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Digital Imaging and Communications in Medicine (DICOM)

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Supplement 116: X-Ray 3D Storage SOP Class

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Foreword

106 This supplement to the DICOM standard introduces the new X-Ray 3D Storage SOP Classes. It is based on the new multi-frame concepts, introduced with the enhanced MR SOP Classes.

108 This document is a Supplement to the DICOM Standard. It is an extension to the following parts of the published DICOM Standard:

	PS 3.2	Conformance
110	PS 3.3	Information Object Definitions
	PS 3.4	Service Class Specifications
112	PS 3.6	Data Dictionary
	PS 3.15	Security and Systems Management Profiles

114

Scope and Field of Application

116 The scope of this Supplement is defining a baseline for a family of dedicated X-Ray multi-dimensional storage SOP Classes that would define the 3D volume or volumes created from X-Ray cone beam projection. The slices of the volumes are in the Cartesian format, i.e., non-curved slices defined by position and orientation properties.

120 The X-Ray 3D Angiographic Image SOP Class allows storage of the results of a 3D reconstruction from either the current XA SOP Class images or the new Enhanced XA SOP Class. The X-Ray 3D Angiographic Image SOP Class definition will include the relationship to the isocenter reference system and the relevant acquisition attributes from 2D projection images.

124 The X-Ray 3D Craniofacial Image SOP Class allows storage of the results of a 3D reconstruction from the current SOP Class images used in dentistry. The X-Ray 3D Craniofacial Image SOP Class definition will include the relationship to the isocenter reference system and the relevant acquisition attributes from 2D projection images.

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Changes to NEMA Standards Publication PS 3.2-2007

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Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

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Item #1: Add new SOP Classes in Table A.1-2

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

UID Value	UID NAME	Category
...		
<u>1.2.840.10008.5.1.4.1.1.13.1.1</u>	<u>X-Ray 3D Angiographic Image Storage</u>	<u>Transfer</u>
<u>1.2.840.10008.5.1.4.1.1.13.1.2</u>	<u>X-Ray 3D Craniofacial Image Storage</u>	<u>Transfer</u>
...		

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Changes to NEMA Standards Publication PS 3.3-2007

Digital Imaging and Communications in Medicine (DICOM)

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Part 3: Information Object Definitions

Item #2: Add new macros to Section 10154 **10.X1 GENERAL CONTRIBUTING SOURCES MACRO**

156 Table 10-X1 contains IOD Attributes that describe the general characteristics of the contributing sources used to create a new SOP Instance.

158 **Table 10-X1
GENERAL CONTRIBUTING SOURCES MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contributing SOP Instances Reference Sequence	(0020,9529)	1C	A sequence that identifies the contributing SOP Instances. Required if this SOP Instance is created from other DICOM SOP Instances. Note: The attribute is absent in the case where the sources used to create this SOP Instance are not SOP Instances, e.g., a volume that was directly generated by an acquisition system. One or more Items may be present.
>Study Instance UID	(0020,000D)	1	Unique identifier for the Study of the Contributing SOP Instances.
>Referenced Series Sequence	(0008,1115)	1	Sequence of Items each of which includes the Attributes of one Series. One or more Items may be present.
>>Series Instance UID	(0020,000E)	1	Unique identifier of the Series containing the referenced Instances.
>>Series Number	(0020,0011)	2	A number that identifies this Series.
>>Referenced Instance Sequence	(0008,114A)	1	Sequence of Items each providing a reference to an Instance that is part of the Series defined by Series Instance UID (0020,000E) in the enclosing Item. One or more Items may be present.
>>>Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.
>>>Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.
>>>Instance Number	(0020,0013)	2	A number that identifies this instance.
Manufacturer	(0008,0070)	2	Manufacturer of the equipment that produced the sources.
Manufacturer's Model Name	(0008,1090)	1C	Manufacturer's model name of the equipment that produced the sources. Required if present and consistent in the contributing SOP Instances.

Device Serial Number	(0018,1000)	1C	<p>Manufacturer's serial number of the equipment that produced the sources.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Software Versions	(0018,1020)	1C	<p>Manufacturer's designation of software version of the equipment that produced the sources.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Acquisition Datetime	(0008,002A)	1C	<p>The time the acquisition of data that resulted in sources started.</p> <p>The value shall be the start date and time of the first contributing SOP Instance of the group specified by the Contributing SOP Instances Reference Sequence (0020,9529).</p> <p>Required if present and consistent in the contributing SOP Instances.</p> <p>Note: The Acquisition Datetime may be created by combining the values of Acquisition Date (0008,0022) and Acquisition Time (0008,0032) attributes in the contributing SOP Instances.</p>
Station Name	(0008,1010)	1C	<p>User defined name identifying the machine that produced the sources.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Operators' Name	(0008,1070)	1C	<p>Name(s) of the operator(s) supporting the Series.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Operator Identification Sequence	(0008,1072)	1C	<p>Identification of the operator(s) supporting the Series. One or more items shall be included in this sequence. If more than one Item, the number and order shall correspond to the value of Operators' Name (0008,1070), if present.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
<i>>Include 'Person Identification Macro' Table 10-1</i>			
Protocol Name	(0018,1030)	1C	<p>User-defined description of the conditions under which the Series was performed.</p> <p>Required if present and consistent in the contributing SOP Instances.</p> <p>Note: This attribute conveys series-specific protocol identification and may or may not be identical to the one presented in the Performed Protocol Code Sequence (0040,0260).</p>

Performed Protocol Code Sequence	(0040,0260)	1C	Sequence describing the Protocol performed for the Procedure Step creating the sources. One or more Items may be included in this Sequence. Required if present and consistent in the contributing SOP Instances.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>		<i>No Baseline Context ID is defined.</i>	
Acquisition Protocol Name	(0018,9423)	1C	User defined name of the protocol used to acquire this image. Required if present and consistent in the contributing SOP Instances.

160 Note: The attributes at the first level of the General Contributing Sources macro contain information that is
162 common to all the Referenced SOP Instances included in the Contributing SOP Instances Reference
164 Sequence. This allows to not duplicate information when the contributing instances are single-frame
166 objects and/or when they are in different Series with the same protocol and manufacturer information.
Typically the General Contributing Sources macro is invoked from inside another sequence. Therefore, if
the "common" attributes of the macro are different among the Referenced SOP Instances, like different
acquisition prococols, software versions etc., the invoking sequence will contain several items.

10.X2 CONTRIBUTING IMAGE SOURCES MACRO

168 Table 10-X2 contains IOD Attributes that describe the image related characteristics of the contributing image sources used to create a new SOP Instance (e.g., a volume SOP Instance).

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**Table 10-X2
CONTRIBUTING IMAGE SOURCES MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Rows	(0028,0010)	1	Number of rows in the images.
Columns	(0028,0011)	1	Number of columns in the images.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See PS 3.5 for further explanation.
Lossy Image Compression	(0028,2110)	1C	<p>Specifies whether the Source Images have undergone lossy compression. Enumerated Values:</p> <p>00 = Image has NOT been subjected to lossy compression.</p> <p>01 = Image has been subjected to lossy compression.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>Required if it is known whether or not Lossy Compression has been performed on the Images.</p> <p>Note: In some SOP Class definitions the Lossy Image Compression attribute is optional.</p>
Lossy Image Compression Ratio	(0028,2112)	1C	<p>See C.7.6.1.1.5 for further explanation.</p> <p>Required if Lossy Image Compression (0028,2110) equals 01.</p>
Lossy Image Compression Method	(0028,2114)	1C	<p>A label for the lossy compression method(s) that have been applied to the source images.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>May be multi-valued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112).</p> <p>Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111).</p> <p>Required if Lossy Image Compression (0028,2110) equals 01.</p>

172

10.X3 PATIENT ORIENTATION MACRO

174 This section describes attributes of the Patient Orientation Macro by specifying the patient orientation
 176 related to gravity and equipment. Table 10-X3 contains IOD Attributes that describe the Patient Orientation
 related to gravity and equipment.

