Digital Imaging and Communications in Medicine (DICOM)

Supplement 32: Digital X-Ray Supplement

DICOM Standards Committee

Working Group 2 Digital X-Ray and Working Group 15 Digital Mammography

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Foreword

The American Dental Association sponsors the ANSI Accredited Standards Committee MD156 (ASC MD156) Task Group for Dental Informatics . In September 1992, the working group on Clinical and Diagnostic Peripheral Devices (Working Group 2) was formed. In February, 1996 this working group undertook the extension of the DICOM Standard to support Digital Radiographic Imaging Modalities used in Dentistry. The American Academy for Oral and Maxillofacial Radiology (AAOMR) formed the Digital Imaging Committee in 1993. The International Association for Dento-Maxillo-Facial Radiology (IADMFR) organized the Digital Image Exchange Committee in 1994. The AAOMR and IADMFR joined with ADA, ACR, NEMA in the DICOM Digital X-Ray project in 1996.

The American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) formed a joint committee to develop a standard for Digital Imaging and Communications in Medicine (DICOM). This Committee subsequently became the DICOM Committee. The DICOM Standard and the corresponding Supplements to the DICOM Standard, including this Supplement, were developed according to the DICOM Committee and NEMA procedures.

At the request of the DICOM Committee, the ACR convened a DICOM Digital Mammography Working Group, to liase with the ACR Breast Taskforce, and to provide a forum for academics, mammographers, medical physicists, regulators and implementors to contribute to the development of extensions to DICOM to support mammography images and reports.

The ACR, ADA, and NEMA participated in the development of this Supplement to the DICOM Standard which has been prepared by the DICOM Working Group 2 (Digital X-Ray) and DICOM Working Group 15 (Digital Mammography).

This Supplement to the Standard is developed in liaison with other standardization organizations including CEN TC251 in Europe, MEDIS-DC and JIRA in Japan, with review also by other organizations including IEEE, HL7 and ANSI in the USA.

The DICOM Standard is structured as a multi-part document using the guidelines established in the following document:

- ISO/IEC Directives, 1989 Part 3 : Drafting and Presentation of International Standards.

This document is a Supplement to the DICOM Standard. It is an extension to PS 3.3, 3.4 and 3.6 of the published DICOM Standard which consists of the following parts:

PS 3.1	-	Introduction and Overview
PS 3.2	-	Conformance
PS 3.3	-	Information Object Definitions
PS 3.4	-	Service Class Specifications
PS 3.5	-	Data Structures and Encoding
PS 3.6	-	Data Dictionary
PS 3.7	-	Message Exchange

PS 3.8	-	Network Communication Support for Message Exchange
PS 3.9	-	Point-to-Point Communication Support for Message Exchange
PS 3.10		Media Storage and File Format for Data Interchange
PS 3.11		Media Storage Application Profiles
PS 3.12		Media Formats and Physical Media for Data Interchange
PS 3.13		Print Management Point-to-Point Communication Support
PS 3.14		Grayscale Standard Display Function

These parts are related but independent documents.

Scope and Field of Application

This Supplement to the DICOM Standard specifies DICOM Image Information Object Definitions (IODs) for Digital X-Ray (DX), Digital Mammography and Digital Intra-oral Radiography Images. The Supplement includes the corresponding Image Storage SOP Classes so that the IODs can be used in Network and Media Storage exchanges.

The scope of the IODs is to support single frame digital X-Ray images produced by projection or transmission radiographic techniques. This includes but is not limited to: chest radiography, linear and multi-directional tomography, intra-oral radiography, orthopantomography, mammography and skeletal radiography. Acquisition of image data may include but is not limited to: CCD-based sensors, stimulable phosphor imaging plates, amorphous selenium, scintillation based amorphous silicon and secondary capture of film-based images.

Where possible, the new IODs have used existing Attributes and Modules, particularly from the existing CR IOD and the XA and XRF IODs. However, it has been necessary to define new Modules in order to allow for the specific characteristics of digital X-Ray images to be described, to mandate the presence of key Attributes, and to allow for a broad range of types and clinical contexts to be specified in a manner that is straightforward and allows a meaningful formal conformance claim.

The goals of this supplement are threefold:

- to define pixel data characteristics appropriate to all forms of projection radiographs, suitable for storing images already processed for presentation, as well as those not yet fully processed,

- to define standardized (but mostly optional) attributes that describe direct and indirect acquisition of projection radiographs for annotation and quality control purposes, and

- to define standardized, mandatory, identification and orientation attributes and values that allow use of the Image Storage SOP Classes as functional substitutes for film in a PACS environment.

The attributes selected to meet the last objective include those that specify body part, laterality, view position and patient relative image orientation. A creator of a DX, Mammography or Intra-oral SOP Instance is required to have this information available, whether through direct coupling with the acquisition device or through a manual quality assurance step performed by an operator. The presence of this information allows downstream systems to correctly disseminate and present images without the need for human intervention. For example, a workstation may use laterality and orientation to correctly “hang” related images on the screen in an appropriate fashion, without the viewer having to manually shuffle or rotate images based on visual cues or expert knowledge.

This choice has been made based on experience with the use of existing, less rigorously defined, DICOM image storage SOP Classes in PACS, and assessment of system or enterprise wide workflow requirements. The intent is to facilitate improved productivity in a heterogeneous filmless environment by:

- improving operator efficiency and reliability by substituting integrated digital markers and orientation for traditional film based lead markers,

- improving image dissemination by providing consistent and reliable acquisition related parameters to cue routing to reading/distribution worklists or nodes,

- improving reader efficiency by providing consistent attributes to trigger patterns and protocols for displaying images to minimize the need for manual reorganization, and

- indicating whether or not burned in annotation is present.

Experience has shown that the acquisition step is the appropriate step at which to define such information, and that consistency between different acquisition devices, in terms of which fields are made available and what values they may contain, is crucial.

Since this document proposes changes to existing Parts of DICOM the reader should have a working understanding of the Standard. This proposed Supplement includes a number of Addenda to existing Parts of DICOM :

- PS 3.3 Addendum: Digital X-Ray Information Object Definitions

- PS 3.4 Addendum: Digital X-Ray Image Storage SOP Classes

- PS 3.6 Addendum: Digital X-Ray Data Dictionary

Changes to:

NEMA Standards Publication PS 3.3

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

Item: Add to PS 3.3 Section 2 Normative References

Breast Imaging Reporting and Data System (BI-RADS), 3rd Edition 1998, American College of Radiology.

ISO 3950-1984, Dentistry - Designation system for teeth and areas of the oral cavity.

Item: Add to PS 3.3 Section 3 Definitions

The following are defined in PS 3.14:

P-Value: A device independent value defined in a perceptually linear grayscale space. The output of the DICOM Presentation LUT is P-Values, i.e. the pixel value after all DICOM defined grayscale transformations have been applied. P-Values are the input to a Standardized Display System.

Item: Add to PS 3.3 Table A.1-1

Table A.1-1
COMPOSITE INFORMATION OBJECT MODULES OVERVIEW

IODs Modules	Digital X-Ray Image	Digital Mammography X-Ray Image	Digital Intra-oral X-Ray Image
Patient	M	M	M
Patient Summary			
Specimen Identification	U	U	U
General Study	M	M	M
Patient Study	U	U	U
Study Content			
General Series	M	M	M
CR Series			
NM Series			
DX Series	M	M	M
Mammography Series		M	
Intra-Oral Series			M
Frame Of Reference	U	C	U
US Frame of Ref.			
General Equipment	M	M	M
SC Equipment			

General Image	M	M	M
Image Plane			
Image Pixel	M	M	M
NM Image Pixel			
Palette Color Lookup Table			
Contrast/ Bolus	U	U	U
Cine			
Multi-frame			
NM Multi-frame			
Frame Pointers			
Mask			
Display Shutter	U	U	U
Device	U	U	U
Therapy	U	U	U
CR Image			
CT Image			
MR Image			
NM Image			
NM Isotope			
NM Detector			
NM TOMO Acquisition			
NM Multi-Gated Acquisition			
NM Phase			
NM Reconstruction			
US Region Calibration			
US Image			
SC Image			
X-Ray Image			
X-Ray Acquisition			
X-Ray Collimator	U	U	U
X-Ray Table			

XRF Positioner			
X-Ray Tomo Acquisition	U	U	U
X-Ray Acquisition Dose	U	U	U
X-Ray Generation	U	U	U
X-Ray Filtration	U	U	U
X-Ray Grid	U	U	U
XA Positioner			
DX Anatomy Imaged	M	M	M
DX Image	M	M	M
DX Detector	M	M	M
DX Positioning	U	U	U
Mammography Image		M	
Intra-oral Image			M
Bi-Plane Sequence			
Bi-Plane Image			
Overlay Identification			
Overlay Plane	C	C	C
Multi-frame Overlay			
Bi-Plane Overlay			
Curve Identification			
Curve	U	U	U
Audio			
Modality LUT			
VOI LUT	C	C	C
Image Histogram	U	U	U
LUT Identification			
Acquisition Context	M	M	M
SOP Common	M	M	M

*Item: Add to PS 3.3 new Section A.X,Y - for clarity, those modules that are changed from the existing standard or new are shown in **Bold and Underlined***

A.X DIGITAL X-RAY IMAGE INFORMATION OBJECT DEFINITION

A.X.1 DX Image IOD Description

The Digital X-Ray (DX) Image Information Object Definition specifies an image which has been created by a digital projection radiography imaging device.

