</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.45.2</u>	<u>Implant Template Group Information Model – FIND</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.45.3</u>	<u>Implant Template Group Information Model – MOVE</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.45.4</u>	<u>Implant Template Group Information Model – GET</u>	<u>SOP Class</u>	<u>PS 3.4</u>
...			

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Changes to NEMA Standards Publication PS 3.15-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 15: Security and Systems Management Profiles

870

Item: Add to Section C2 and C3

C.2 CREATOR RSA DIGITAL SIGNATURE PROFILE

...

- 875 xx. any Attributes of the Implant Template module that are present
 yy. any Attributes of the Implant Assembly Template module that are present
 zz. any Attributes of the Implant Template Group module that are present

C.3 AUTHORIZATION RSA DIGITAL SIGNATURE PROFILE

880 ...

- xx. any Attributes of the Implant Template module that are present
 yy. any Attributes of the Implant Assembly Template module that are present
 zz. any Attributes of the Implant Template Group module that are present

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Changes to NEMA Standards Publication PS 3.16-2009

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Digital Imaging and Communications in Medicine (DICOM)

Part 16: Content Mapping Resource

Item: Add following to Annex B

900

CID 7300 IMPLANT MATERIALS

**Context ID 7300
Implant Materials**

Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT F-61166		Nickel Titanium
SRT F-611FC		Gold Alloy
SRT	F-61207	Stainless Steel Material
SRT F-61DF9		Polymer
SRT F-61202		Carbon Fiber

905

CID 7301 INTERVENTION TYPES

**Context ID 7301
Intervention Types**

Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	P1-14810	Hip joint reconstruction
SRT	P1-14505	Hip joint implantation
SRT	P1-103D3	Resurfacing of the femoral head
SRT	P1-189C2	Resurfacing of the patella

910

CID 7302 IMPLANT TEMPLATES VIEW ORIENTATIONS

**Context ID 7302
Implant Templates View Orientations
Type: Extensible Version: 20101102**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT R-10206		Antero-Posterior
SRT R-10226		Medio-Lateral
SRT R-10228		Lateral-Medial

915

CID 7303 IMPLANT TEMPLATES MODIFIED VIEW ORIENTATIONS

Context ID 7303
Implant Templates Modified View Orientations
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM 112300		AP+45
DCM 112301		AP-45

920

CID 7304 IMPLANT TARGET ANATOMY

Context ID 7304
Implant Target Anatomy
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT T-15750		Ankle Joint
SRT T-11501		Cervical Spine
SRT T-D00F7		Cervico-Thoracic Spine
SRT T-D8300		Elbow
SRT T-11196		Facial Bones
SRT T-12710		Femur
SRT	T-12711	Head of Femur
SRT T-D078C		Proximal Femur
SRT T-12717		Shaft of Femur
SRT T-D078D		Distal Femur
SRT T-1553D		Finger Joint
SRT T-15710		Hip Joint
SRT T-D1213		Jaw Region
SRT T-D9200		Knee
SRT T-11503		Lumbar Spine
SRT T-D0059		Lumbo-Sacral Spine
SRT T-11180		Mandible
SRT T-11170		Maxilla
SRT T-12730		Patella
SRT T-12310		Clavicle
SRT T-D2220		Shoulder
SRT T-12410		Humerus
SRT	T-1240F	Proximal Humerus

SRT	T-12412	Shaft of Humerus
SRT T-1241F		Distal Humerus
SRT T-12420		Radius
SRT T-1242A		Proximal Radius
SRT T-12423		Shaft of Radius
SRT T-1242B		Distal Radius
SRT T-12430		Ulna
SRT T-1243A		Proximal Ulna
SRT T-12435		Shaft of Ulna
SRT T-1243B		Distal Ulna
SRT T-11100		Skull
SRT T-12600		Hand
SRT T-11502		Thoracic Spine
SRT T-D00FA		Thoraco-Lumbar Spine
SRT T-15460		Wrist Joint
SRT T-12375		Pelvis
SRT T-12750		Fibula
SRT T-12780		Talus
SRT T-12770		Calcaneus
SRT T-12740		Tibia
SRT T-12746		Shaft of Tibia
SRT T-1274B		Distal Tibia

925

CID 7305 IMPLANT PLANNING LANDMARKS

Context ID 7305
Implant Planning Landmarks
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
<i>Include CID 7306 Human Hip Implant Planning Landmarks</i>		

930

CID 7306 HUMAN HIP IMPLANT PLANNING LANDMARKS

Context ID 7306
Human Hip Implant Planning Landmarks
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	112302	Anatomical axis of femur

DCM	112303	Acetabular Center of Rotation
DCM	112304	Femur Head Center of Rotation

935

CID 7307 IMPLANT COMPONENT TYPES

Context ID 7307
Implant Component Types
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
<i>Include CID 7308 Human Hip Implant Component Types</i>		
<i>Include CID 7309 Human Trauma Implant Component Types</i>		

940

CID 7308 HUMAN HIP IMPLANT TYPES

Context ID 7308
Human Hip Implant Component Types
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	112305	Acetabular Cup Shell
DCM	112306	Acetabular Cup Insert
DCM	112307	Acetabular Cup Monoblock
SRT	A-04459	Femoral Head Prosthesis
DCM	112308	Femoral Head Ball Component
DCM	112309	Femoral Head Cone Taper Component
DCM 112310		Femoral Stem
DCM	112311	Femoral Stem Distal Component
DCM	112312	Femoral Stem Proximal Component
DCM	112313	Femoral Stem Component
DCM 112314		Neck Component
DCM 112315		Monoblock Stem
DCM 112315		Distal Centralizer
DCM 112316		Prosthetic Shaft Augment
DCM	112317	Femoral Head Resurfacing Component