**Table 10-X3
 PATIENT ORIENTATION MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Patient Orientation Code Sequence	(0054,0410)	1	Sequence that describes the orientation of the patient with respect to gravity. See C.8.11.5.1.2 for further explanation. Only a single Item shall be permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1.			Baseline Context ID 19
> Patient Orientation Modifier Code Sequence	(0054,0412)	1C	Patient Orientation Modifier. Required if needed to fully specify the orientation of the patient with respect to gravity. Only a single Item shall be permitted in this Sequence.
>>Include 'Code Sequence Macro' Table 8.8-1.			Baseline Context ID 20
Patient Gantry Relationship Code Sequence	(0054,0414)	3	Sequence that describes the orientation of the patient with respect to the head of the table. See Section C.8.4.6.1.3 for further explanation. Only a single Item shall be permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1.			Baseline Context ID 21

180 10.X3.1 Relation with other positioning attributes

182 The attributes of this macro may be used to correlate the patient based coordinate system (see C.7.6.2)
 and the equipment.

184 Note: The Patient Orientation Code Sequence (0054,0410) allows a more precise and comprehensive
 positioning than the Patient Position (0018,5100) attribute. If this sequence is present the Patient
 Position (0018,5100) attribute is not used.

Item #3: Add new IODs in Table A.1-1

IODs Modules	<u>3D</u> <u>XA</u>	<u>3D</u> <u>DX</u>
Patient	<u>M</u>	<u>M</u>
Clinical Trial subject	<u>U</u>	<u>U</u>
General Study	<u>M</u>	<u>M</u>
Patient Study	<u>U</u>	<u>U</u>
Clinical Trial Study	<u>U</u>	<u>U</u>

General Series	<u>M</u>	<u>M</u>
Clinical Trial Series	<u>U</u>	<u>U</u>
<u>Enhanced Series</u>	<u>M</u>	<u>M</u>
Frame of Reference	<u>M</u>	<u>M</u>
General Equipment	<u>M</u>	<u>M</u>
Enhanced General Equipment	<u>M</u>	<u>M</u>
Image Pixel	<u>M</u>	<u>M</u>
Enhanced Contrast/Bolus	<u>C</u>	<u>C</u>
Device	<u>U</u>	<u>U</u>
Intervention	<u>U</u>	<u>U</u>
Acquisition Context	<u>M</u>	<u>M</u>
Multi-frame Functional Groups	<u>M</u>	<u>M</u>
Multi-frame Dimension	<u>U</u>	<u>U</u>
Cardiac Synchronization	<u>C</u>	
Respiratory Synchronization	<u>C</u>	
<u>Patient Orientation</u>	<u>U</u>	<u>U</u>
<u>Coordinate System Relationship</u>	<u>U</u>	<u>U</u>
<u>X-Ray 3D Image</u>	<u>M</u>	<u>M</u>
<u>X-Ray 3D Angiographic Image Contributing Sources</u>	<u>U</u>	
<u>X-Ray 3D Craniofacial Image Contributing Sources</u>		<u>U</u>
<u>X-Ray 3D Angiographic Acquisition</u>	<u>U</u>	
<u>X-Ray 3D Craniofacial Acquisition</u>		<u>U</u>
<u>X-Ray 3D Reconstruction</u>	<u>U</u>	<u>U</u>
SOP Common	<u>M</u>	<u>M</u>

Item #4: Add section to Annex A

188 **A.X X-RAY 3D ANGIOGRAPHIC IMAGE INFORMATION OBJECT DEFINITION**

A.X.1 X-Ray 3D Angiographic Image IOD Description

190 This Section defines the Information Object for multi-dimensional reconstructed cone beam X-Ray
 191 Angiographic Images and includes those data elements and information objects necessary for the
 192 interchange of Multi-dimensional X-Ray volumes.

193 Examples of X-Ray 3D Angiographic Images are: 3D reconstruction of static vascular structures (e.g., in
 194 Neuro-Radiology), ECG triggered cardiac volumes at different phases in the cardiac cycle, coronary artery
 tree reconstructions.

196 **A.X.2 X-Ray 3D Angiographic Image IOD Entity-Relationship Model**

197 The E-R Model in Section A.1.2 depicts those components of the DICOM Application Information Model
 198 that directly reference the X-Ray 3D Angiographic Image IOD.

A.X.3 X-Ray 3D Angiographic Image IOD Image Module Table

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**Table A.X-1
 X-RAY 3D ANGIOGRAPHIC IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced Series	C.7.3.X	M
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	Image Pixel	C.7.6.3	M
	Enhanced Contrast/Bolus	C.7.6.4b	C – Required if contrast media was applied.
	Device	C.7.6.12	U
	Intervention	C.7.6.13	U
	Acquisition Context	C.7.6.14	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	U

Cardiac Synchronization	C.7.6.18.1	C – Required if cardiac synchronization was applied.
Respiratory Synchronization	C.7.6.18.2	C – Required if respiratory synchronization was applied.
Patient Orientation	C.7.6.X1	U
Image – Equipment Coordinate Relationship	C.7.6.X2	U
X-Ray 3D Image	C.8.X.2	M
X-Ray 3D Angiographic Image Contributing Sources	C.8.X.3.1	U
X-Ray 3D Angiographic Acquisition	C.8.X.4.2	U
X-Ray 3D Reconstruction	C.8.X.5	U
SOP Common	C.12.1	M

202

A.X.3.1 X-Ray 3D Angiographic Image IOD Content Constraints

204 **A.X.3.1.1 Modality Type Attribute**

The Modality Type attribute (0008,0060) shall have the value XA.

206 **A.X.3.1.2 Restrictions for Standard Extended SOP Classes**

208 The Overlay Plane Module, VOI LUT Module and Softcopy Presentation LUT Module shall not be used in a Standard Extended SOP Class of the X-Ray 3D Angiographic Image.

- Notes:
- 1. The VOI LUT function is provided by a Frame VOI LUT Functional Group.
 - 2. The Curve Module was previously included in the Image IE for this IOD but has been retired. See PS 3.3 2004.

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A.X.4 X-Ray 3D Angiographic Image Functional Group Macros

214 Table A.X-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the X-Ray 3D Angiographic Image IOD.

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**Table A.X-2
X-RAY 3D ANGIOGRAPHIC IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M– May not be used as a Shared Functional Group.
Plane Position	C.7.6.16.2.3	M
Plane Orientation	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	U
Derivation Image	C.7.6.16.2.6	C – Required if the Image Type (0008,0008) Value 1 equals DERIVED.
Cardiac Trigger	C.7.6.16.2.7	U
Frame Anatomy	C.7.6.16.2.8	M

Pixel Value Transformation	C.7.6.16.2.9	U
Frame VOI LUT	C.7.6.16.2.10	M
Real World Value Mapping	C.7.6.16.2.11	U
Contrast/Bolus Usage	C.7.6.16.2.12	C – Required if the Enhanced Contrast/Bolus Module is present.
Respiratory Trigger	C.7.6.16.2.17	U
X-Ray 3D Frame Type	C.8.X.6.1	M

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A.X.4.1 X-Ray 3D Angiographic Image Functional Group Macros Content Constraints

220 **A.X.4.1.1 Frame Anatomy Functional Group Macro**

The Defined Context ID for the Anatomic Region Sequence (0008,2218) shall be CID 4031.

222 **A.Y X-RAY 3D CRANIOFACIAL IMAGE INFORMATION OBJECT DEFINITION**

A.Y.1 X-Ray 3D Craniofacial Image IOD Description

224 This Section defines the Information Object for multi-dimensional reconstructed cone beam X-Ray
 226 Craniofacial Images and includes those data elements and information objects necessary for the
 interchange of Multi-dimensional X-Ray volumes.

228 Examples of X-Ray 3D Craniofacial Images are: 3D reconstruction of craniofacial structures for surgical
 placement of implants, dimensional analysis for orthodontic therapy and evaluation of craniofacial
 pathology.

230 **A.Y.2 X-Ray 3D Craniofacial Image IOD Entity-Relationship Model**

232 The E-R Model in Section A.1.2 depicts those components of the DICOM Application Information Model
 that directly reference the X-Ray 3D Craniofacial Image IOD.