Notes: 1. This includes but is not limited to: chest radiography, linear and multi-directional tomography, orthopantomography and skeletal radiography. Acquisition of image data may include but is not limited to: CCD-based sensors, stimulable phosphor imaging plates, amorphous selenium, scintillation based amorphous silicon and secondary capture of film-based images.

2. Specific IODs are defined for intra-oral radiography and mammography that further specialize the DX IOD.

A DX image shall consist of the result of a single X-Ray exposure, in order to ensure that the anatomical and orientation attributes are meaningful for the image, permitting safe annotation, appropriate image processing and appropriate dissemination.

Notes: 1. This requirement specifically deprecates the common film/screen and Computed Radiography practice of making multiple exposures on different areas of a cassette or plate by using lead occlusion between exposures. Such acquisitions could be separated and transformed into multiple DX images during an appropriate quality assurance step by an operator.

2. This requirement does not deprecate the acquisition of multiple paired structures during a single exposure, provided that they can be described by the relevant orientation Attributes. For example, an AP or PA projection of both hands side by side is typically obtained in a single exposure, and can be described by a Patient Orientation (0020,0020) of R\H or L\H since both hands are in the same traditional Anatomical Position. See Annex E.

The DX Image IOD is used in two SOP Classes as defined in PS 3.4 Storage Service Class, a SOP Class for storage of images intended for presentation, and a SOP Class for storage of images intended for further processing before presentation. These are distinguished by their SOP Class UID and by the Enumerated Value of the mandatory Attribute in the DX Series Module, Presentation Intent Type (0008,0068).

A.X.2 DX Image IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model which directly reference the DX Image IOD.

A.X.3 DX Image IOD Module Table

Table A.X-1
DIGITAL X-RAY IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Specimen Identification	**C.7.1.2**	**U**

Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
	DX Series	**C.8.X.1**	**M**
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/Bolus	C.7.6.4	U
	Display Shutter	**C.7.6.11**	**U**
	Device	C.7.6.12	U
	Therapy	C.7.6.13	U
	DX Anatomy Imaged	**C.8.X.2**	**M**
	DX Image	**C.8.X.3**	**M**
	DX Detector	**C.8.X.4**	**M**
	X-Ray Collimator	C.8.7.3	U
	DX Positioning	**C.8.X.5**	**U**
	X-Ray Tomo Acquisition	**C.8.7.7**	**U**
	X-Ray Acquisition Dose	**C.8.7.8**	**U**
	X-Ray Generation	**C.8.7.9**	**U**
	X-Ray Filtration	**C.8.7.10**	**U**
	X-Ray Grid	**C.8.7.11**	**U**
	Overlay Plane	C.9.2	C - Required if graphic annotation is present - See A.X.4
	Curve	C.10.2	U
	VOI LUT	**C.11.2**	**C - Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION. Shall not be present otherwise. See Note 8.**
	Image Histogram	**C.11.5**	**U**
	Acquisition Context	**C.7.6.X**	**M**
	SOP Common	C.12.1	M

Notes: 1. The Overlay Plane requirement is determined by the presence of “graphic annotation”. Graphic annotation includes user or machine drawn graphics or text (such as computer assisted diagnosis) to indicate regions of interest or descriptions. It specifically does not include patient or image identification or technique information that is defined in other Attributes of the IOD..

2. The Device and Therapy Modules are User optional, though it is desirable that, if present, they are stored by an SCP. It is recognized that in some cases the digital image acquisition system will not have a user interface or direct connection that allows acquisition of these parameters, even if device or therapy have been used.

3. The Frame of Reference, X-Ray Collimator, DX Positioner and DX Tomo Acquisition Modules are User optional, though it is desirable that, if present, they are stored by an SCP. It is recognized that in some cases the parameters of the mechanical devices used for collimation, positioning and tomography may not be available to a digital image acquisition system that is not integrated with the X-Ray generation and positioning system.

4. The Acquisition Context Module is mandatory, but may be empty. The intent is that all Storage SCPs will preserve any information present, without requiring acquisition systems to be required to generate any contents, or requiring display systems to use the information for annotation (which is beyond the scope of DICOM).

5. Expectations on what an SCP of a SOP Class based on this IOD will store may be determined by evaluating a Conformance Statement of the form defined in PS 3.2 that specifies the level of conformance to the Storage SOP Classes as defined in PS 3.4. For example, Level 2 (Full) conformance indicates that all standard and optional attributes will be stored and may be accessed.

6. The Histogram Module may contain a single or multiple statistical representations of the pixel data used to derive the VOI LUT Module, or intended to be used to derive or replace the VOI LUT Module. The Histogram Module may contain statistics of a subset of the stored image pixel data (such as from a cropped area or region of interest that is not the full field of view) that are useful for deriving a better VOI LUT than might be derived from the statistics obtained from the entire stored pixel data.

7. The Specimen Identification Module is User optional, because although its Attributes may be helpful for identification and correlation with Pathology Information Systems, much specimen radiography, including forensic radiography, is performed with conventional clinical X-Ray equipment which is not likely to support specific specimen identification features.

8. The VOI LUT Module Attributes and behaviour are further specialized in the DX Image Module.

A.X.4 Overlay Plane Module

If the Overlay Plane Module is present, any Overlays defined in that Module shall store the overlay data in Overlay Data (60xx,3000), and not any unused high bits in Pixel Data (7FE0,0010).

A.Y DIGITAL MAMMOGRAPHY X-RAY IMAGE INFORMATION OBJECT DEFINITION

A.Y.1 Digital Mammography X-Ray Image IOD Description

The Digital Mammography X-Ray Image Information Object Definition specifies an image which has been created by a digital mammography projection radiography imaging device.

Note: It meets all of the requirements of the DX IOD in A.X in addition to those specified in this section.

The Digital Mammography Image IOD is used in two SOP Classes as defined in PS 3.4 Storage Service Class, a SOP Class for storage of images intended for presentation, and a SOP Class for storage of images intended for further processing before presentation. These are distinguished by their SOP Class UID and by the Enumerated Value of the mandatory Attribute in the DX Series Module, Presentation Intent Type (0008,0068).

A.Y.2 Digital Mammography X-Ray Image IOD Module Table

Table A.Y-1
DIGITAL MAMMOGRAPHY X-RAY IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Specimen Identification	**C.7.1.2**	**U**
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
	DX Series	**C.8.X.1**	**M**
	Mammography Series	**C.8.X.6**	**M**
Frame of Reference	Frame of Reference	C.7.4.1	C - Required if multiple images are obtained without releasing breast compression
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/Bolus	C.7.6.4	U
	Display Shutter	**C.7.6.11**	**U**
	Device	C.7.6.12	U
	Therapy	C.7.6.13	U
	DX Anatomy Imaged	**C.8.X.2**	**M**
	DX Image	**C.8.X.3**	**M**
	DX Detector	**C.8.X.4**	**M**
	X-Ray Collimator	C.8.7.3	U
	DX Positioning	**C.8.X.5**	**U**
	X-Ray Tomo Acquisition	**C.8.7.7**	**U**
	X-Ray Acquisition Dose	**C.8.7.8**	**U**
	X-Ray Generation	**C.8.7.9**	**U**
	X-Ray Filtration	**C.8.7.10**	**U**
	X-Ray Grid	**C.8.7.11**	**U**

Mammography Image	**C.8.X.7**	**M**
Overlay Plane	C.9.2	C - Required if graphic annotation is present - See A.Y.3
Curve	C.10.2	U
VOI LUT	**C.11.2**	**C - Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION. Shall not be present otherwise.**
Image Histogram	**C.11.5**	**U**
Acquisition Context	**C.7.6.X**	**M**
SOP Common	C.12.1	M

A.Y.3 Overlay Plane Module

If the Overlay Plane Module is present, any Overlays defined in that Module shall store the overlay data in Overlay Data (60xx,3000), and not any unused high bits in Pixel Data (7FE0,0010).

A.Z DIGITAL INTRA-ORAL X-RAY IMAGE INFORMATION OBJECT DEFINITION

A.Z.1 Digital Intra-oral X-Ray Image IOD Description

The Digital Intra-oral X-Ray Image Information Object Definition specifies an image that has been created by an intra-oral projection radiography imaging device.

Note: It meets all of the requirements of the DX IOD in A.X in addition to those specified in this section.