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CID 7309 HUMAN TRAUMA IMPLANT TYPES

Context ID 7309
Human Trauma Implant Component Types
Type: Extensible Version: 20101102

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT A-12030		Screw
SRT A-12010		Bone Plate
SRT A-12018		DHS Plate
SRT A-12020		Bone Nail

950

CID 7310 IMPLANT FIXATION METHOD

Context ID 7310
Implant Fixation Method
Type: Extensible Version: 20101102






Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT P0-02126		Anchoring
SRT P0-02125		Fusion
SRT P0-021D6		Gluing
SRT	P1-1099B	Internal fixation using internal fixator system
SRT	P1-10999	Internal fixation using plate
SRT	P1-10998	Internal fixation using screw
SRT	P1-10997	Internal fixation using staple
SRT	R-41C37	Cemented component fixation
SRT	R-42808	Uncemented component fixation
SRT	P1-08080	Repair by nailing
DCM 112318		Pinning
DCM 112319		Sewing
DCM 112320		Bolting
DCM 112321		Wedging




955




Item: Add the following entries to the table in Annex D.




DICOM Code Definitions

Code Value	Code Meaning	Definition	Notes
112305	Acetabular Cup Shell	Prosthetic component implanted into the acetabulum. Provides hold for the insert that is mounted inside the cup.	

			
112306	Acetabular Cup Insert	Prosthetic pelvic joint component. Inserted into the cup, takes in the femoral head replacement. 	
112307	Acetabular Cup Monoblock	Prosthetic pelvic joint cup including insert. 	
A-04459	Femoral Head Prosthesis	Prosthetic component that replaces the original femoral head. Mounted on the neck of a femoral stem replacement or partial replacement. 	
112308	Femoral Head Ball Component	Component for Femoral Head Prosthesis where the conic intake for the stem neck can be exchanged. Combined with a Femoral Head Cone Taper Component. 	
112309	Femoral Head Cone Taper Component	Exchangeable neck intake for composite femoral head prosthesis.	

		Combined with a Femoral Head Ball Component.	
112310	Femoral Stem	Prosthesis Implanted into the femoral bone to provide force transmission between joint replacement and bone. On the proximal end a conic neck holds the femoral head replacement. 	
112311	Femoral Stem Distal Component	Distal half of a modular stem prosthesis system. Combined with a Stem Proximal Component. 	
112312	Femoral Stem Proximal Component	Proximal half of a modular stem prosthesis system. Combined with a Stem Distal Component. 	

112313 Femoral	Stem Component	<p>Stem prosthetic component with a modular insert for an exchangeable neck component. Combined with a Neck Component.</p> 	
112314	Neck Component	<p>Prosthetic Neck to be combined with a Stem Component.</p> 	
112315	Monoblock Stem	<p>Prosthetic Stem and Femoral Head in one piece.</p> 	
112315	Distal Centralizer	<p>Attachment to the distal end of a cemented stem assuring that the stem is in a central position inside the drilled femoral canal before cementation.</p>	

			
112316	Prosthetic Shaft Augment	A proximal attachment to the shaft used to compensate for bone deficiencies or bone loss. 	
112317	Femoral Head Resurfacing Component	Artificial femur head surface needed for the partial replacement of the femoral head where only the surface is replaced. 	
P1-103D3	Resurfacing of the femoral head	Partial replacement of the femoral head where only the surface is replaced.	
112300	AP+45	View Orientation Modifier indicates that the view orientation of the imaging plane is rotated +45° along the cranial-caudal axis	
112301	AP-45	View Orientation Modifier indicates that the view orientation of the imaging plane is rotated -45° along the cranial-caudal axis.	
112318	Pinning	Fixation using a pin	
112319	Sewing	Fixation sewing several objects together	
112320	Bolting	Fixation using a bolt	
112321	Wedging	Fixation due to forcing an object into a narrow space	
112302	Anatomical axis of femur	The axis following the shaft of the femur	
112303	Acetabular Center of Rotation	Center of Rotation of the natural Acetabulum	

112304	Femur Head Center of Rotation	Center of Rotation of the natural femur head	
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Changes to NEMA Standards Publication PS 3.17-2009

Digital Imaging and Communications in Medicine (DICOM)

970

Part 17: Explanatory Information

Item: Add following Section to PS 3.17

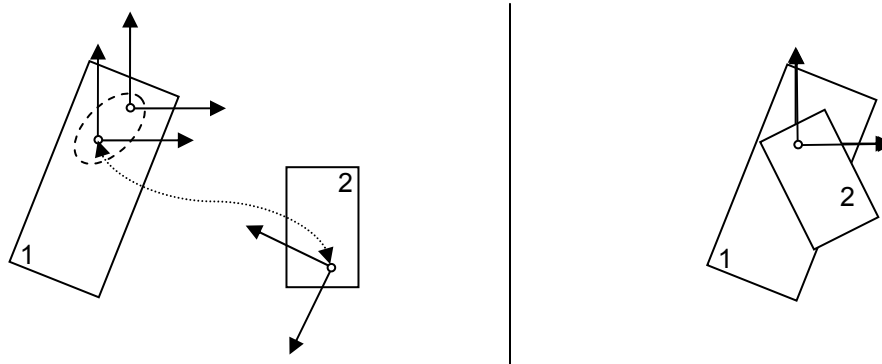
X Implant Template Description

975 X.1 IMPLANT MATING

In this section, the usage of mating features for assembly of implants is declared.