A.Y.3 X-Ray 3D Craniofacial Image IOD Module Table

234

**Table A.Y-1
 X-RAY 3D Craniofacial Image IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced Series	C.7.3.X	M
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M

Image	Image Pixel	C.7.6.3	M
	Enhanced Contrast/Bolus	C.7.6.4b	C – Required if contrast media was applied.
	Device	C.7.6.12	U
	Intervention	C.7.6.13	U
	Acquisition Context	C.7.6.14	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	U
	Patient Orientation	C.7.6.X1	U
	Image – Equipment Coordinate Relationship	C.7.6.X2	U
	X-Ray 3D Image	C.8.X.2	M
	X-Ray 3D Craniofacial Image Contributing Sources	C.8.X.3.2	U
	X-Ray 3D Craniofacial Acquisition	C.8.X.4.3	U
	X-Ray 3D Reconstruction	C.8.X.5	U
	SOP Common	C.12.1	M

236

A.Y.3.1 X-Ray 3D Craniofacial Image IOD Content Constraints

238 **A.Y.3.1.1 Modality Type Attribute**

The Modality Type attribute (0008,0060) shall have the value DX.

240 **A.Y.3.1.2 Restrictions for Standard Extended SOP Classes**

242 The Overlay Plane Module, VOI LUT Module and Softcopy Presentation LUT Module shall not be used in a Standard Extended SOP Class of the X-Ray 3D Craniofacial Image.

Notes: 1. The VOI LUT function is provided by a Frame VOI LUT Functional Group.

244 2. The Curve Module was previously included in the Image IE for this IOD but has been retired. See PS 3.3 2004.

246

A.Y.4 X-Ray 3D Craniofacial Image Functional Group Macros

248 Table A.Y-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the X-Ray 3D Craniofacial Image IOD.

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**Table A.Y-2
X-RAY 3D CRANIOFACIAL IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M– May not be used as a Shared Functional Group.
Plane Position	C.7.6.16.2.3	M
Plane Orientation	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	U
Derivation Image	C.7.6.16.2.6	C – Required if the Image Type (0008,0008) Value 1 equals DERIVED..
Frame Anatomy	C.7.6.16.2.8	M
Pixel Value Transformation	C.7.6.16.2.9	U
Frame VOI LUT	C.7.6.16.2.10	M
Real World Value Mapping	C.7.6.16.2.11	U
Contrast/Bolus Usage	C.7.6.16.2.12	C – Required if the Enhanced Contrast/Bolus Module is present.
X-Ray 3D Frame Type	C.8.X.6.1	M

252

A.Y.4.1 X-Ray 3D Craniofacial Image Functional Group Macros Content Constraints

254 **A.Y.4.1.1 Frame Anatomy Functional Group Macro**

The Defined Context ID for the Anatomic Region Sequence (0008,2218) shall be CID 4028 or CID 4016.

256 In the case of CID 4016, the Defined Context ID for the Anatomic Region Modifier Sequence (0008,2220) shall be CID 4017, if present, and the Defined Context ID for the Primary Anatomic Structure Sequence

258 (0008,2228) shall be either CID 4018 or CID 4019, if present.

Item #5: Add new section to Section C.7.3

260 **C.7.3.X Enhanced Series Module**

262 Table C.7-5X Table specifies the Attributes that identify and describe general information about the Series within a Study.

264 Note: This table contains a subset of the attributes of General Series Module (Table C.7-5a) but the Type designation is changed into Type 1. Including this module in an IOD overwrites the Type designation of the General Series Module.

266

268 **Table C.7-5X
ENHANCED SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Series Number	(0020,0011)	1	A number that identifies this Series. Notes: 1. The value of this attribute should be unique for all series in a study created on the same equipment. 2. Because series can be created on more than one equipment, it can not be guaranteed that the value of Series Number (0020,0011) is unique in a study.
Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related (e.g. a Modality or General-Purpose Performed Procedure Step SOP Instance). Only a single Item is permitted in this sequence. Required if the Modality Performed Procedure Step SOP Class or General Purpose Performed Procedure Step SOP Class is supported.
>Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.

270 **Item #6: Add new sections to Section C.7.6**

C.7.6.X1 Patient Orientation Module

272 This section describes attributes of the Patient Orientation Module by describing the patient orientation related to gravity and equipment. Table C.6.7.X1-1 contains IOD Attributes that describe the Patient Orientation.
274

**Table C.6.7.X1-1
PATIENT ORIENTATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Include 'Patient Orientation Macro' Table 10-X3			

278 **C.7.6.X2. Image – Equipment Coordinate Relationship Module**

This section describes the Image – Equipment Coordinate Relationship module. Table C.7.6.X2-1 contains the attributes that specify how the equipment (e.g. gantry) and patient oriented coordinate system (in conjunction with the Image Position (Patient) (0020,0032) and Image Orientation (Patient) (0020,0037) attributes) are related.
282

**Table C.7.6.X2-1
IMAGE – EQUIPMENT COORDINATE RELATIONSHIP MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image to Equipment Mapping Matrix	(0028,9520)	1	A 4x4 homogeneous transformation matrix that maps patient coordinate space of the reconstructed image to the equipment defined original coordinate space. Matrix elements shall be listed in row-major order. See C.7.6.X2.1.
Equipment Coordinate System Identification	(0028,9537)	1	Identification of the type of equipment coordinate system in which the projection images were acquired. See C.7.6.X2.2. Defined Terms: ISOCENTER

286 **C.7.6.X2.1 Image to Equipment Mapping Matrix**

The Image to Equipment Mapping Matrix (0028,9520) is used to describe the relationship between the Patient oriented coordinate system and a modality specific equipment coordinate system. This mapping can only be used with systems that have a well-defined equipment coordinate system (such as XA, etc.).
288

290 The Image to Equipment Mapping Matrix ${}^A M_B$ describes how to transform a point $({}^B x, {}^B y, {}^B z)$ with respect to the Patient coordinate system into $({}^A x, {}^A y, {}^A z)$ with respect to the equipment coordinate system according to the equation below.
292

$$\begin{bmatrix} {}^A x \\ {}^A y \\ {}^A z \\ 1 \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} & T_x \\ M_{21} & M_{22} & M_{23} & T_y \\ M_{31} & M_{32} & M_{33} & T_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} {}^B x \\ {}^B y \\ {}^B z \\ 1 \end{bmatrix}$$

294 The Image to Equipment Mapping Matrix is a rigid transformation that involves only translations and
rotations. Mathematically, the matrix shall be orthonormal and can describe six degrees of freedom: three
296 translations, and three rotations.

Note: Both the Patient Coordinate System and the Equipment Coordinate System are expressed in millimeters.

298

C.7.6.X2.2 Equipment Coordinate System Identification

300 The Equipment Coordinate System Identification (0028,9537) identifies the Reference Coordinate System
to which the Image to Equipment Mapping Matrix (0028,9520) is related.

302 The Defined Term ISOCENTER refers to a coordinate reference system where the origin corresponds with
the center of rotation of the projections.

304 Note: For X-Ray 3D Angiographic Images created from SOP Instances of the Enhanced XA SOP Class
(1.2.840.10008.5.1.4.1.1.12.1.1) the isocenter coordinate system is used to describe the positioning of
306 the table and positioner (see C.8.19.6.13), and will use only the Defined Term ISOCENTER.

Item #7: Add new sections to C.8 MODALITY SPECIFIC MODULES

308 **C.8.X.2 X-Ray 3D Image Module**

310 This section describes the X-Ray 3D Image Module. Table C.8.X2-1 contains IOD Attributes that describe a X-Ray 3D Image by specializing Attributes of the General Image and Image Pixel Modules, and adding additional Attributes.