The Digital Intra-oral X-Ray Image IOD is used in two SOP Classes as defined in PS 3.4 Storage Service Class, a SOP Class for storage of images intended for presentation, and a SOP Class for storage of images intended for further processing before presentation. These are distinguished by their SOP Class UID and by the Enumerated Value of the mandatory Attribute in the DX Series Module, Presentation Intent Type (0008,0068).

A.Z.2 Digital Intra-oral X-Ray Image IOD Module Table

Table A.Z-1
DIGITAL INTRA-ORAL X-RAY IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Specimen Identification	**C.7.1.2**	**U**
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
	DX Series	**C.8.X.1**	**M**
	Intra-oral Series	**C.8.X.8**	**M**
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/Bolus	C.7.6.4	U
	Display Shutter	**C.7.6.11**	**U**
	Device	C.7.6.12	U
	Therapy	C.7.6.13	U
	DX Anatomy Imaged	**C.8.X.2**	**M**
	DX Image	**C.8.X.3**	**M**
	DX Detector	**C.8.X.4**	**M**
	X-Ray Collimator	C.8.7.3	U
	DX Positioning	**C.8.X.5**	**U**
	X-Ray Tomo Acquisition	**C.8.7.7**	**U**
	X-Ray Acquisition Dose	**C.8.7.8**	**U**
	X-Ray Generation	**C.8.7.9**	**U**
	X-Ray Filtration	**C.8.7.10**	**U**
	X-Ray Grid	**C.8.7.11**	**U**

	Intra-oral Image	**C.8.X.9**	**M**
	Overlay Plane	C.9.2	C - Required if graphic annotation is present - See A.Z.3
	Curve	C.10.2	U
	VOI LUT	**C.11.2**	**C - Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION. Shall not be present otherwise.**
	Image Histogram	**C.11.5**	**U**
	Acquisition Context	**C.7.6.X**	**M**
	SOP Common	C.12.1	M

A.Z.3 Overlay Plane Module

If the Overlay Plane Module is present, any Overlays defined in that Module shall store the overlay data in Overlay Data (60xx,3000), and not any unused high bits in Pixel Data (7FE0,0010).

Item: The Specimen Identification Module is new, but is derived from Section C.7.1.2 Specimen Module which is not yet defined in the standard but is proposed in Supplement 15 Visible Light - it is reproduced here for clarity, from the 1.1a version of the frozen draft of VL.

The Specimen Module is specialized here to include only identification attributes, and it is expected that this change can be propagated to VL also for consistency

C.7.1.2 Specimen Identification Module

Table C.7-X specifies the Attributes which identify a Specimen.

Table C.7-X
SPECIMEN IDENTIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Specimen Accession Number	(0040,050A)	1	A departmental Information System identifier which identifies the Accession. See Section C.7.1.2.1.1 for further explanation.
Specimen Sequence	(0040,0550)	2	Detailed description of one or more specimens. Zero or more Items may be included in this Sequence.
>Specimen Identifier	(0040,0551)	2C	A departmental information system identifier for the Specimen. See Section C.7.1.2.1.2 for further explanation. Required if a sequence item is present.

>Specimen Type Code Sequence	(0040,059A)	2C	Specimen Type. Only a single Item shall be permitted in this Sequence. Required if a sequence item is present and Specimen Identifier (0040,0551) is sent.
>>Include 'Code Sequence Macro' Table 8.8-1		Baseline Context IDs are defined in 37	
>Slide Identifier	(0040,06FA)	2C	Identifier of the Slide. Required if a sequence item is present and the Specimen is a Slide.

Item: Amend Section C.7.3.1 General Series Module to add new Defined Terms for Modality, to qualify Laterality, and introduce Series Presentation Intent.

C.7.3.1 General Series Module

Table C.7-4 specifies the Attributes which identify and describe general information about the Series within a Study.

Table C.7-4
GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
...	...	...	...
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined. Required if the body part examined is a paired structure **and Image Laterality (0020,0062) is not sent**. Enumerated Values: R = right, L = left **Note: Some IODs support Image Laterality (0020,0062) at the Image level, which can provide a more comprehensive mechanism for specifying the laterality of the body part(s) being examined.**
...	...	...	...

Body Part Examined	(0018,0015)	3	Text description of the part of the body examined. Defined Terms: SKULL, CSPINE, TSPINE, LSPINE, SSPINE, COCCYX, CHEST, CLAVICLE, BREAST, ABDOMEN, PELVIS, HIP, SHOULDER, ELBOW, KNEE, ANKLE, HAND, FOOT, EXTREMITY, HEAD, HEART, NECK, LEG, ARM**, JAW** Note: Some IODs support the Anatomic Region Sequence (0008,2218) at the Image level, which can provide a more comprehensive mechanism for specifying the body part being examined.
...	...	...	...

C.7.3.1.1 General Series Attribute Descriptions

C.7.3.1.1.1 Modality

Defined Terms for the Modality (0008,0060) are:

CR = Computed Radiography
CT = Computed Tomography
MR = Magnetic Resonance
NM = Nuclear Medicine
US = Ultrasound
OT = Other
AS = Angioscopy
BI = Biomagnetic imaging
CD = Color flow Doppler
CP = Culposcopy
CS = Cystoscopy
DD = Duplex Doppler
DG = Diaphanography
DM = Digital microscopy
EC = Echocardiography
ES = Endoscopy
FA = Fluorescein angiography
FS = Fundoscopy
LP = Laparoscopy
LS = Laser surface scan
MA = Magnetic resonance angiography
MS = Magnetic resonance spectroscopy
PT = Positron emission tomography (PET)
RG = Radiographic imaging (conventional film/screen)
ST = Single-photon emission computed tomography (SPECT)
TG = Thermography
XA = X-Ray Angiography
RF = Radio Fluoroscopy
DX = Digital Radiography
MG = Mammography
IO = Intra-oral Radiography
PX = Panoramic X-Ray

Retired Defined Terms for the Modality (0008,0060) are:

DS = Digital Subtraction Angiography (retired)
CF = Cinefluorography (retired)
DF = Digital fluoroscopy (retired)
VF = Videofluorography (retired)

Note: 1. The XA modality incorporates the retired modality DS.

2. The RF modality incorporates the retired modalities CF, DF, VF.

3. The modality listed in the Modality Data Element (0008,0060) may not match the name of the IOD in which it appears. For example, a SOP instance from XA IOD may list the RF modality when an RF implementation produces an XA object.

4. Unless a more specific Defined Term is available (such as MG or IO or PX),Digital Radiography (DX) may include all acquisition devices that generate a single frame projection radiographic image whether it be using an integrated digital detector with a semiconductor detector directly or via a scintillator, or using a photo-stimulable plate exposed separately from the digital acquisition device and read later, or using a conventional film/screen exposure that is optically scanned subsequently.

Item: The existing Section C.7.4.1 Frame of Reference Module is amended to add notes about use with mammography biopsy images

C.7.4.1.1.2 Position Reference Indicator

The Position Reference Indicator (0020,1040) specifies the part of the patient's anatomy which was used as an anatomical reference point associated with a specific Frame of Reference UID. The Position Reference Indicator may or may not coincide with the origin of the fixed frame of reference related to the Frame of Reference UID.

The Position Reference Indicator shall be used only for annotation purposes and is not intended to be used as a mathematical spatial reference.

Note: The Position Reference Indicator may be sent zero length when it has no meaning, for example, when the Frame of Reference Module is required to relate mammographic images of the breast acquired without releasing breast compression, but where there is no meaningful anatomical reference point as such.

Item: Amend the existing Section C.7.5.1 General Equipment Module to add note about Pixel Padding Value

C.7.5.1 General Equipment Module

Table C.7-6 specifies the Attributes which identify and describe the piece of equipment which produced a Series of Images.

Table C.7-6
GENERAL EQUIPMENT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
…	…	…	…
Pixel Padding Value	(0028,0120)	3	Value of pixels added to non-rectangular image to pad to rectangular format. See C.7.5.1.1.2 for further explanation. **Note: The Value Representation of this Attribute is determined by the value of Pixel Representation (0028,0103).**

…

C.7.5.1.1.2 Pixel Padding Value

Pixel Padding Value (0028,0120) is used to pad non-rectangular images to rectangl~~e~~**ular** format. The native format of some images is not rectangular. It is common for devices with this format to pad the images to the rectangular format required by the DICOM Standard with a specific pixel value that is not contained in the native image. This attribute specifies the value of this padding value.

Notes: 1. When the relationship between pixel value and X-Ray Intensity is unknown, it is recommended that the following values be used to pad with black:

0 if Photometric Interpretation (0028,0004) is MONOCHROME2.

$2^{BitsStored}$ - 1 if Photometric Interpretation (0028,0004) is MONOCHROME1.

2. When the relationship between pixel value and X-Ray Intensity is known (for example as defined by Pixel Intensity Relationship (0028,1040) and Pixel Intensity relationship Sign (0028,1041)), it is recommended that a value equivalent to air be used.