X.1.1 Mating Features

980 These Attributes establish a Cartesian coordinate system relative to the Frame of Reference of the implant. When two implants are assembled using a pair of mating features, a rigid spatial registration can be established, that transforms one Frame of Reference so that the mating features align. The figure below gives a simple example in 2D how two implants (symbolized by two rectangles) are matched according to a mating feature pair. For each 2D and 3D template present, a set of coordinates is assigned to each Mating Feature Sequence Item.



985 **Figure X.1-1 IMPLANT TEMPLATE MATING (EXAMPLE).**

X.1.2 Mating Feature ID

990 It is recommended to give Mating Features that are somehow related, the same Mating Feature ID (0068,63F0) in different implant templates. This may help applications to switch between components while keeping connections to other components. The Example in Figure X.1-2 shows that the first and the last hole in the plates get the same Mating Feature ID in each Template.

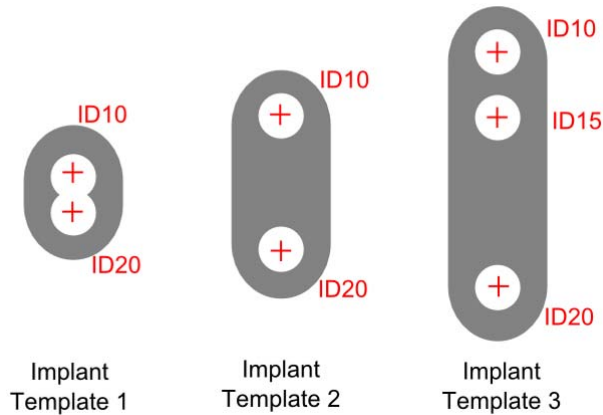


Figure X.1-2
IMPLANT TEMPLATE MATING FEATURE IDS (EXAMPLE).

995 **X.1.3 Mating Feature Sets**

The Mating Features are organized in sets of alternative features: Only one feature of any set shall be used for assembly with other components in one plan. This enables the definition of variants for one kind of contact a component can make while ensuring consistent plans.

1000 An example for Mating Feature Sets is shown in Figure X.1-2. A hip stem template shows a set of five mating features, drawn as circles on the tip of its cone. Different head components use different mating points, depending on the base radius of the conic intake on the head.

HPGL Document ID		View Orientation	
1 MEDIAL-LAT		ERAL	
2		ANTERIOR-POSTERIOR	
Mating Feature ID: 1			
2D Mating Feature Coordinates Sequence			
Referenced HPGL Document ID	2D Mating Point	2D Mating Axes	
1	6.87 / 44.91	1 / 0 / 0 / 1	
2	44.24 / 16.7	0.6947 / 0.7193 / -0.7193 / 0.6947	
Mating Feature ID: 2			
2D Mating Feature Coordinates Sequence			
Referenced HPGL Document ID	2D Mating Point	2D Mating Axes	
1	6.87 / 44.23	1 / 0 / 0 / 1	
2	43.58 / 16	0.6947 / 0.7193 / -0.7193 / 0.6947	

Figure X.1-2
2D MATING FEATURE COORDINATES SEQUENCE (EXAMPLE).