312

**Table C.8.X2-1
X-Ray 3D IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.X.2.1.1 for specialization.
<i>Include 'Common CT/MR Image Description Macro' Table C.8-131</i>			
Bits Allocated	(0028,0100)	1	Number of bits allocated for each voxel sample. Each sample shall have the same number of bits allocated. Enumerated Values: 8 and 16.
Bits Stored	(0028,0101)	1	Number of bits stored for each voxel sample. Each sample shall have the same number of bits stored. Enumerated Values: 8 to16.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101).
Samples per Pixel	(0028,0002)	1	Number of samples (color planes) in this image shall have a value of 1.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the voxel data. Enumerated Values: MONOCHROME2
Content Qualification	(0018,9004)	1	Content Qualification Indicator Enumerated Values: PRODUCT RESEARCH SERVICE See C.8.13.2.1.1 for further explanation.
Burned In Annotation	(0028,0301)	1	Indicates whether or not the image contains sufficient burned in annotation to identify the patient and date the image was acquired. Enumerated Values: NO

Lossy Image Compression	(0028,2110)	1	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression. See C.7.6.1.1.5 for further explanation.
Lossy Image Compression Ratio	(0028,2112)	1C	See C.7.6.1.1.5 for further explanation. Required if Lossy Image Compression (0028,2110) equals 01.
Lossy Image Compression Method	(0028,2114)	1C	A label for the lossy compression method(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multi-valued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112). Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111). Required if Lossy Image Compression (0028,2110) equals 01.
Referenced Image Evidence Sequence	(0008,9092)	1C	Full set of Composite SOP Instances referred to inside the Referenced Image Sequences of this SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items may be permitted in this sequence. Required if the Referenced Image Sequence (0008,1140) is present.
<i>>Include 'SOP Instance Reference Macro' Table C.17-3</i>			
Image Comments	(0020,4000)	3	User-defined comments about the image.
Quality Control Image	(0028,0300)	3	Indicates whether or not this image is a quality control or phantom image. Enumerated Values: YES NO If this Attribute is absent, then the image may or may not be a quality control or phantom image.
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image.
<i>> Include 'Image Pixel Macro' Table C.7-11b</i>			See C.7.6.1.1.6 for further explanation.

Presentation LUT Shape	(2050,0020)	1	Specifies a predefined identity transformation for the Presentation LUT such that the output of all grayscale transformations, if any, are defined to be in P-Values. Enumerated Values: IDENTITY = output is in P-Values
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314

C.8.X.2.1 X-Ray 3D Image Module Attribute Description

316 **C.8.X.2.1.1 Image Type and Frame Type**

In addition to the requirements specified in C.8.16.1 Image Type, the following additional requirements and Defined Terms are specified.

C.8.X.2.1.1.1 Pixel Data Characteristics

320 Value 1 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.1. No additional requirements or Defined Terms.

C.8.X.2.1.1.2 Patient Examination Characteristics

322 Value 2 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.2. No additional requirements or Defined Terms.

C.8.X.2.1.1.3 Image Flavor

326 Value 3 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.3. No additional requirements or Defined Terms.

C.8.X.2.1.1.4 Derived Pixel Contrast

328 Value 4 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.4. The value shall be NONE.

C.8.X.3 X-Ray 3D Contributing Image Sources Modules

332 This section describes the X-Ray 3D Image Contributing Sources Modules.

- 334 Notes:
1. These modules supply general information of the sources without the need to have access to all the contributing SOP Instances or when these SOP Instances do not exist.
 2. These modules do not contain specific information of the X-Ray acquisition itself. For this purpose the X-Ray 3D Acquisition Modules may be used.

338 **C.8.X.3.1 X-Ray 3D Angiographic Image Contributing Sources Module**

This section describes the X-Ray 3D Angiographic Image Contributing Sources Module. The attributes in this Module specify the overall characteristics of one or more sources that were used to create a X-Ray 3D Angiographic Image SOP Class instance. Table C.8.X4-1 contains the relevant IOD Attributes that describe X-Ray 3D Angiographic Image Contributing Sources.

**Table C.8.X4-1
X-RAY 3D ANGIOGRAPHIC IMAGE CONTRIBUTING SOURCES MODULE ATTRIBUTES**

344

Attribute Name	Tag	Type	Attribute Description
Contributing Sources Sequence	(0018,9506)	1	A sequence that describes characteristics of the sources that are used to create a derived SOP Instance. One or more Items may be present.
<i>>Include 'General Contributing Sources Macro' Table 10-X1</i>			
<i>>Include 'Contributing Image Source Macro' Table 10-X2</i>			
>Acquisition Device Processing Description	(0018,1400)	1C	Indicates any visual processing performed on the frame prior to exchange. See Section C.8.7.1.1.3. Required if present and consistent in the contributing SOP Instances.
>Acquisition Device Processing Code	(0018,1401)	1C	Code representing the device-specific processing associated with the frame (e.g. Organ Filtering code) Required if present and have an equal value in the contributing SOP Instances.
>Plane Identification	(0018,9457)	1C	Identification of the plane used to acquire this image. Defined Terms: MONOPLANE PLANE A PLANE B Required if present and consistent in the contributing SOP Instances.
>Imager Pixel Spacing	(0018,1164)	1C	Physical distance measured at the receptor plane of the detector between the centers of each pixel specified by a numeric pair – row spacing value (delimiter) column spacing value in mm. Required if present and consistent in the contributing SOP Instances.

346 **C.8.X.3.2 X-Ray 3D Craniofacial Image Contributing Sources Module**

348 This section describes the X-Ray 3D Craniofacial Image Contributing Sources Module. The attributes in
 348 this Module specify the overall characteristics of one or more sources that were used to create a X-Ray 3D
 350 Craniofacial Image SOP Class instance. Table C.8.X4-2 contains the relevant IOD Attributes that describe
 350 X-Ray 3D Craniofacial Image Contributing Sources.

Table C.8.X4-2

352 **X-RAY 3D CRANIOFACIAL IMAGE CONTRIBUTING SOURCES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contributing Sources Sequence	(0018,9506)	1	A sequence that describes characteristics of the sources that are used to create a derived SOP Instance. One or more Items may be present.
<i>>Include 'General Contributing Sources Macro' Table 10-X1</i>			
<i>>Include 'Contributing Image Source Macro' Table 10-X2</i>			
>Acquisition Device Processing Description	(0018,1400)	1C	Indicates any visual processing performed on the frame prior to exchange. See Section C.8.7.1.1.3. Required if present and consistent in the contributing SOP Instances.
>Acquisition Device Processing Code	(0018,1401)	1C	Code representing the device-specific processing associated with the frame (e.g. Organ Filtering code). Required if present and have an equal value in the contributing SOP Instances.
>Imager Pixel Spacing	(0018,1164)	1C	Physical distance measured at the receptor plane of the detector between the centers of each pixel specified by a numeric pair – row spacing value (delimiter) column spacing value in mm. Required if present and consistent in the contributing SOP Instances.

354 **C.8.X.4 X-Ray 3D Acquisition Modules**

356 This section describes the X-Ray 3D Acquisition Modules and Macros to specify the acquisition context
 356 information used as input for one or more reconstructions. The Macros in this section define the attributes
 that are common for all modalities. The Macros are used in the modality specific Modules.

358 The attributes of each item in the X-Ray 3D Acquisition Sequence (0018,9507) define the acquisition
 characteristics of the projection images that were used to create one or more reconstructions.

360 Note: The intention of this sequence is to supply acquisition information without the need to have access to all
 the contributing SOP Instances or when these SOP Instances do not exist.

362 For each item of the X-Ray 3D Reconstruction Sequence (0018,9530) in the X-Ray 3D Reconstruction
 364 Acquisition Sequence (0018,9507) that contribute to the reconstruction.