Item: Amend the existing Section C.7.6.1 General Image Module to add further Attributes to describe Lossy Image Compression, Quality Control Image, Burned in Annotation and to comment on the use of Referenced Image Sequence for breast biopsy images:

C.7.6.1 General Image Module

Table C.7-7 specifies the Attributes which identify and describe an image within a particular series.

Table C.7-7
GENERAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
…	…	…	…
Referenced Image Sequence	(0008,1140)	3	A sequence which provides reference to a set of Image SOP Class/Instance identifying other images significantly related to this image (e.g. post-localizer CT image **or Mammographic biopsy images**) Encoded as sequence of items: (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced Image Sequence (0008,1140) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Image Sequence (0008,1140) is sent.
…	…	…	…
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.**
Burned In Annotation	**(0028,0301)**	**3**	**Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired .** **Enumerated Values:** **YES** **NO** **If this Attribute is absent, then the image may or may not contain burned in annotation.**
…	…	…	…

Lossy Image Compression Ratio	**(0028,2112)**	**3**	**Describes the approximate lossy compression ratio(s) that have been applied to this image.** **See C.7.6.1.1.5 for further explanation.** **May be multivalued if successive lossy compression steps have been applied.** **Notes: 1. For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30.** **2. For historical reasons, the lossy compression ratio should also be described in Derivation Description (0008,2111).**

Item: The proposed Section C.7.6.X Acquisition Context Module is derived from the Frozen Draft 1.1a of the Visible Light Supplement 15 and relevant sections of it are reproduced here for clarity.

The goal of this Module is to provide an extensible, structured and coded means of describing aspects of acquisition beyond those that are "hard-coded" into the IOD. It is expected that as the IODs evolve to satisfy particular clinical contexts (e.g. dental and mammography), that appropriate clinically specific contexts will be defined that will use this Module as a basis.

Note that the Referenced Frame Numbers Attribute is not applicable to the single frame IODs defined in this Supplement.

Also, various Concept Types that are not applicable to DX or that are conveyed in DX specific Attributes have been removed from the "Descriptors of Acquisition Context Table".

C.7.6.x Acquisition Context Module

Table C.7.6.x-1 specifies Attributes for description of the clinically-relevant Anatomic, Chemical, Functional, Physical, and Spatial conditions present during data acquisition.

This Module shall not contain descriptions of conditions that replace those that are already described in specific Modules or Attributes that are also contained within the IOD that contains this Module.

Notes: 1. Each item of the Acquisition Context Sequence (0040,0555) contains one item of the Concept-name Code Sequence (0040,A043) and one of the mutually-exclusive Observation-value Attributes: Concept Code Sequence (0040,A168), the pair of Numeric Value (0040,A30A) and Measurement Units Code Sequence (0040,08EA), Date (0040,A121), Time (0040,A122), Person Name (0040,A123) or Text Value (0040,A160).

2. Acquisition Context includes concepts such as: "pre-contrast", "inspiration", "valgus stress", "post-void", and date and time of contrast administration.

3. If this SOP Instance is a Multi-frame SOP Instance, each item of the Acquisition Context Sequence (0040,0555) may be configured to describe one frame, all frames, or any specifically enumerated subset set of frames of the Multi-frame SOP Instance.

4. SNOMED DICOM Microglossary (SDM) Templates and Context Groups provide semantic templates (frames) and controlled terminology for a rich variety of procedure-description concepts, such as Image-Acquisition Context (TID 2), Illumination (TID 5), Magnification (TID 6), Vital Staining (CID 168), Anatomic Frame of Reference (TID 7), Drug or Contrast-agent Administration (TID 8), Geometric Projection (CID 22), and others. See Section C.7.6.x.1.2 for further explanation.

5. The Attributes of Table C.7.6.x-1 can convey clinically-relevant Procedure-Description Attributes in any specific clinical or operational context. A generic “Name/Value pair” mechanism is provided for conveying Acquisition Context Attributes encoded as Coded Values, Text, or specific Named Types (such as Date, Time, or Numeric Value). For example, the Attributes of radiographic-contrast administration may be documented with Codes drawn from SDM Context Groups such as radiographic contrast agent (CID 12) or administration route (CID 11); or with Numeric Values described by LOINC Codes for fluid volume, drug dose, or administration-rate measurements.

Table C.7.6.x-1 - ACQUISITION CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Acquisition Context Sequence	(0040,0555)	2	A sequence of repeating items that describes the conditions present during the acquisition of an Image. Zero or more items may be included in this sequence.
>Concept-name Code Sequence	(0040,A043)	1C	A concept that constrains the meaning of (i.e. defines the role of) the Observation Value. The "Name" component of a Name/Value pair. This sequence shall contain exactly one item. Required if a sequence item is present.
>>*Include 'Code Sequence Macro' Table 8.8-1*			Baseline Context ID Numbers are specified in Section C.7.6.x.1.1.
>Referenced Frame Numbers	(0040,A136)	1C	References one or more frames in a Multi-frame SOP Instance. The first frame shall be denoted as frame number one. Required if Acquisition Context Sequence (0040,0555) is sent and this SOP Instance is a Multi-frame SOP Instance and the values in this sequence item do not apply to all frames.
>Numeric Value	(0040,A30A)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a set of one or more numeric values. Required if Concept-name Code Sequence (0040,A043) is present and the value it requires (implies) is a set of one or more integers or real numbers. Shall not be present otherwise.
>Measurement Units Code Sequence	(0040,08EA)	1C	Units of measurement. Only a single Item shall be permitted in this Sequence. Required if a sequence item is present and Numeric Value (0040,A30A) is sent. Shall not be present otherwise.
>>*Include 'Code Sequence Macro' Table 8.8-1*			Baseline Context ID is 82.
>Date	(0040,A121)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a date. Note: The purpose or role of the date value could be specified in Concept-name Code Sequence (0040,A043). Required if Concept-name Code Sequence (0040,A043) is present and the value it requires (implies) is a date. Shall not be present otherwise.

>Time	(0040,A122)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a time. Note: The purpose or role of the time value could be specified in Concept-name Code Sequence (0040,A043). Required if Concept-name Code Sequence (0040,A043) is present and the value it requires (implies) is a time. Shall not be present otherwise.
>Person Name	(0040,A123)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a Person Name. Note: The role of the person could be specified in Concept-name Code Sequence (0040,A043). Required if Concept-name Code Sequence (0040,A043) is present and the value it requires (implies) is a person name. Shall not be present otherwise.
>Text Value	(0040,A160)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a Text Observation Value. Required if Date (0040,A121), Time (0040,A122), and Person Name (0040,A123) do not fully describe the concept specified by Concept Name Code Sequence (0040,A043). Shall not be present otherwise.
>Concept Code Sequence	(0040,A168)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept-name Code Sequence (0040,A043) is a Coded Value. This sequence shall contain exactly one item. Required if a sequence item is present and Date (0040,A121), Time (0040,A122), Person Name (0040,A123), Text Value (0040,A160), and the pair of Numeric Value (0040,A30A) and Measurement Units Code Sequence (0040,08EA) are not present.
>>*Include 'Code Sequence Macro' Table 8.8-1*			Baseline Context ID Numbers are specified in Section C.7.6.x.1.2.
Acquisition Context Description	(0040,0556)	3	Free-text description of the image-acquisition context.

C.7.6.x.1 Acquisition Context Module Attribute Descriptions

C.7.6.x.1.1 Concept-name Code Sequence

Table C.7.6.x.1.1-1 specifies the SNOMED DICOM Microglossary Templates and Context Groups that define the Defined Terms for Code Value (0008,0100) of the Concept-name Code Sequence (0040,A043) for naming the Attributes of Image-Acquisition Context. The Baseline Context Groups provide suggested Value Sets. The Baseline Templates provide suggested Properties and corresponding Value Sets. See clinical data interchange guidelines published by professional specialty societies for recommendations in specific clinical or operational contexts.

Table C.7.6.x.1.1-1 - ATTRIBUTES OF ACQUISITION CONTEXT

Concept Type	Description	Baseline CID	Baseline TID
Context Group names, SDM	Names of the SNOMED DICOM Microglossary Context Groups	291	
Image-Acquisition Context	General-purpose template of clinically-significant procedure-description concepts. Contains other Templates by reference (i.e TID 5, TID 6, TID 7, and TID 14).	212	2
Chemical agent administration	Concepts describing the delivery (administration) of radiographic contrast agent or other chemical agent.	213	14

C.7.6.x.1.2 Concept Code Sequence

Table C.7.6.x.1.2-1 specifies the SNOMED DICOM Microglossary Context Groups that provide the Defined Terms for Code Value (0008,0100) of the Concept Code Sequence (0040,A168) for description of Image-Acquisition Context. See clinical data interchange guidelines published by professional specialty societies for recommendations in specific clinical or operational contexts. See the SNOMED DICOM Microglossary for subset Context Groups indexed by clinically-significant factors, such as specialty, imaging modality, or anatomic region.