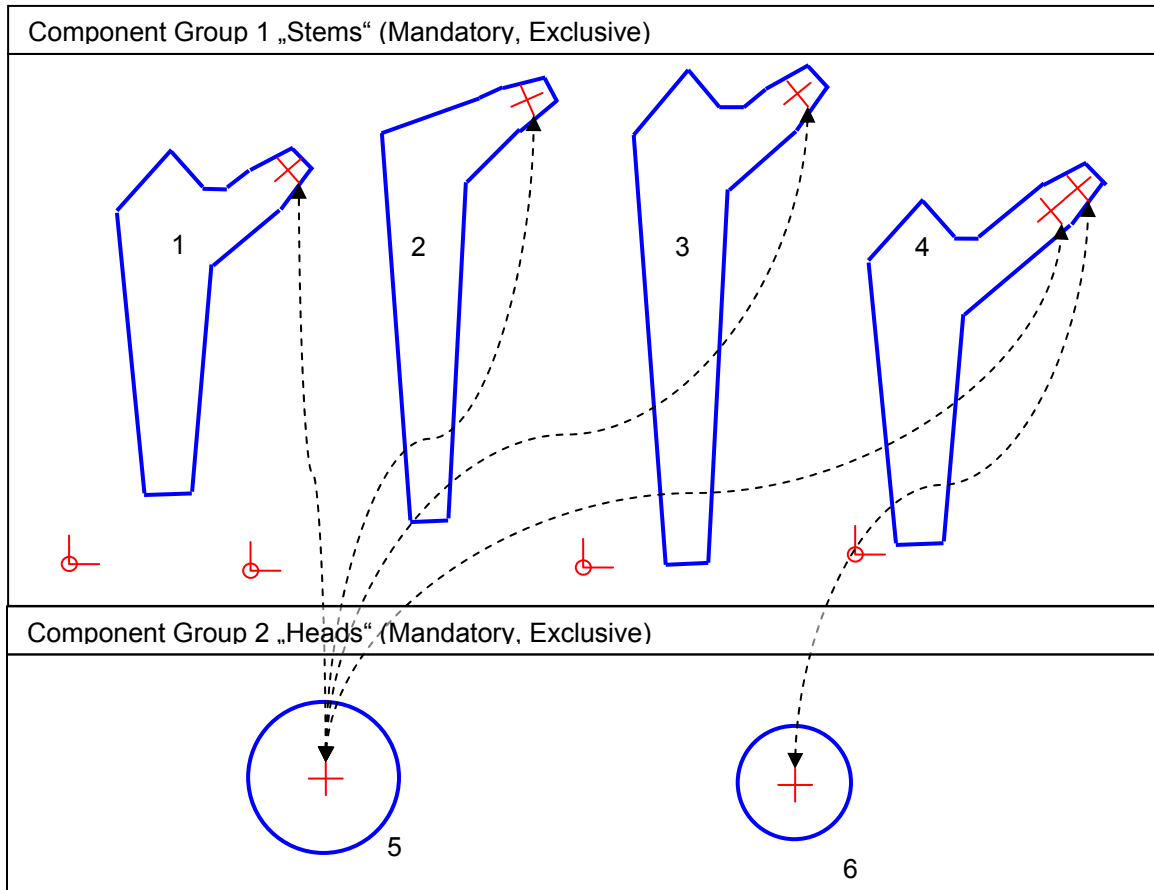
1005 **X.1.4 Degrees of Freedom**

For each Item of the Mating Feature Sequence (0068,63E0), degrees of freedom can be specified. A degree of freedom is defined by one axis, and can be either rotational or translational. For each 2D and 3D template present, the geometric specifications of the mating points can be provided.

1010 **X.1.5 Implant Assembly Templates**

Instances of the Implant Assembly Template IOD are utilized to define intended combinations of implant templates. An Implant Assembly Template consists of a sequence of component type definitions (Component Type Sequence (0076,0032)) which references Implant Template Instances and assigns roles to the referenced implants. In the example in Figure X.1-3, the component types "Stems" and "Heads" are defined. Four different stems and two different heads are referenced. Both groups are flagged mandatory and exclusive, i.e. a valid assembly requires exactly one representative of each group.

1020 The Component Assembly Sequence (0076,0060) declares possible connections between components referenced by the component groups. Each sequence item refers to exactly two implant templates which are part of at least one component group in the same Implant Assembly Template Instance. An Component Assembly Sequence Item references one mating feature in each of the templates according to which the assembly is geometrically constrained. The double-pointed dashed lines represent the Items of the Component Assembly Sequence in Figure X.1-3.



1025

**Figure X.1-3
IMPLANT ASSEMBLY TEMPLATE (EXAMPLE).**

X.2 PLANNING LANDMARKS

1030

Registration of implant templates with patient images according to anatomical landmarks is one of the major features of implantation planning. For that purpose, geometric features can be attached to Implant Template Instances. Three kinds of landmarks are defined: Points, lines, and planes. Each landmark consists of its geometric definition which is defined per template and a description.

1035

When registering an Implant Template to a patient dataset like an Image or a Surface Segmentation, the planning software should establish a spatial transformation that matches to planning landmarks to corresponding geometric features in the patient dataset.

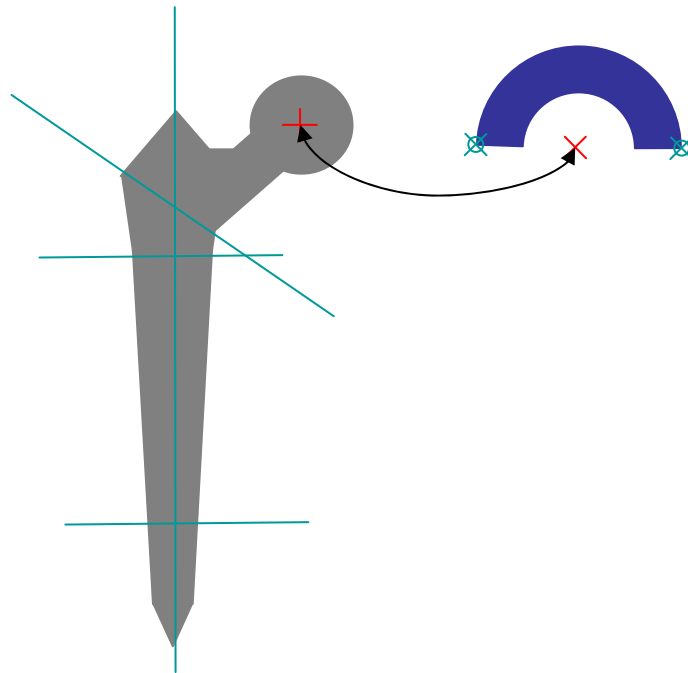
X.3 IMPLANT REGISTRATION AND MATING EXAMPLE

1040

In this section, an example is presented that shows the usage of Implant Templates together with an Implant Assembly Template to create an Implantation Plan with patient images. The example is in 2D but can easily be extended to 3D as well. The example looks at a simplified case of hip reconstruction planning, using a monoblock stem component and a monoblock cup component.

1045

Planning consists of 2 steps: Selection and placement of the best fitting cup from the cups referenced by the Assembly Template based on the dimension of the patient's hip is the first step. With that done, a stem is selected that can be mated with the selected cup and has a neck configuration that leads to an optimal outcome with regard to leg length and other parameters. Therefore, the available stems are placed so that the features align. The femoral planning landmarks are used to calculate the displacement of the femur this configuration would result in. The workflow is shown in the following set of figures.



1050

Figure X.3-1
IMPLANT TEMPLATES USED IN THE EXAMPLE.

In the first step, the planning landmarks marked with the green arrows in Figure X.3-2 are aligned with compliant positions in the patient's x-ray.



1055

Figure X.3-2
CUP IS ALIGNED WITH PATIENT'S ACETABULUM USING 2 LANDMARKS

In the second step, the femoral length axis is detected from the patient's x-ray and the stem template is aligned accordingly using the femoral axis landmark. The proximal and distal fixation boundary planes are used to determine the insertion depth of the stem along that axis.