366 Note: For example, a SOP Instance consists of two volumes in two sets of frames. The first volume is
 368 calculated from an acquisition without contrast and a second volume is calculated from the acquisitions
 370 with and without contrast. In this case the X-Ray 3D Acquisition Sequence (0018,9507) contains two
 372 items. The first Item describes the acquisition details of the frames that are acquired without contrast.
 The second Item describes the acquisition details of the frames that are acquired with contrast. For the
 frames of the second volume both acquisitions contribute to the calculation. See Figures C.8.X.4-1 thru
 C.8.X.4-5

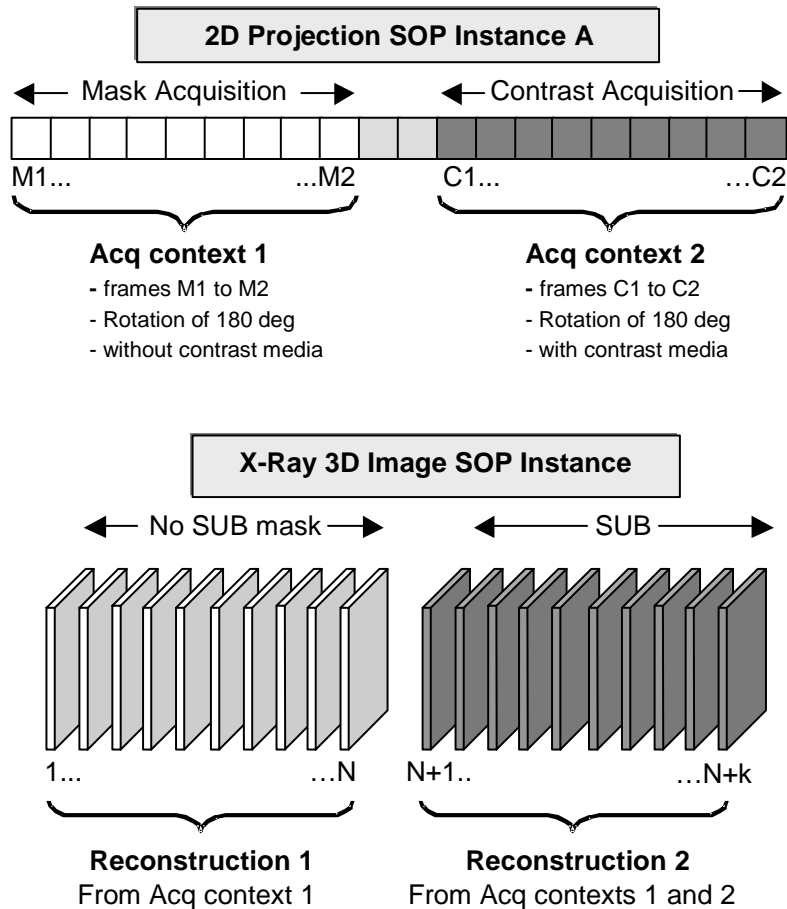
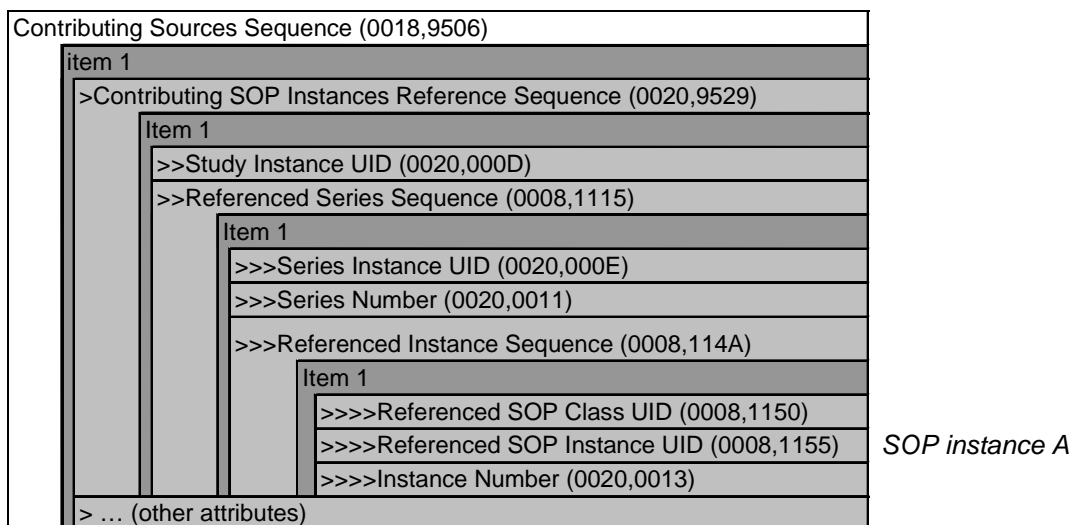


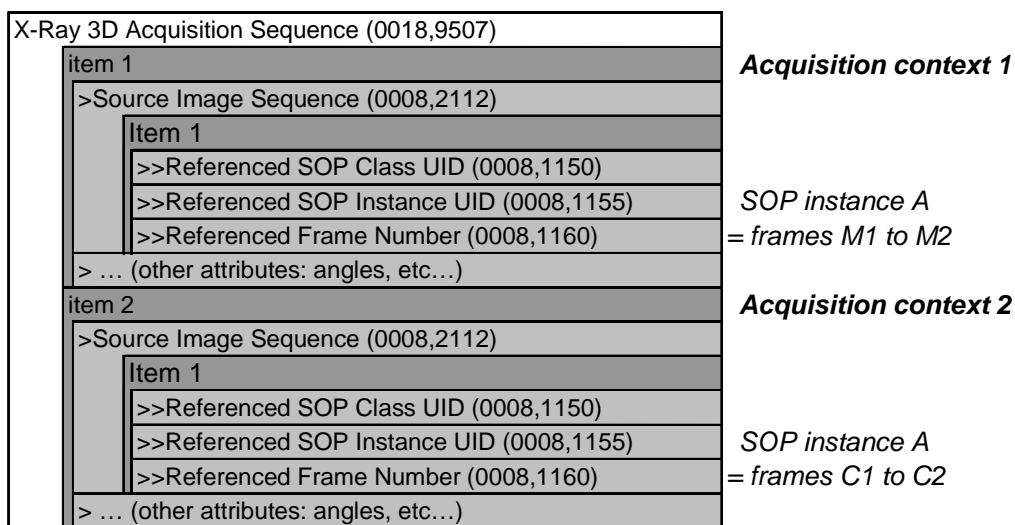
Figure C.8.X.4-1 Example of usage Acquisition



376

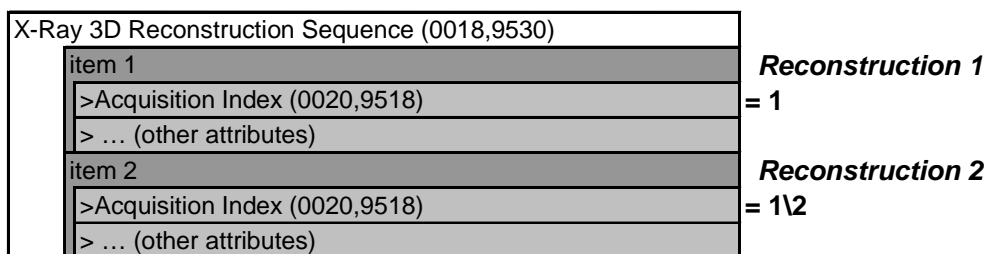
Figure C.8.X.4-2 Example of contents of Contributing Sources Sequence

378



380

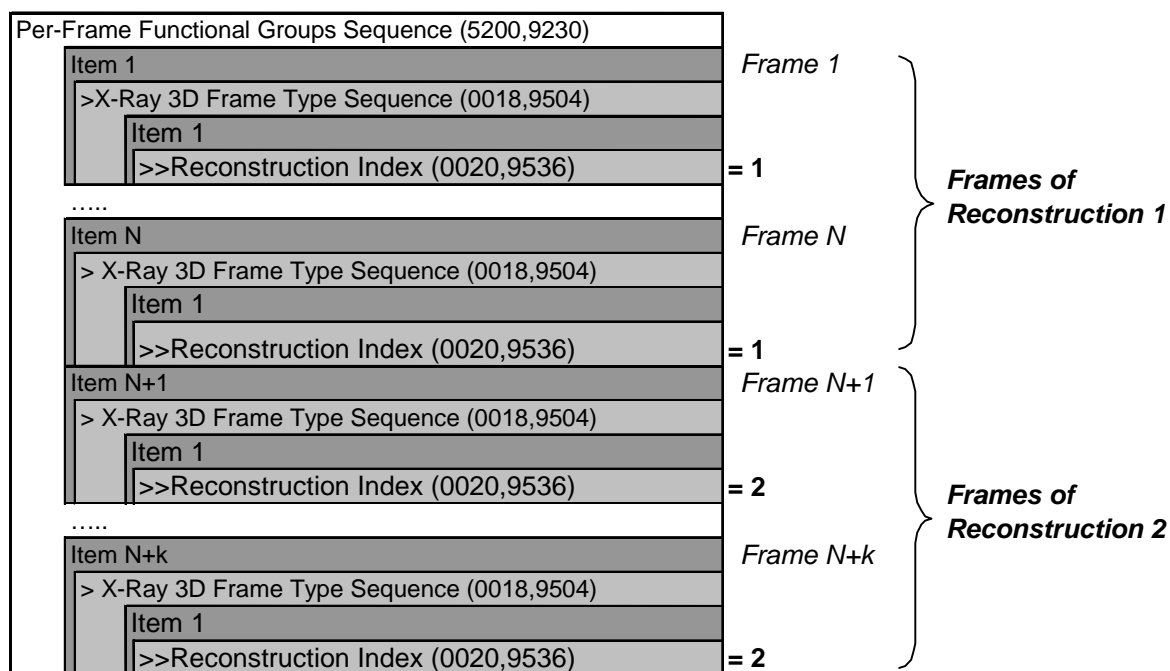
Figure C.8.X.4-3 Example of contents of X-Ray 3D Acquisition Sequence