Note: Each SDM Template provides a detailed specification of the semantic network that describes a complex concept. TID 2 describes Image-Acquisition Context; TID 5 describes Illumination; TID 6 describes Magnification; TID 7 describes Anatomic frame of reference; and TID 14 describes Chemical agent administration.

Table C.7.6.x.1.2-1 - DESCRIPTORS OF ACQUISITION CONTEXT

Concept Type	Examples	Baseline TID	Baseline CID	Modality Constraint
IMAGE ACQUISITION CONTEXT				
Functional condition present during image acquisition	breathing, phonation	2	91	
Image labels used commonly to indicate acquisition context (or the role of the image in a procedure)	post-void, I+, C, non-contrast, flexion, neutral, scout	2	171	
Interventional drug	epinephrine	2	10	

Physical agent used to apply the physical force during image acquisition	compression paddle, knee brace	2	86	
Physical force applied during image acquisition	distraction, valgus stress	2	89	
Radiographic contrast agent	barium sulfate, meglumine diatrizoate	2	12	
CHEMICAL AGENT ADMINISTRATION				
Active ingredient	barium sulfate	14	56	
Administration route	intravenous, oral	14	11	
Carrier ingredient	normal saline	14	56	

Note: Some examples of the use of Concept-name Code Sequence as applied to common situations encountered in projection radiography are described in the following table. None of these concepts requires a value.

Table C.7.6.x.1.2-2 - EXAMPLES OF ACQUISITION CONTEXT (Informative)

Baseline CID	Code Value (0008,0100)	Code Meaning (0008,0104)
27	F-10100	Extension
89	F-10106	Passive extension
89	F-10107	Active extension
27	F-10110	Flexion
89	F-10116	Passive flexion
89	F-10117	Active flexion
27	F-10120	Abduction
89	F-10126	Passive abduction
89	F-10127	Active abduction
27	F-10130	Adduction
89	F-10136	Passive adduction
89	F-10137	Active adduction
27	F-10210	Internal rotation
27	F-10220	External rotation
27	F-10226	Supination
27	F-10216	Pronation
89	F-12300	Weight bearing

89 171	A-A2000	Stress
171	F-20010	Inspiration
171	F-20020	Expiration
91	F-F7102	Valsalva maneuver

Item: The existing Section C.8.7.3 X-Ray Collimator Module is amended as follows to remove references to Image Intensifiers that have nothing to do with collimation per se.

C.8.7.3 X-Ray Collimator

An X-Ray Collimator is a device placed close to the X-Ray Source to restrict the span of the X-Ray beam. It is often made of lead shutters. Figure C.8-1 presents in a graphical form its relationship with the Field Of View Dimensions (0018,1149)**~~and the Intensifier Size (0018,1162) defined in Section C.8.7.2~~**.

Geometry of the collimator is specified with respect to a row and column coordinate system where the origin is the upper left hand pixel. This origin is specified by the values 1,1 for row/column. A row coordinate represent**s** a number of raw spacing (vertical) and a column coordinate represents a column spacing (horizontal). Up to three different collimator shapes may be used and superimposed.

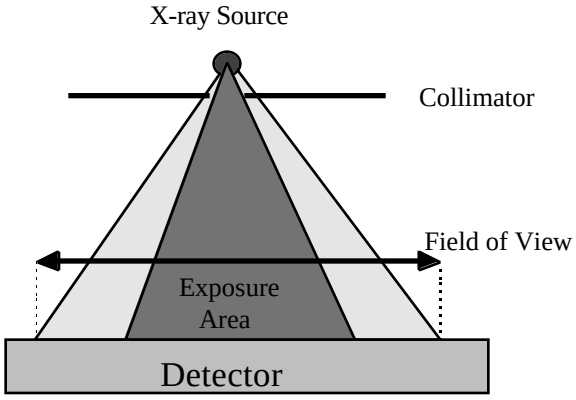


Figure C.8-1
Relationships of X-Ray Collimator

Item: Rename Section C.8.7.7 from XRF to X-Ray Tomography Acquisition Module and extend it with further, optional, parameters.

C.8.7.7 ~~XRF~~ X-Ray Tomography Acquisition Module

This Module describes the attributes of a Tomography ~~RF~~ acquisition (translation of X-Ray source during the acquisition of a single frame image).

Table C.8-32
~~XRF~~ X-RAY TOMOGRAPHY ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Tomo Type	**(0018,1490)**	**3**	**Type of tomography.** **Defined Terms:** **LINEAR** **SPIRAL** **POLYCYCLOIDAL** **CIRCULAR**
Tomo Class	**(0018,1491)**	**3**	**Form of tomography:** **Defined Terms:** **MOTION** **TOMOSYNTHESIS**
Tomo Layer Height	(0018,1460)	1	Distance in mm between the table surface and the sharp image plane.
Tomo Angle	(0018,1470)	3	Angle span in degrees of rotation of X-Ray Source during X-Ray acquisition. Only meaningful if Tomo Type (0018,1490) is LINEAR.
Tomo Time	(0018,1480)	3	Time in seconds the source has taken to rotate the Tomo Angle during X-Ray acquisition.
Number of Tomosynthesis Source Images	**(0018,1495)**	**3**	**The number of source images used to construct this tomosynthetic image. Only meaningful if Tomo Class (0018,1491) is TOMOSYNTHESIS. These may be listed in Source Image Sequence (0008,2112) of the General Image Module.**

Item: Add new Section C.8.7.8 X-Ray Acquisition Dose Module.

C.8.7.8 X-Ray Acquisition Dose Module

This Module describes the attributes related to dose delivery from an X-Ray source during the acquisition of an X-Ray image.

Table C.8-33
X-RAY ACQUISITION DOSE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	3	Peak kilo voltage output of the X-Ray generator used.
X-Ray Tube Current	(0018,1151)	3	X-Ray Tube Current in mA.

Exposure Time	(0018,1150)	3	Duration of X-Ray exposure in msec.
Exposure	(0018,1152)	3	The product of exposure time and X-Ray Tube Current expressed in mAs.
Exposure in µAs	(0018,1153)	3	The product of exposure time and X-Ray Tube Current expressed in µAs.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center. Note: This value is traditionally referred to as Source Image Distance (SID).
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to the table, support or bucky side that is closest to the Imaging Subject, as measured along the central ray of the X-Ray beam. Note: 1. This definition is less useful in terms of estimating geometric magnification than a measurement to a defined point within the Imaging Subject, but accounts for what is realistically measurable in an automated fashion in a clinical setting. 2. This measurement does not take into account any air gap between the Imaging Subject and the “front” of the table or bucky. 3. If the detector is not mounted in a table or bucky, then the actual position relative to the patient is implementation or operator defined. 4. This value is traditionally referred to as Source Object Distance (SOD).
Image Area Dose Product	(0018,115E)	3	X-Ray dose, measured in dGy*cm*cm, to which the patient was exposed for the acquisition of this image plus any non-digitally recorded fluoroscopy which may have been performed to prepare for the acquisition of this image. Notes: 1. The sum of the Image Area Dose Product of all images of a Series or a Study may not result in the actual area dose product to which the patient was exposed. 2. This may be an estimated value based on assumptions about the patient’s body size and habitus.

Body Part Thickness	(0018,11A0)	3	The average thickness in mm of the body part examined when compressed, if compression has been applied during exposure.
Relative X-Ray Exposure	(0018,1405)	3	Indication of the applied dose, in manufacturer specific units. Notes: 1. This value is intended to provide a single location where manufacturer specific information can be found for annotation on a display or film, that has meaning to a knowledgeable observer. 2. This may be a calculated or measured value. Examples are the detector entrance dose (K_B), the CR sensitivity value (S), or the logarithmic median (lgM).
Entrance Dose	(0040,0302)	3	Average entrance dose value measured in dGy at the surface of the patient during the acquisition of this image. Note: This may be an estimated value based on assumptions about the patient's body size and habitus.
Exposed Area	(0040,0303)	3	Typical dimension of the exposed area at the detector plane. If Rectangular: row dimension followed by column; if Round: diameter. Measured in cm. Notes: 1. The exposed area should be consistent with values specified in the X-Ray Collimator Module, if present. 2. This may be an estimated value based on assumptions about the patient's body size and habitus.
Distance Source to Entrance	(0040,0306)	3	Distance in mm from the source to the surface of the patient closest to the source during the acquisition of this image. Note: This may be an estimated value based on assumptions about the patient's body size and habitus.
Comments on Radiation Dose	(0040,0310)	3	User-defined comments on any special conditions related to radiation dose encountered during the acquisition of this image.