1060

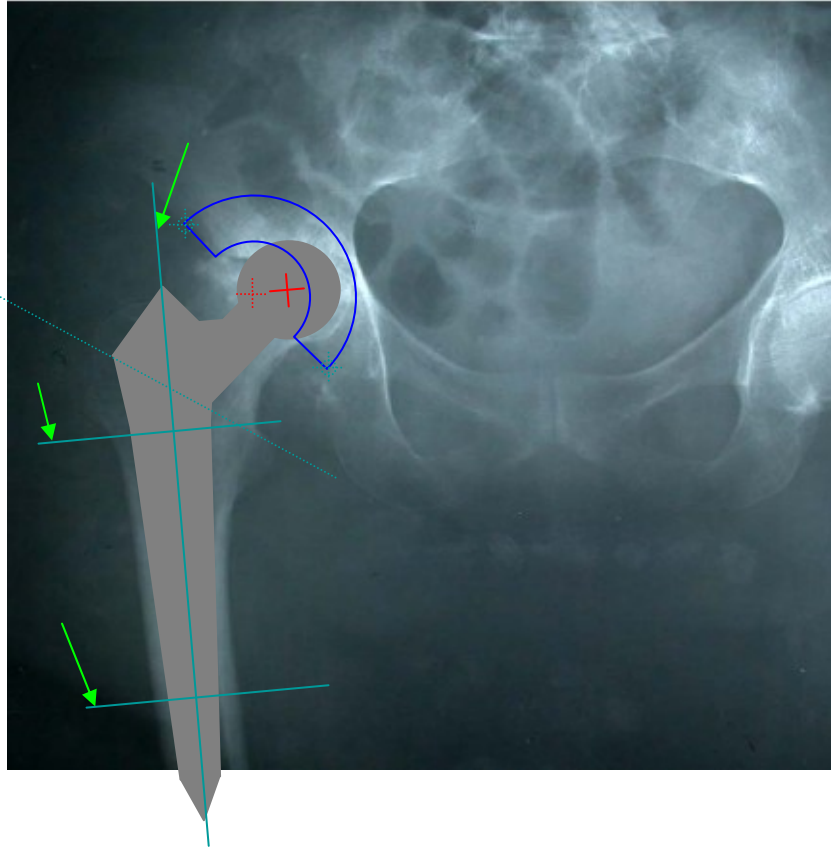


Figure X.3-3
STEM IS ALIGNED WITH PATIENT'S FEMUR.

1065

In the third step, the image is split into a femoral and a pelvic part according to the proposed resection plane of the stem template. The mating features are used to calculate the spatial relation between the femoral and the pelvic component.

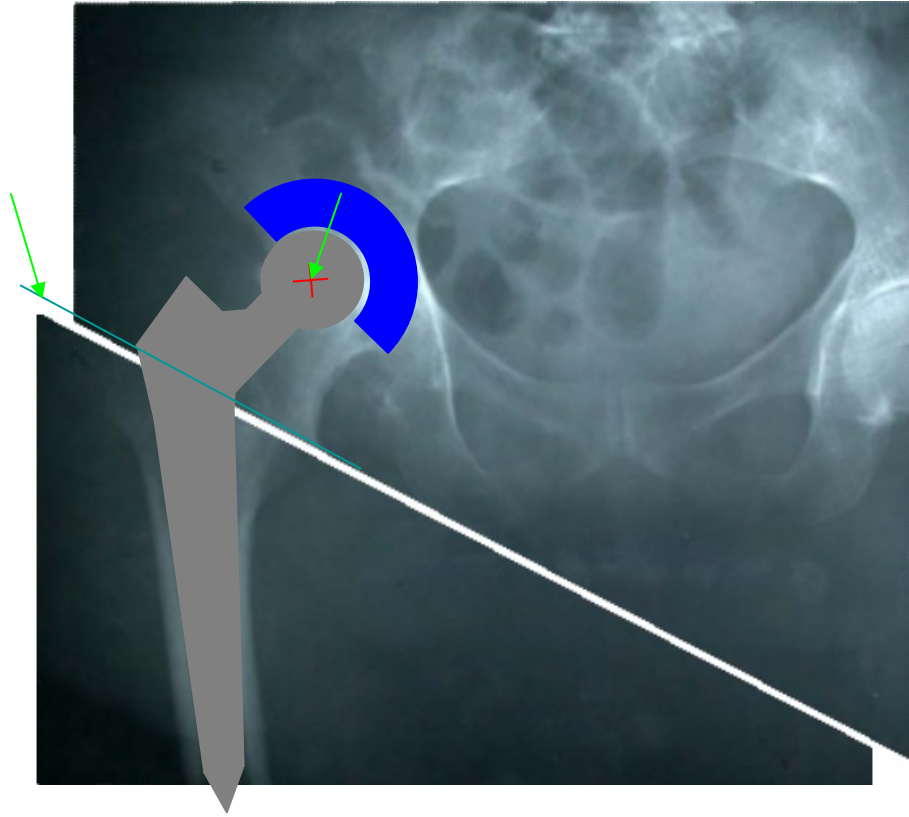


Figure X.3-4
FEMORAL AND PELVIC SIDE ARE REGISTERED.

1070 **X.3.1 Degrees Of Freedom**

The hip joint has several degrees of freedom, of course. The Implant Template should contain this information in the Mating Features. In the given 2D projections, the rotational freedom of the joint is expressed by one single rotation around the axis of projection intersecting with the printing space at the 2D coordinate of the Mating Feature. Therefore, a Degree Of Freedom Sequence Item added to either the stem, the cup, or both.

1075

In planning, this information could be used to visualize the rotational capacities of the joint after implantation.