382

Figure C.8.X.4-4 Example of contents of X-Ray 3D Reconstruction Sequence

384



386

Figure C.8.X.4-5 Example of contents of X-Ray 3D Frame Type Sequences

388

C.8.X.4.1 X-Ray 3D General Acquisition Macros

390 This section describes the X-Ray 3D General Acquisition Macros. These macros specify the attributes of the acquisition context common for the family of X-Ray 3D image SOP Classes.

392 C.8.X.4.1.1 X-Ray 3D General Shared Acquisition Macro

394 Table C.8.X5.1 describes the X-Ray 3D General Shared Acquisition Macro that specifies the attributes that are applicable for all the projection images belonging to this application context.

396

**Table C.8.X5-1
X-RAY 3D GENERAL SHARED ACQUISITION MACRO**

Attribute Name	Tag	Type	Attribute Description
Source Image Sequence	(0008,2112)	1C	<p>A Sequence that identifies the set of Images that constitute this acquisition context.</p> <p>Required if the reconstruction is created from DICOM SOP Instances.</p> <p>Note: The attribute is absent in the case where the images used to create the volume are not available as SOP Instances, e.g., the volume was directly generated by acquisition system.</p> <p>One or more Items may be included in this Sequence.</p>
<i>>Include 'Image SOP Instance Reference Macro' Table 10-3</i>			
Field of View Shape	(0018,1147)	1C	<p>Shape of the Field of View in the referenced images.</p> <p>Enumerated Values: RECTANGLE ROUND HEXAGONAL</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Field of View Dimension(s) in Float	(0018,9461)	1C	<p>Dimensions in mm of the Field of View in the referenced images . If Field of View Shape (0018,1147) is:</p> <p>RECTANGLE: row dimension followed by column.</p> <p>ROUND: diameter.</p> <p>HEXAGONAL: diameter of the circle circumscribing the hexagon.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Field of View Origin	(0018,7030)	1C	<p>Offset of the TLHC of a rectangle circumscribing the Field of View in the referenced images, before rotation or flipping, from the TLHC of the physical detector area measured in physical detector pixels as a row offset followed by a column offset.</p> <p>See C.8.11.4.1.1 for further explanation.</p> <p>Required if X-Ray Receptor Type (0018,9420) is present and equals DIGITAL_DETECTOR.</p>

Field of View Rotation	(0018,7032)	1C	<p>Clockwise rotation in degrees of Field of View in the referenced images, relative to the physical detector.</p> <p>Enumerated Values: 0, 90, 180, 270</p> <p>See C.8.11.4.1.1 for further explanation. Required if present and consistent in the contributing SOP Instances.</p>
Field of View Horizontal Flip	(0018,7034)	1C	<p>Whether or not a horizontal flip has been applied to the Field of View in the referenced images, after rotation relative to the physical detector as described in Field of View Rotation (0018,7032).</p> <p>Enumerated Values: NO YES</p> <p>See C.8.11.4.1.1 for further explanation. Required if present and consistent in the contributing SOP Instances.</p>
Grid	(0018,1166)	1C	<p>Identifies the grid. May be multi-valued.</p> <p>Defined Terms are: FIXED FOCUSED RECIPROCATING PARALLEL CROSSED NONE</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
X-Ray Receptor Type	(0018,9420)	1C	<p>Identifies the type of X-ray receptor used.</p> <p>Enumerated Values: IMG_INTENSIFIER DIGITAL_DETECTOR</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
KVP	(0018,0060)	1C	<p>Average of the peak kilo voltage outputs of the X-Ray generator used for all frames.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
X-Ray Tube Current in mA	(0018,9330)	1C	<p>Average of the nominal X-ray tube currents in milliamperes for all frames.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
Exposure Time in ms	(0018,9328)	1C	<p>Duration of X-Ray exposure in milliseconds. See C.8.7.2.1.1.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>

Exposure in mAs	(0018,9332)	1C	The exposure expressed in milliampereseconds, for example calculated from Exposure Time and X-ray Tube Current. Required if present and consistent in the contributing SOP Instances.
Contrast/Bolus Agent	(0018,0010)	1C	Contrast or bolus agent. Required if present and consistent in the contributing SOP Instances.
Contrast/Bolus Agent Sequence	(0018,0012)	1C	Sequence that identifies the contrast agent. One or more Items may be present. Required if present and consistent in the contributing SOP Instances.
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Baseline Context ID is 12.</i>
Start Acquisition Datetime	(0018,9516)	1C	Start date and time of that part of an acquisition used for this acquisition context. Required if present and consistent in the contributing SOP Instances.
End Acquisition Datetime	(0018,9517)	1C	End date and time of that part of an acquisition used for this acquisition context. Required if present and consistent in the contributing SOP Instances.

398 **C.8.X.4.1.2 X-Ray 3D General Per Projection Acquisition Macro**

400 Table C.8.X5.2 describes the X-Ray 3D General Per Projection Acquisition Macro that specifies the attributes that are applicable for a single projection belonging to this application context.

Table C.8.X5-2
X-RAY 3D GENERAL PER PROJECTION ACQUISITION MACRO

402

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	1C	Exact peak kilo voltage output of the X-Ray generator used for this projection. Required if present and consistent in the contributing SOP Instances.
X-Ray Tube Current in mA	(0018,9330)	1C	Exact Nominal X-ray tube current in milliamperes applied during the Frame Acquisition Duration (0018,9220) for this projection. Required if present and consistent in the contributing SOP Instances.
Frame Acquisition Duration	(0018,9220)	1C	The actual amount of time [in milliseconds] that was used to acquire data for this projection. See C.7.6.16.2.2.1 and C.7.6.16.2.2.3 for further explanation. Required if present and consistent in the contributing SOP Instances.
Collimator Shape	(0018,1700)	1C	Shape(s) of the collimator. Enumerated Values: RECTANGULAR CIRCULAR POLYGONAL This multi-valued Attribute shall contain at most one of each Enumerated Value. Required if present and consistent in the contributing SOP Instances.
Collimator Left Vertical Edge	(0018,1702)	1C	Required if Collimator Shape (0018,1700) is RECTANGULAR. Location of the left edge of the rectangular collimator with respect to pixels in the image given as column. See C.8.7.3.1.1.
Collimator Right Vertical Edge	(0018,1704)	1C	Required if Collimator Shape (0018,1700) is RECTANGULAR. Location of the right edge of the rectangular collimator with respect to pixels in the image given as column. See C.8.7.3.1.1.
Collimator Upper Horizontal Edge	(0018,1706)	1C	Required if Collimator Shape (0018,1700) is RECTANGULAR. Location of the upper edge of the rectangular collimator with respect to pixels in the image given as row. See C.8.7.3.1.1.
Collimator Lower Horizontal Edge	(0018,1708)	1C	Required if Collimator Shape (0018,1700) is RECTANGULAR. Location of the lower edge of the rectangular collimator with respect to pixels in the image given as row. See C.8.7.3.1.1.