X-Ray Output	(0040,0312)	3	The X-Ray output at the patient entrance surface and kVp used to acquire the image, measured in mGy/mAs. Note: This value may be a calibrated value rather than measured during the exposure.
Half Value Layer	(0040,0314)	3	The thickness of Aluminum in mm required to reduce the X-Ray Output (0040,0312) by a factor of two. Note: This value may be a calibrated value rather than measured during the exposure.
Organ Dose	(0040,0316)	3	Average organ dose value measured in dGy during the acquisition of this image. Note: This may be an estimated value.
Organ Exposed	(0040,0318)	3	Organ to which Organ Dose (0040,0316) applies. Defined Terms: BREAST GONADS BONE MARROW FETUS LENS Note: The anatomic regions described by these terms are those that are particularly radiosensitive and for which it is conventional to obtain organ specific dose parameters.
Anode Target Material	(0018,1191)	3	The primary material in the anode of the X-Ray source. Defined Terms: TUNGSTEN MOLYBDENUM RHODIUM
Filter Material	(0018,7050)	3	The X-Ray absorbing material used in the filter. Defined Terms: MOLYBDENUM ALUMINUM COPPER RHODIUM NIOBIUM EUROPIUM LEAD
Filter Thickness Minimum	(0018,7052)	3	The minimum thickness in mm of the X-Ray absorbing material used in the filters.

Filter Thickness Maximum	(0018,7054)	3	The maximum thickness in mm of the X-Ray absorbing material used in the filters.
Rectification Type	(0018,1156)	3	Type of rectification used in the X-Ray generator. Defined Terms: SINGLE PHASE THREE PHASE CONST POTENTIAL

Item: Add new Section C.8.7.9 X-Ray Generation Module.

C.8.7.9 X-Ray Generation Module

This Module describes the attributes related to generation of X-rays during the acquisition of an X-Ray image.

Table C.8-34
X-RAY GENERATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	3	Peak kilo voltage output of the X-Ray generator used.
X-Ray Tube Current	(0018,1151)	3	X-Ray Tube Current in mA.
Exposure Time	(0018,1150)	3	Duration of X-Ray exposure in msec.
Exposure	(0018,1152)	3	The product of exposure time and X-Ray Tube Current expressed in mAs.
Exposure in µAs	(0018,1153)	3	The product of exposure time and X-Ray Tube Current expressed in µAs.
Exposure Control Mode	(0018,7060)	3	Type of exposure control. Defined Terms: MANUAL AUTOMATIC
Exposure Control Mode Description	(0018,7062)	3	Text description of the mechanism of exposure control. May describe the number and type of exposure sensors or position of the sensitive area of the imaging detector.
Exposure Status	(0018,7064)	3	Whether the exposure was normally completed or not. Defined Terms: NORMAL ABORTED

Phototimer Setting	(0018,7065)	3	Nominal percentage phototimer setting, where a more positive value indicates greater exposure and a more negative value indicates less exposure.
Focal Spot	(0018,1190)	3	Nominal focal spot size in mm used to acquire this image.
Anode Target Material	(0018,1191)	3	The primary material in the anode of the X-Ray source. Defined Terms: TUNGSTEN MOLYBDENUM RHODIUM
Rectification Type	(0018,1156)	3	Type of rectification used in the X-Ray generator. Defined Terms: SINGLE PHASE THREE PHASE CONST POTENTIAL

Item: Add new Section C.8.7.10 X-Ray Filtration Module.

C.8.7.10 X-Ray Filtration Module

This Module describes the attributes related to the filtration of X-rays during the acquisition of an X-Ray image.

Table C.8-35
X-RAY FILTRATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Filter Type	(0018,1160)	3	Type of filter(s) inserted into the X-Ray beam (e.g. wedges). Defined Terms: STRIP WEDGE BUTTERFLY MULTIPLE NONE

Filter Material	(0018,7050)	3	The X-Ray absorbing material used in the filter. Defined Terms: MOLYBDENUM ALUMINUM COPPER RHODIUM NIOBIUM EUROPIUM LEAD
Filter Thickness Minimum	(0018,7052)	3	The minimum thickness in mm of the X-Ray absorbing material used in the filters.
Filter Thickness Maximum	(0018,7054)	3	The maximum thickness in mm of the X-Ray absorbing material used in the filters.

Item: Add new Section C.8.7.11 X-Ray Grid Module.

C.8.7.11 X-Ray Grid Module

This Module describes the attributes related to the use of a grid to reduce scatter of X-rays during the acquisition of an X-Ray image.

Table C.8-36
X-RAY GRID MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Grid	(0018,1166)	3	Identifies the grid. May be multi-valued. Defined Terms are: FIXED FOCUSED RECIPROCATING PARALLEL CROSSED NONE
Grid Absorbing Material	(0018,7040)	3	The X-Ray absorbing material used in the grid.
Grid Spacing Material	(0018,7041)	3	The spacing material used in the grid.
Grid Thickness	(0018,7042)	3	The thickness in mm of the X-Ray absorbing material used in the grid.
Grid Pitch	(0018,7044)	3	The pitch in mm of the X-Ray absorbing material used in the grid.

Grid Aspect Ratio	(0018,7046)	3	Ratio of the vertical spacing and horizontal spacing of the X-Ray absorbing material used in the grid. Specified by a pair of integer values where the first value is the vertical size, and the second value is the horizontal size.
Grid Period	(0018,7048)	3	Period in mSec of reciprocation cycle. Only meaningful if Grid (0018,1166) is RECIPROCATING.
Grid Focal Distance	(0018,704C)	3	Focal distance in mm of a FOCUSED grid.

Item: Add to PS 3.3 new Section C.8.X

C.8.X DX Modules

C.8.X.1 DX Series Module

The Digital X-Ray IODs use the General Series module described in section C.7.3.1, specialized by the DX Series Module, to describe the DICOM Series Entity described in A.1.2.3, and to define what constitutes a Series for the context of projection Digital X-Ray.

Note: In an abstract sense, a series may be viewed from the perspective of an acquisition device or a display device.

In the former case, it is convenient to group images related by commonality of acquisition parameters, such as the imaging subject's physical relationship to the equipment (such as a patient lying in a particular position with respect to the equipment), a single acquisition initiation (such as an MR pulse sequence or spiral CT run), or a single workflow action on the part of the operator (such as the reading of a collection of CR plates from the same examination).

In the latter case, it is often convenient to organize images for viewing or browsing into series based upon other criteria such as physical or temporal proximity that may not necessarily correspond with the order or grouping in which the images were acquired.

This conflict is most apparent in the existing CR Image IOD C.8.1, where the definition of View Position at the Series Level in CR Series C.8.1.1 implies, for example, that a Lateral and PA Chest X-Ray may not be grouped into a single series. While this may be in keeping with the traditional CT and MR notions that a change in an imaging subject's physical orientation with respect to the imaging equipment implies a new series, it is most unnatural from the point of view of a reader viewing or browsing a collection of projection radiographic images.

A similar example pertains in the case of the traditional set of views of the maxillary and mandibular dentition, in which all the images are logically grouped in one sequence, but the imaging equipment moves with respect to the imaging subject, and the size of the detector may vary between images.

Accordingly, the constraint (apparent from the CT, MR and CR IODs) that a change in position, detector, body part or laterality implies a new series has been relaxed in the DX IODs, through the use of the DX Anatomy Imaged Module and the DX Positioning Module which define Attributes at the Image level that specify these concepts with finer granularity. This approach is consistent with that used in the XA, XRF, US and NM IODs.

Images within a series are still required, if the Condition for the inclusion of the Frame of Reference Module is met, to be relative to the same Frame of Reference.

Table C.8-N specifies the Attributes which identify and describe general information about the DX Series.

Table C.8-N
DX SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Enumerated Values: DX PX IO MG See section C.7.3.1.1.1 for further explanation.
Referenced Study Component Sequence	(0008,1111)	1C	Uniquely identifies the Study Component SOP Instance or Modality Performed Procedure Step SOP Instance to which the Series is related. The Sequence shall have one Item. Required if Study Component SOP Class or Modality Performed Procedure Step SOP Class is supported.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Referenced Study Component Sequence(0008,1111) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Study Component Sequence(0008,1111) is sent.
Presentation Intent Type	(0008,0068)	1	Identifies the intent of the images that are contained within this Series. Enumerated Values: FOR PRESENTATION FOR PROCESSING See C.8.X.1.1.1 for further explanation.

C.8.X.1.1 DX Series Attribute Descriptions

C.8.X.1.1.1 Presentation Intent Type

Presentation Intent Type (0008,0068) shall identify the intent for the purposes of display or other presentation of all Images within this Series.

Notes: 1. Since this is a Series level attribute, all Images within a Series have the same value for this Attribute.

2. The intent of this restriction is to ensure that FOR PRESENTATION and FOR PROCESSING images are placed in separate Series, so that no confusion can arise

as to which images are suitable for diagnostic reading as determined by local policy.

A Series of Images intended for viewing by an observer, after application of any grayscale transformations specified in the image object such as VOI LUT, shall have an Enumerated Value of FOR PRESENTATION.

Notes: 1. These images may still be of Image Type (0008,0008) ORIGINAL rather than DERIVED despite the possibility that they may have undergone some processing, such as unsharp masking. In this case a DERIVED image would have undergone yet further processing to make it substantially different from the original. See Figure C.8-x.