Note: Technically, the degree of freedom could also have been added to the cup or even (each with half the range of freedom) to both. But since we are used to see femurs rotation with respect to pelvises and not the other way around, it seemed natural to do it that way.

1080

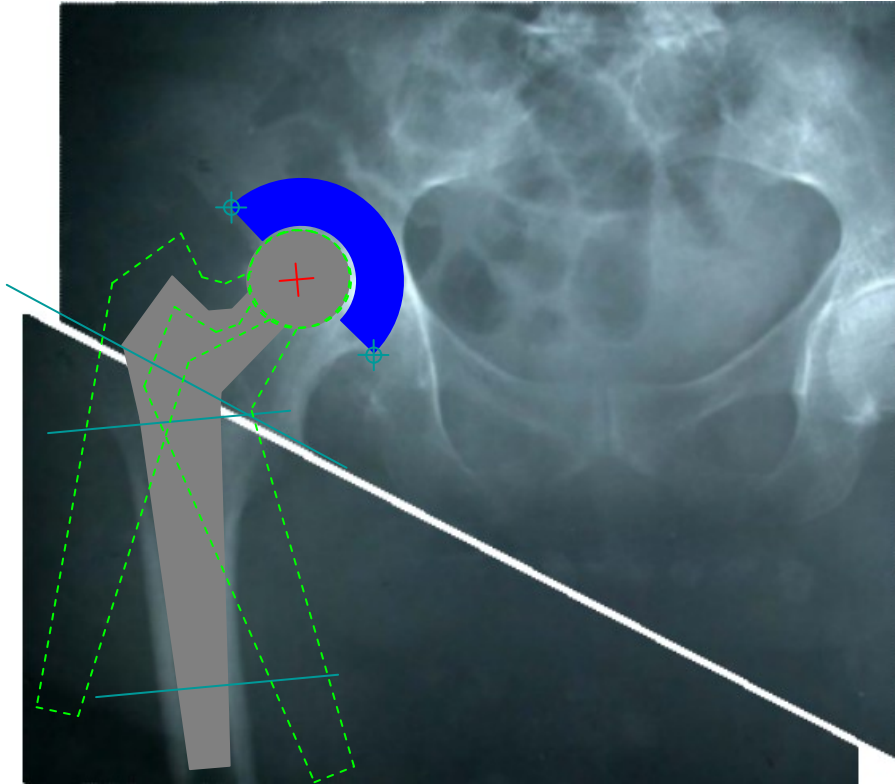


Figure X.3-5
ROTATIONAL DEGREE OF FREEDOM

X.4 ENCODING EXAMPLE

1085 The Templates used in the example can be encoded as follows:

Table X.4-1
Attributes Used to Describe a Mono Stem Implant for Total Hip Replacement

Attribute	Value	Comment
SOP Common Module		
SOP Class UID	1.2.840.10008.5.1.4.43.1	
SOP Instance UID	1.2.3.4.5.6.7.0.1	
Generic Implant Template Module		
Manufacturer ACME		
Implant Name	MONO_STEM	
Implant Size	MEDIUM	
Implant Part Number	ACME_MST_M	
Effective DateTime	26.06.2009 12:00	
Implant Template Version	1	
Implant Template Type	ORIGINAL	
Implant Target Anatomy Sequence		
>Anatomic Region Sequence		
>>Code Value	T-12710	
>>Coding Scheme Designator	SRT	
>>Code Meaning	Femur	
Frame of Reference UID 1.2.3.4.5.6.7.1.1		
Overall Template Spatial Tolerance	1.0	
HPGL Document Sequence		
>HPGL Document ID	1	

>View Orientation Code Sequence		
>>Code Value	R-10206	
>>Coding Scheme Designator	SRT	
>>Code Meaning	Antero-Posterior	
>HPGL Document Scaling	1.0	
>HPGL Document	IN PA ...	HPGL commands
>HPGL Contour Pen Number	2	
>HPGL Pen Sequence		
>>HPGL Pen Number	2	
>>HPGL Pen Label	Contour	
>>HPGL Pen Number	3	
>>HPGL Pen Label	Landmarks	
>>HPGL Pen Number	4	
>>HPGL Pen Label	Mating Features	
>Recommended Rotation Point	39.6/72.4	
>Bounding Rectangle	14.2/5.7/46/78.8	
Material Code Sequence		
>Coding Scheme Designator	SRT	
>Code Value	F-61207	
>Code Meaning	Stainless Steel Material	
Implant Type Code Sequence		
>Coding Scheme Designator	DCM	
>Code Value	112315	
>Code Meaning	Monoblock Stem	
Fixation Method Code Sequence		
>Coding Scheme Designator	SRT	
>Code Value	R-42808	
>Code Meaning	Uncemented Component Fixation	
Mating Feature Sets Sequence		
>Mating Feature Set ID	1	
>Mating Feature Set Label	Head Rotation Point	
>Mating Feature Sequence		
>>Mating Feature ID	1	
>>2D Mating Feature Coordinates Sequence		
>>>Referenced HPGL Document ID	1	
>>>2D Mating Point	39.6/72.4	
>>>2D Mating Axes	1/0/0/1	
>>Mating Feature Degree of Freedom Sequence		
>>>Degree of Freedom ID	1	
>>>Degree of Freedom Type	ROTATION	
>>>2D Degree of Freedom Sequence		
>>>>Referenced HPGL Document ID	1	
>>>>2D Degree Of Freedom Axis	0/0/1	
>>>>Range of Freedom	-15/15	

Table X.4-2
Attributes Used to Describe a Mono Cup Implant for Total Hip Replacement

1090

Attribute	Value	Comment
SOP Common Module		
SOP Class UID	1.2.840.10008.5.1.4.43.1	