Center of Circular Collimator	(0018,1710)	1C	Required if Collimator Shape (0018,1700) is CIRCULAR. Location of the center of the circular collimator with respect to pixels in the image given as row and column. See C.8.7.3.1.1.
Radius of Circular Collimator	(0018,1712)	1C	Required if Collimator Shape (0018,1700) is CIRCULAR. Radius of the circular collimator with respect to pixels in the image given as a number of pixels along the row direction. See C.8.7.3.1.1.
Vertices of the Polygonal Collimator	(0018,1720)	1C	Required if Collimator Shape (0018,1700) is POLYGONAL. Multiple Values where the first set of two values are: row of the origin vertex; column of the origin vertex. Two or more pairs of values follow and are the row and column coordinates of the other vertices of the polygon collimator. Polygon collimators are implicitly closed from the last vertex to the origin vertex and all edges shall be non-intersecting except at the vertices.

404 **C.8.X.4.2 X-Ray 3D Angiographic Acquisition Module**

This section describes the X-Ray 3D Angiographic Acquisition Module.

406

**Table C.8.X5-3
X-RAY 3D ANGIOGRAPHIC ACQUISITION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Acquisition Sequence	(0018,9507)	1	Each item represents an acquisition context related to one or more reconstructions. The values of the Acquisition Index (0020,9518) attribute may be used as index to Items in this sequence. One or more Items may be present.
>Include 'X-Ray 3D General Shared Acquisition Macro' Table C.8.X5-1			
>Include 'Digital X-Ray Detector Macro' Table C.8-71b			
>Physical Detector Size	(0018,9429)	1C	Dimensions of the physical detector measured in mm as a row size followed by a column size. Required if present and consistent in the contributing SOP Instances.

>Position of Isocenter Projection	(0018,9430)	1C	<p>Position of the Isocenter measured in physical detector elements as a row offset followed by a column offset from the TLHC of a rectangle circumscribing the physical detector area.</p> <p>Required if Isocenter Reference System Sequence (0018,9462) is present.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
>Distance Source to Detector	(0018,1110)	1C	<p>Distance from source to receptor plane perpendicular to the receptor plane in mm or distance in mm from source to detector center on the chest wall line See C.8.11.7.1.1.</p> <p>Required if present and consistent in the contributing SOP Instances.</p> <p>Note: This value is traditionally referred to as Source Image Receptor Distance (SID).</p>
>Distance Source to Isocenter	(0018,9402)	1C	<p>Distance from source to isocenter in mm.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
>Focal Spot	(0018,1190)	1C	<p>Nominal focal spot size in mm used to acquire this image.</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
>Filter Type	(0018,1160)	1C	<p>Type of filter(s) inserted into the X-Ray beam (e.g. wedges).</p> <p>Defined Terms:</p> <p>STRIP WEDGE BUTTERFLY MULTIPLE NONE</p> <p>Required if present and consistent in the contributing SOP Instances.</p>
>Filter Material	(0018,7050)	1C	<p>The X-Ray absorbing material used in the filter. May be multi-valued.</p> <p>Defined Terms:</p> <p>MOLYBDENUM ALUMINUM COPPER RHODIUM NIOBIUM EUROPIUM LEAD</p> <p>Required if present and consistent in the contributing SOP Instances.</p>

>Filter Thickness Minimum	(0018,7052)	1C	The minimum thickness in mm of the X-Ray absorbing material used in the filters. May be multi-valued, with values corresponding to the respective values in Filter Material (0018,7050). Required if present and consistent in the contributing SOP Instances.
>Filter Thickness Maximum	(0018,7054)	1C	The maximum thickness in mm of the X-Ray absorbing material used in the filters. May be multi-valued, with values corresponding to the respective values in Filter Material (0018,7050). Required if present and consistent in the contributing SOP Instances.
>Primary Positioner Scan Arc	(0018,9508)	1C	Total amount of rotation of the primary positioner in degrees. Required if present and consistent in the contributing SOP Instances.
>Primary Positioner Scan Start Angle	(0018,9510)	1C	Start position of the primary positioner in degrees. See C.8.7.5.1.2. Required if present and consistent in the contributing SOP Instances.
>Primary Positioner Increment	(0018,9514)	1C	Nominal increment of the primary positioner angle in degrees. Positive values indicate moving from RAO to LAO position through the anterior. See C.8.7.5.1.2. Required if present and consistent in the contributing SOP Instances.
>Secondary Positioner Scan Arc	(0018,9509)	1C	Total amount of rotation of the secondary positioner in degrees. Required if present and consistent in the contributing SOP Instances.
>Secondary Positioner Scan Start Angle	(0018,9511)	1C	Start position of the secondary positioner in degrees. See C.8.7.5.1.2. Required if present and consistent in the contributing SOP Instances.
>Secondary Positioner Increment	(0018,9515)	1C	Nominal increment of the secondary positioner angle in degrees. Positive values indicate moving from CAU to CRA through the anterior. See C.8.7.5.1.2. Required if present and consistent in the contributing SOP Instances.

>Per Projection Acquisition Sequence	(0018,9538)	1C	Sequence containing detailed acquisition context of each individual projection used in this acquisition context. Zero or more items may be present. Required if present and consistent in the contributing SOP Instances.
>>Include 'X-Ray 3D General Acquisition Per Projection Macro' Table C.8.X5-2			
>>Positioner Isocenter Primary Angle	(0018,9463)	1C	Position of the X-Ray center beam for this projection in the isocenter reference system in the X direction (deg). See C.8.19.6.13.1.2 for further explanation. Required if present and consistent in the contributing SOP Instances.
>>Positioner Isocenter Secondary Angle	(0018,9464)	1C	Position of the X-Ray center beam for this projection in the isocenter reference system in the Z direction (deg). See C.8.19.6.13.1.2 for further explanation. Required if present and consistent in the contributing SOP Instances.
>>Positioner Isocenter Detector Rotation Angle	(0018,9465)	1C	Rotation of the X-Ray detector plane for this projection (deg). See C.8.19.6.13.1.2 for further explanation. Required if present and consistent in the contributing SOP Instances.

C.8.X.4.3 X-Ray 3D Craniofacial Acquisition Module

410 This section describes the X-Ray 3D Craniofacial Acquisition Module.

Table C.8.X5-4**X-RAY 3D CRANIOFACIAL ACQUISITION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Acquisition Sequence	(0018,9507)	1	Each item represents a acquisition context related to a set of frames of SOP Instance defined by this IOD, The values of the Acquisition Index (0020,9518) attribute may be used as index to Items in this sequence. One or more Items may be present.
<i>>Include 'X-Ray 3D General Shared Acquisition Macro' Table C.8.X5-1</i>			
<i>>Include 'Digital X-Ray Detector Macro' Table C.8-71b</i>			
<i>>Per Projection Acquisition Sequence</i>	(0018,9538)	1C	Sequence containing detailed acquisition context of each individual projection used in this acquisition context. Zero or more items may be present. Required if present and consistent in the contributing SOP Instances.
<i>>>Include 'X-Ray 3D General Acquisition Per Projection Macro' Table C.8.X5-2</i>			

414 C.8.X.5 X-Ray 3D Reconstruction Module

416 This section describes the X-Ray 3D Reconstruction Module. Table C.8.X6-1 contains IOD Attributes that describe the reconstructions used to create this SOP Instance. A single SOP Instance may contain the result of one or more reconstructions (e.g., a set of volumes). Each item in the X-Ray 3D Reconstruction
418 Sequence specifies the characteristics of such a result.

Table C.8.X6-1**X-RAY 3D RECONSTRUCTION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Reconstruction Sequence	(0018,9530)	1	A sequence of Items each describing the characteristics of one 3D reconstruction included in this SOP instance. One or more items may be present.
<i>>Reconstruction Description</i>	(0018,9531)	3	Free text description of the purpose of the reconstruction, e.g., mask volume.
<i>>Application Name</i>	(0018,9524)	1	Name of the application that created the reconstruction.
<i>>Application Version</i>	(0018,9525)	1	Version of the application that created the reconstruction.
<i>>Application Manufacturer</i>	(0018,9526)	1	Name of the manufacturer of the application that created the reconstruction.