2. These images may still be subjected to processing or further processing, if appropriate, depending on the application.

3. These images are intended for display on a device, without (further) processing, since that device may not be capable of image processing. The quality of the displayed image or its suitability for any purpose is beyond the scope of the DICOM Standard.

Images that have been corrected to account for characteristics of the detector but which are intended to be further processed before being displayed, shall have an Enumerated Value of FOR PROCESSING.

Note: This type is provided to allow the functions of image acquisition and image processing for presentation to be separated and yet have images conveyed between the two processes using a DICOM object. Individual sites or users may choose to substitute their own specialized processing in place of that supplied by the implementor.

Images available at this stage of processing may be useful for quality control and problem solving purposes, as well as academic research.

Images of this type may also be archived, retrieved and processed with different algorithms or parameters in order to alter the appearance of specific features for clinical purposes.

The nature of the detector correction that may have been applied before sending an image of type FOR PROCESSING is not specified. In particular, acquisitions that acquire several sets of matrices of pixel values (such as image data, gain offset and a defect map) must perform some processing (detector correction) before a DX Image object can be instantiated.

The nature of the processing that may have been applied before sending an image of type FOR PRESENTATION is also not specified.

It is expected that individual implementors will use Private Attributes to convey specifics of the processing applied that may be of use for further processing by those aware of the parameters and algorithms. The diversity of detector types and processing algorithms make it undesirable to standardize such parameters.

If images from the same exposure exist with different Values of Presentation Intent Type (0008,0068), then they shall have different SOP Instance UIDs.

Notes: 1. Source Image Sequence (0008,2112) may be used to relate these images.

2. The SOP Class UIDs of the two images will also be different.

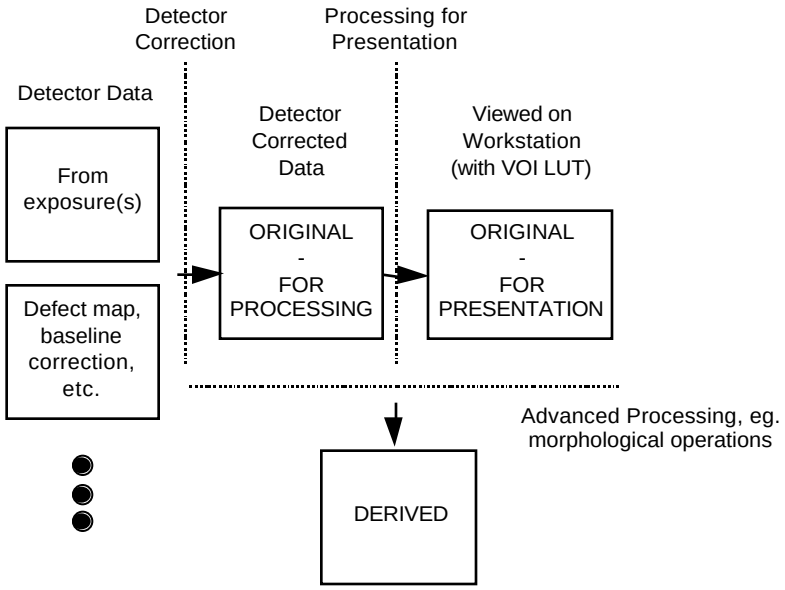


Figure C.8-x
Explanation of Presentation Intent Type

C.8.X.2 DX Anatomy Imaged Module

Table C.8-N contains IOD Attributes that describe the anatomy contained in a DX IOD.

Table C.8-N
DX ANATOMY IMAGED MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Laterality	(0020,0062)	1	Laterality of (possibly paired) body part (as described in Anatomic Region Sequence (0008,2218)) examined. Enumerated Values: R = right L = left U = unpaired B = both left and right Note: This Attribute is mandatory, in order to ensure that images may be positioned correctly relative to one another for display. Shall be consistent with any laterality information contained in Primary Anatomic Structure Modifier Sequence (0008,2230), if present. Note: Laterality (0020,0060) is a Series level Attribute and must be the same for all Images in the Series, hence it must be absent.
Anatomic Region Sequence	(0008,2218)	2	Sequence that identifies the anatomic region of interest in this image (i.e. external anatomy, surface anatomy, or general region of the body). This anatomic region is placed on the table or bucky for examination. Note: It is strongly recommended that this Attribute be sent with a value, in order to ensure that images may be positioned correctly relative to one another for display. See C.8.X.2.1.1 for further explanation. Only a single Item shall be permitted in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.			Baseline Context ID is 4009

>Anatomic Region Modifier Sequence	(0008,2220)	3	Sequence that modifies the anatomic region of interest in this image (i.e. prone, supine, decubitus right). May be present only if Anatomic Region Sequence (0008,2218) is sent. See C.8.X.2.1.1 for further explanation. One or more Items may be included in this Sequence.
>>*Include 'Code Sequence Macro' Table 8.8-1*.			Baseline Context ID is 2
Primary Anatomic Structure Sequence	(0008,2228)	3	Sequence that identifies the primary anatomic structures of interest in this image. See C.8.X.2.1.2 for further explanation. One or more Items may be included in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.			Baseline Context ID is 1
>Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	Sequence that modifies the primary anatomic structure of interest in this image. May be present only if Primary Anatomic Structure Sequence (0008,2228) is sent. See C.8.X.2.1.2 for further explanation. One or more Items may be included in this Sequence.
>>*Include 'Code Sequence Macro' Table 8.8-1*.			Baseline Context ID is 2

C.8.X.2.1 DX Anatomy Imaged Attribute Descriptions

The Attributes in this Module extend the function of Body Part Examined (0018,0015) as used in other IODs, and are intended to be used to facilitate the management of images and series in terms of routing, storage and display, as well as to dictate certain Conditions on Attributes and Modules in the DX IOD.

C.8.X.2.1.1 Anatomic Region

The general region of the body (e.g. the anatomic region, organ, or body cavity being examined) may be identified by the Anatomic Region Sequence (0008,2218). Characteristics of the anatomic region being examined may be refined by the Anatomic Region Modifier Sequence (0008,2220).

Note: Coding mechanisms may be defined for specific clinical contexts.

The Coding Scheme Designator (0008,0102) may be SNM3.

The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Contexts, or other contexts which are the same or a superset of, the following terms, depending upon the SOP Class in which this module is included.

Anatomic Region Sequence(0008,2218) for DX Anatomy Imaged from the SNOMED DICOM Microglossary Context ID 4009 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see Note 1)	Body Part Examined (0018,0015) (see Note 2)
T-D3000	Chest	CHEST
T-280A0	Apex of Lung	
T-25000	Trachea	
T-26000	Bronchus	
T-24100	Larynx	
T-D3300	Mediastinum	
T-32000	Heart	HEART
T-D1600	Neck	NECK
T-11210	Sternum	
T-15610	Sternoclavicular joint	
T-11300	Rib	
T-11500	Spine	
T-11501	Cervical spine	CSPINE
T-11502	Thoracic spine	TSPINE
T-11503	Lumbar spine	LSPINE
T-11AD0	Sacrum	SSPINE
T-11BF0	Coccyx	COCCYX
T-D4000	Abdomen	ABDOMEN
T-D0300	Extremity	EXTREMITY
T-D8200	Arm	ARM
T-D8810	Thumb	
T-D8800	Finger	
T-D8700	Hand	HAND
T-D8600	Wrist	
T-12402	Forearm bone	
T-D8300	Elbow	ELBOW
T-12410	Humerus	
T-D2220	Shoulder	SHOULDER
T-12310	Clavicle	CLAVICLE
T-12280	Scapula	
T-15420	Acromioclavicular joint	
T-D9800	Toe	

T-12980	Sesamoid bones of foot	
T-D9700	Foot	FOOT
T-12770	Calcaneus	
T-15770	Tarsal joint	
T-15750	Ankle joint	ANKLE
T-D9400	Leg	LEG
T-D9200	Knee	KNEE
T-12730	Patella	
T-12710	Femur	
T-15710	Hip joint	HIP
T-D6000	Pelvis	PELVIS
T-15680	Sacroiliac joint	
T-D1100	Head	HEAD
T-11100	Skull	SKULL
T-11196	Facial bones	
T-11167	Zygomatic arch	
T-11149	Nasal bone	
T-D1480	Orbit	
T-11102	Optic canal	
T-11180	Mandible	JAW
T-11170	Maxilla	
T-D1217	Maxilla and mandible	JAW
T-15290	Temporomandibular joint	
T-22000	Paranasal sinus	
T-11133	Mastoid bone	
T-D1460	Sella turcica	
T-04000	Breast	BREAST
T-61100	Parotid gland	
T-61300	Submandibular gland	
T-63000	Gall bladder	
T-60610	Bile duct	
T-56000	Esophagus	
T-57000	Stomach	
T-58200	Duodenum	
T-58000	Small intestine	
T-59000	Large intestine	

T-59600	Rectum	
T-70010	Upper urinary tract	
T-74000	Bladder	
T-75000	Urethra	
T-D6151	Uterus and fallopian tubes	

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. Not all Defined Terms specified in the other modules for this Attribute have equivalent values from this context.