SOP Instance UID	1.2.3.4.5.6.7.0.2	
Generic Implant Template Module		
Manufacturer ACME		
Implant Name	MONO_CUP	
Implant Size	MEDIUM	
Implant Part Number	ACME_MCP_M	
Effective DateTime	26.06.2009 12:00	
Implant Template Version	1	
Implant Template Type	ORIGINAL	
Implant Target Anatomy Sequence		
>Anatomic Region Sequence		
>>Code Value	T-15710	
>>Coding Scheme Designator	SRT	
>>Code Meaning	Hip Joint	
Frame of Reference UID 1.2.3.4.5.6.7.1.2		
Overall Template Spatial Tolerance	1.0	
HPGL Document Sequence		
>HPGL Document ID	1	
>View Orientation Code Sequence		
>>Code Value	G-5215	
>>Coding Scheme Designator	SRT	
>>Code Meaning	Anterior Projection	
>HPGL Document Scaling	1	
>HPGL Document	IN PA ...	HPGL commands
>HPGL Contour Pen Number	2	
>HPGL Pen Sequence		
>>HPGL Pen Number	2	
>>HPGL Pen Label	Contour	
>>HPGL Pen Number	3	
>>HPGL Pen Label	Landmarks	
>>HPGL Pen Number	4	
>>HPGL Pen Label	Mating Features	
>Recommended Rotation Point	12.9/0	
>Bounding Rectangle	0/0/25.8/12.9	
Material Code Sequence		
>Coding Scheme Designator	SRT	
>Code Value	F-61207	
>Code Meaning	Stainless Steel Material	
Implant Type Code Sequence		
>Coding Scheme Designator	DCM	
>Code Value	112307	
>Code Meaning	Acetabular Cup Monoblock	
Fixation Method Code Sequence		
>Coding Scheme Designator	SRT	
>Code Value	R-42808	
>Code Meaning	Uncemented Component Fixation	
Mating Feature Sets Sequence		
>Mating Feature Set ID	1	
>Mating Feature Set Label	Hip Joint Mating Feature	
>Mating Feature Sequence		

>>Mating Feature ID	1	
>>2D Mating Feature Coordinates Sequence		
>>>Referenced HPGL Document ID	1	
>>>2D Mating Point	12.9/0	
>>>2D Mating Axes	0.707/0.707/-0.707/0.707	

Table X.4-3
Attributes Used to Describe the Assembly of Cup and Stem

Attribute	Value	Comment
SOP Common Module		
SOP Class UID	1.2.840.10008.5.1.4.44.1	
SOP Instance UID	1.2.3.4.5.6.7.0.3	
Implant Assembly Template Module		
Implant Assembly Template Name	Acme Hip Assembly	
Implant Assembly Template Issuer	ACME	
Effective DateTime	26.06.2009 12:00	
Implant Assembly Template Version	1	
Implant Assembly Template Type	ORIGINAL	
Implant Assembly Template Target Anatomy Sequence		
>Anatomic Region Sequence		
>>Code Value	T-15710	
>>Coding Scheme Designator	SRT	
>>Code Meaning	Hip Joint	
Procedure Type Code Sequence		
>Code Value	P1-14810	
>Coding Scheme Designator	SRT	
>Code Meaning	Hip Joint Reconstruction	
Component Types Sequence		
>Component Type Code Sequence		Sequence Item 1
> Coding Scheme Designator	DCM	
> Code Value	112310	
> Code Meaning	Femoral Stem	
>Exclusive Component Type	YES	
>Mandatory Component Type	YES	
>Component Sequence		
>>Referenced SOP Class UID 1.2.840.10008.5.1.4.43.1		
>>Referenced SOP Instance UID 1.2.3.4.5.6.7.0.1		
>>Component ID	1	
>Component Type Code Sequence		
> Coding Scheme Designator	DCM	
> Code Value	112305	
> Code Meaning	Acetabular Cup Shell	
>Exclusive Component Type	YES	
>Mandatory Component Type	YES	
>Component Sequence		
>>Referenced SOP Class UID 1.2.840.10008.5.1.4.43.1		
>>Referenced SOP Instance UID 1.2.3.4.5.6.7.0.2		
>>Component ID	2	
Component Assembly Sequence		

>Component 1 Referenced ID	1 The	stem
>Component 1 Referenced Mating Feature Set ID	1	
> Component 1 Referenced Mating Feature ID	1	
>Component 2 Referenced ID	2 The	cup
> Component 2 Referenced Mating Feature Set ID	1	
> Component 2 Referenced Mating Feature ID	1	

1095

X.5 IMPLANT TEMPLATE VERSIONS AND DERIVATION

The Generic Implant Module contains several Attributes to express the relations between different versions of implant templates. These Attributes are

(0022,1097)	Implant Part Number	Number (or alphanumerical code) assigned by the manufacturer of an implant to one particular release of one particular part. Whenever changes on the implant design are made, a new implant part number is assigned.
(0068,6226)	Effective DateTime	Date and time from which on an Implant Template Instance is valid.
(0068,6221)	Implant Template Version	Number assigned by the creator of an ORIGINAL Implant Template Instance. When an implant manufacturer issues a new version of an implant template without doing changes on the implant itself, it issues a new instance with the same part number but a different template version.
(0068,6222)	Replaced Implant Template Sequence	When a manufacturer issues a new version of an Implant Template, the instance contains a reference to it direct predecessor.
(0068,6223)	Implant Type	When a software vendor, user or other entity creates a "proprietary" version of an Implant Template by adding Attributes, the resulting Instance is labeled DERIVED.
(0068,6225)	Original Implant Template	When an Instance is DERIVED, it contains a reference to the ORIGINAL instance it was derived from (directly or with several derived versions in between).
(0068,6224)	Derivation Implant Template Sequence	When an Implant Template Instance is derived from another instance, it contains a reference to the Implant Template Instance it was directly derived from.