>Algorithm Type	(0018,9527)	1	Type of algorithm used to create the reconstruction. Defined Terms: FILTER_BACK_PROJ ITERATIVE
>Algorithm Description	(0018,9528)	3	Description of the algorithm used to create the reconstruction.
>Acquisition Index	(0020,9518)	1	The Item number(s) of the X-Ray 3D Acquisition Sequence (0018,9507) that describes the acquisition context(s) contributing to this reconstruction.

422 **C.8.X.6 X-Ray 3D Image Functional Group Macros**

The following sections contain Functional Group macros specific to the X-Ray 3D IOD.

424 Note: The attribute descriptions in the Functional Group Macros are written as if they were applicable to a
 426 single frame (i.e., the macro is part of the Per-frame Functional Groups Sequence). If an attribute is
 applicable to all frames (i.e. the macro is part of the Shared Functional Groups Sequence) the phrase
 "this frame" in the attribute description shall be interpreted to mean "for all frames".

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C.8.X.6.1 X-Ray 3D Frame Type Macro

430 Table C.8.X7-1 specifies the attributes of the X-Ray 3D Frame Type Functional Group macro.

**Table C.8.X7-1
X-RAY 3D FRAME TYPE MACRO ATTRIBUTES**

432

Attribute Name	Tag	Type	Attribute Description
X-Ray 3D Frame Type Sequence	(0018,9504)	1	A sequence that describes general characteristics of this frame. Only a single Item shall be permitted in this sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed. See C.8.16.1 and C.8.13.3.1.1.
>Include Common CT/MR Image Description Macro' Table C.8-131			
>Reconstruction Index	(0020,9536)	1	The Item number of the X-Ray 3D Reconstruction Sequence (0018,9530) that describes the characteristics of the 3D Reconstruction to which this frame is part of.

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Changes to NEMA Standards Publication PS 3.4-2007

Digital Imaging and Communications in Medicine (DICOM)

444

Part 4: Service Class Specifications

Item #8: Add SOP Classes to Table B.5-1

446 **B.5 STANDARD SOP CLASSES**

448 **Table B.5-1
Standard SOP Classes**

SOP Class	SOP Class UID	IOD Specification (defined in PS 3.3)
X-Ray 3D Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.13.1.1	
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	

450 **Item #9: Add SOP Classes to Table I.4-1**

452 **I.4 MEDIA STORAGE SOP CLASSES**

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

SOP Class	SOP Class UID	IOD Specification
X-Ray 3D Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.13.1.1	IOD defined in PS 3.3
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	IOD defined in PS 3.3

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Changes to NEMA Standards Publication PS 3.6-2007

464

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

466

466 **Item #10: Add the following rows to Section 6**

Tag	Name	VR	VM
(0018,9504)	X-Ray 3D Frame Type Sequence	SQ	1
(0018,9506)	Contributing Sources Sequence	SQ	1
(0018,9507)	X-Ray 3D Acquisition Sequence	SQ	1
(0018,9508)	Primary Positioner Scan Arc	FL	1
(0018,9509)	Secondary Positioner Scan Arc	FL	1
(0018,9510)	Primary Positioner Scan Start Angle	FL	1
(0018,9511)	Secondary Positioner Scan Start Angle	FL	1
(0018,9514)	Primary Positioner Increment	FL	1
(0018,9515)	Secondary Positioner Increment	FL	1
(0018,9516)	Start Acquisition Datetime	DT	1
(0018,9517)	End Acquisition Datetime	DT	1
(0018,9524)	Application Name	LO	1
(0018,9525)	Application Version	LO	1
(0018,9526)	Application Manufacturer	LO	1
(0018,9527)	Algorithm Type	CS	1
(0018,9528)	Algorithm Description	LO	1
(0018,9530)	X-Ray 3D Reconstruction Sequence	SQ	1
(0018,9531)	Reconstruction Description	LO	1
(0018,9538)	Per Projection Acquisition Sequence	SQ	1

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Tag	Name	VR	VM
(0020,9518)	Acquisition Index	US	1-n
(0020,9529)	Contributing SOP Instances Reference Sequence	SQ	1
(0020,9536)	Reconstruction Index	US	1

Tag	Name	VR	VM
(0028,9520)	Image to Equipment Mapping Matrix	DS	16
(0028,9537)	Equipment Coordinate System Identification	CS	1

470

Item #11: Add the following rows to Table A-1

UID Value	UID Name	UID Type	Part
1.2.840.10008.5.1.4.1.1.13.1.1	X-Ray 3D Angiographic Image Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.13.1.2	X-Ray 3D Craniofacial Image Storage	SOP Class	PS 3.4

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Changes to NEMA Standards Publication PS 3.15-2007

482

Digital Imaging and Communications in Medicine (DICOM)

Part 15: Security and System Management Profiles

484

484 **Item #12: Add to Section C2 and C3**

486 **C.2 CREATOR RSA DIGITAL SIGNATURE PROFILE**

...

- 488 a. the SOP Class and Instance UIDs
- b. the SOP Creation Date and Time, if present
- 490 c. the Study and Series Instance UIDs
- d. any attributes of the General Equipment module that are present
- 492 e. any attributes of the Overlay Plane, Curve or Graphic Annotation modules that are present
- f. any attributes of the General Image and Image Pixel modules that are present
- 494 g. any attributes of the SR Document General and SR Document Content modules that are present
- 496 h. any attributes of the Waveform and Waveform Annotation modules that are present
- i. any attributes of the Multi-frame Functional Groups module that are present
- 498 j. any attributes of the Enhanced MR Image module that are present
- k. any attributes of the MR Spectroscopy modules that are present
- 500 l. any attributes of the Raw Data module that are present
- m. any attributes of the Enhanced CT Image module that are present
- 502 n. any attributes of the Enhanced XA/XRF Image module that are present
- 504 o. **any attributes of the X-Ray 3D Image module that are present**

C.3 AUTHORIZATION RSA DIGITAL SIGNATURE PROFILE

506 ...

- a. the SOP Class and Instance UIDs
- 508 b. the Study and Series Instance UIDs
- c. any attributes whose Values are verifiable by the technician or physician (e.g., their Values are displayed to the technician or physician)
- 510 d. any attributes of the Overlay Plane, Curve or Graphic Annotation modules that are present
- 512 e. any attributes of the General Image and Image Pixel modules that are present
- f. any attributes of the SR Document General and SR Document Content modules that are present
- 514 g. any attributes of the Waveform and Waveform Annotation modules that are present
- 516 h. any attributes of the Multi-frame Functional Groups module that are present
- i. any attributes of the Enhanced MR Image module that are present
- 518 j. any attributes of the MR Spectroscopy modules that are present
- k. any attributes of the Raw Data module that are present
- 520 l. any attributes of the Enhanced CT Image module that are present
- m. any attributes of the Enhanced XA/XRF Image module that are present
- 522 n. **any attributes of the X-Ray 3D Image module that are present**

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Changes to NEMA Standards Publication PS 3.16-2007

Digital Imaging and Communications in Medicine (DICOM)

534

Part 16: Content Mapping Resource

536 **Item #13: Add new Context Group**

CID 4028 Craniofacial Anatomic Regions

538

**Context ID 4028
Craniofacial Anatomic Regions**

540

Type: Extensible Version: 20070123

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SNM3	T-11501	Cervical spine
SNM3	T-11196	Facial bones
SNM3	T-D1100	Head
SRT	T-D1000	Head and Neck
SRT	T-AB959	Internal Auditory Canal
SNM3	T-D1213	Jaw region
SNM3	T-24100	Larynx
SNM3	T-11180	Mandible
SNM3	T-11133	Mastoid bone
SNM3	T-11170	Maxilla
SNM3	T-11149	Nasal bone
SNM3	T-D1600	Neck
SNM3	T-11102	Optic canal
SNM3	T-D0801	Orbital region
SNM3	T-22000	Paranasal sinus
SNM3	T-11100	Skull
SNM3	T-61300	Submandibular gland
SNM3	T-15290	Temporomandibular joint
SNM3	T-25000	Trachea
SRT	T-11011	Vertebral column and cranium
SNM3	T-11167	Zygomatic arch

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