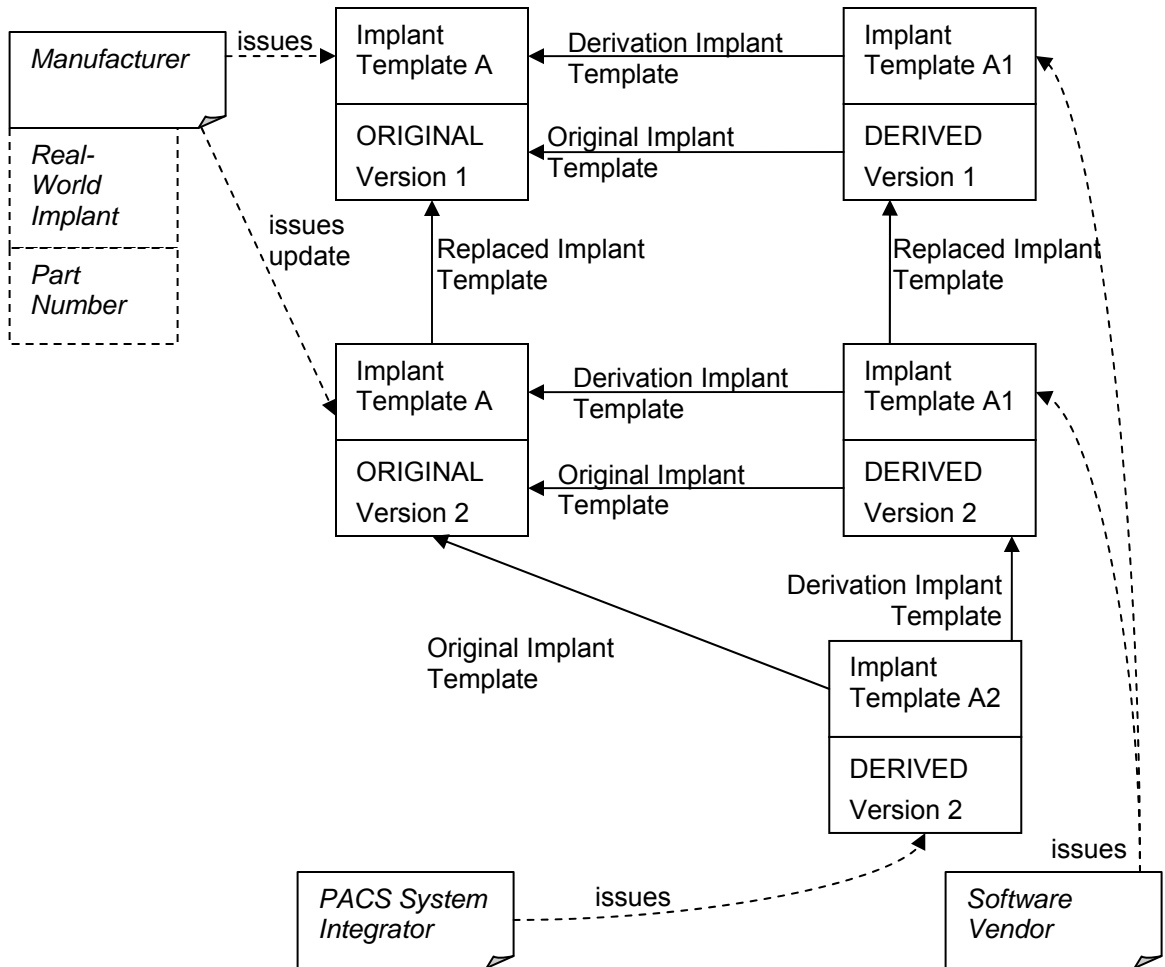
1100

Different versions of Implant Templates reflect the changes a manufacturer is doing on the Implant Templates he issues. The Implant Templates which are issued by a manufacturer (or a third party who is acting on behalf of the manufacturer) are always ORIGINAL. Software vendors, PACS integrators, or other stakeholders will add information to such templates for different purposes. The Instances which are generated by this process is called derivation and the

1105 resulting instances are labeled DERIVED. Implantation Plans, i.e. electronic documents describing the result of implantation planning, are specified in an instance of the Implantation Plan SR Document. There, the implants which are relevant for one plan are included by reference. When such plans are exchanged between systems or organizations it is likely that the receiving party has access to other versions of templates as the sending party has. In order to maintain readability of exchanged plans, the following is required:

- 1110 1. All necessary information about an implant which is relevant to display and understand a plan is present in the ORIGINAL Implant Templates which were issued by a manufacturer. This is assured by these Attributes being Type 1 in the IOD.
2. When deriving Instances, information may only be added but not removed from the ORIGINAL Instance. This information may be encoded in standard or private Tags.
- 1115 3. Derived Instances contain the information about the source Instances they were derived from. All Instances contain a reference to the ORIGINAL Instance they were derived from. If an application receives a plan which references an implant it does not have in its database, it will find the UID of the ORIGINAL Instance in the plan, too. It can query its database for an instance which was derived from that Instance and thereby find an
1120 Instance it can use to present the plan.

Figure X.5-1 shows an example of the relationships between two versions of a manufacturer's Implant Template and several different Implant Templates derived by software vendors from these versions.



**Figure X.5-1
 IMPLANT VERSIONS AND DERIVATION.**