C.8.X.2.1.2 Primary Anatomic Structure

The specific anatomic structures of interest within the image are identified by the Primary Anatomic Structure Sequence (0008,2228). Characteristics of the anatomic structure may be refined by the Primary Anatomic Structure Modifier Sequence (0008,2230).

C.8.X.3 DX Image Module

Table C.8-N contains IOD Attributes that describe a DX Image by specializing Attributes of the General Image and Image Pixel Modules, and adding additional Attributes.

Table C.8-N
DX IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.X.3.1.1 for specialization.
Samples per Pixel	(0028,0002)	1	Number of samples in this image. Shall have an Enumerated Value of 1.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. Enumerated Values: MONOCHROME1 MONOCHROME2
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Enumerated Values: 8, 16
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Enumerated Values: 6 to 16

High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Shall have an Enumerated Value of one less than the value in Bit Stored (0028,0101).
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Shall have the Enumerated Value: 0000H = Unsigned Integer.
Pixel Intensity Relationship	(0028,1040)	1	The relationship between the Pixel sample values and the X-Ray beam intensity. Enumerated Values: LIN = Linearly proportional to X-Ray beam intensity LOG = Logarithmically proportional to X-Ray beam intensity See C.8.X.3.1.2 for further explanation.
Pixel Intensity Relationship Sign	(0028,1041)	1	The sign of the relationship between the Pixel sample values stored in Pixel Data (7FE0,0010) and the X-Ray beam intensity. Enumerated Values; 1 = Lower pixel values correspond to less X-Ray beam intensity -1 = Higher pixel values correspond to less X-Ray beam intensity See C.8.X.3.1.2 for further explanation.
Rescale Intercept	(0028,1052)	1	The value b in the relationship between stored values (SV) in Pixel Data (7FE0,0010) and the output units specified in Rescale Type (0028,1054). Output units = m*SV + b. Enumerated Value: 0 See C.8.X.3.1.2 for further explanation.
Rescale Slope	(0028,1053)	1	m in the equation specified by Rescale Intercept (0028,1052). Enumerated Value: 1 See C.8.X.3.1.2 for further explanation.
Rescale Type	(0028,1054)	1	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). Enumerated Value: US = Unspecified See C.8.X.3.1.2 for further explanation.

Presentation LUT Shape	(2050,0020)	1	Specifies an identity transformation for the Presentation LUT, other than to account for the value of Photometric Interpretation (0028,0004), such that the output of all grayscale transformations defined in the IOD containing this Module are defined to be P-Values. Enumerated Values: IDENTITY - output is in P-Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME2. INVERSE - output after inversion is in P-Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME1. See C.8.X.3.1.2 for further explanation.
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 Compression has been performed on the Image.
Derivation Description	(0008,2111)	3	A text description of how this image was derived. See C.8.X.3.1.4 for further explanation.
Acquisition Device Processing Description	(0018,1400)	3	Indicates any visual processing performed on the images prior to exchange. See C.8.X.3.1.3 for further explanation.
Acquisition Device Processing Code	(0018,1401)	3	Code representing the device-specific processing associated with the image (e.g. Organ Filtering code) Note: This Code is manufacturer specific but provides useful annotation information to the knowledgeable observer.
Patient Orientation	(0020,0020)	1	Patient direction of the rows and columns of the image. See C.7.6.1.1.1 for further explanation.

Calibration Image	(0050,0004)	3	Indicates whether a reference object (phantom) of known size is present in the image and was used for calibration. Enumerated Values: YES NO Device is identified using the Device module. See C.7.6.12 for further explanation.
Burned In Annotation	(0028,0301)	1	Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired **.** Enumerated Values: YES NO
VOI LUT Sequence	(0028,3010)	1C	Defines a sequence of VOI LUTs. See C.8.X.3.1.5 for further explanation. Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION and Window Center (0028,1050) is not present. May also be present if Window Center (0028,1050) is present.
>LUT Descriptor	(0028,3002)	1C	Specifies the format of the LUT Data in this Sequence. See See C.8.X.3.1.5 for further explanation. Required if the VOI LUT Sequence (0028,3010) is sent.
>LUT Explanation	(0028,3003)	3	Free form text explanation of the meaning of the LUT.
>LUT Data	(0028,3006)	1C	LUT Data in this Sequence. Required if the VOI LUT Sequence (0028,3010) is sent.
Window Center	(0028,1050)	1C	Defines a Window Center for display. See See C.8.X.3.1.5 for further explanation. Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION and VOI LUT Sequence (0028, 3010) is not present. May also be present if VOI LUT Sequence (0028, 3010) is present.

Window Width	(0028,1051)	1C	Window Width for display. See C.8.X.3.1.5 for further explanation. Required if Window Center (0028,1050) is sent.
Window Center & Width Explanation	(0028,1055)	3	Free form explanation of the meaning of the Window Center and Width. Multiple values correspond to multiple Window Center and Width values.

C.8.X.3.1 DX Image Attribute Descriptions

C.8.X.3.1.1 Image Type

Value 1 shall identify the Pixel Data Characteristics in accordance with Section C.7.6.1.1.2 where the Enumerated Values are defined to be ORIGINAL or DERIVED.

Note: DX images may still be of type ORIGINAL rather than DERIVED despite the possibility that they may have undergone some processing. In this case a DERIVED image would have undergone yet further processing to make it substantially different from the original.

Value 2 shall identify the Patient Examination Characteristics in accordance with Section C.7.6.1.1.2 where the Enumerated Values are defined to be PRIMARY or SECONDARY.

Note: DX images generally use PRIMARY value for images captured from patient exposure.

If images from the same exposure exist with different Values of Image Type, then they shall have different SOP Instance UIDs.

Note: Source Image Sequence (0008,2112) may be used to relate these images.

Value 3 (which is specific to the IOD) shall be present and have zero length (null value).

Other Values (4 and beyond) are optional and implementation specific.

C.8.X.3.1.2 Pixel Intensity Relationship and Grayscale Transformations

Pixel Intensity Relationship (0028,1040) and Pixel Intensity Relationship Sign (0028,1041) describe how the stored pixel values in Pixel Data (7FE0,0010) are related to the X-Ray beam intensity incident on the detector.

They do not define a transformation intended to be applied to the pixel data for presentation.

Note: For example, if Pixel Intensity Relationship (0028,1040) is LIN and Pixel Intensity Relationship Sign (0028,1041) is -1, then lower values of Pixel Data (7FE0,0010) indicate higher X-Ray beam intensities corresponding to less radiographically dense regions projected on the image such as through air, and higher values of Pixel Data (7FE0,0010) indicate lower X-Ray beam intensities corresponding to more radiographically dense regions projected on the image such as through bone and radio-opaque contrast agents.

The transformation to be applied to the pixel data for presentation is defined by the successive application of the conceptual Modality LUT, the VOI Attributes and the conceptual Presentation LUT. This shall result in the output of P-Values.

Rescale Slope (0028,1052) and Rescale Intercept (0028,1053) define a linear subset of a conceptual Modality LUT transformation. For IODs that include this Module, these Attributes define an identity transformation. IODs that include the DX Image Module shall not include the Modality LUT Module.

The Presentation LUT Shape (2050,0020) defines a subset of a conceptual Presentation LUT. For IODs that include this Module, this Attribute defines an identity transformation or inverse identity transformation. IODs that include the DX Image Module shall not include the Presentation LUT Module.

Photometric Interpretation (0028,0004) indicates whether lower values that are the output of the VOI Attributes should be displayed as darker or lighter. Since the output of the equivalent of a conceptual Presentation LUT is in P-Values, which are defined in PS 3.14 such that lower values correspond to lower luminance levels, then the definition of the Presentation LUT Shape (2050,0020), otherwise intended to be an identity transformation, must take into account the effect of the value specified for Photometric Interpretation (0028,0004).

Note: Regardless of the values of Pixel Intensity Relationship (0028,1040) and Pixel Intensity Relationship Sign (0028,1041), the grayscale transformations to be applied to the Pixel Data (7FE0,0010) are defined by the equivalent of the Modality LUT (Rescale Slope (0028,1052) and Rescale Intercept (0028,1053)), Value of Interest Attributes, Photometric Interpretation (0028,0004) and the equivalent of the Presentation LUT (Presentation LUT Shape (2050,0020)). However, the combination of the grayscale transformations and the description of the pixel intensity relationship, together define whether, for example, air is expected to be displayed as black or white.

C.8.X.3.1.3 Acquisition Device Processing Description

Acquisition Device Processing Description (0018,1400) provides some indication in human readable text of the digital processing on the images before exchange. Examples of this processing are: edge enhanced, subtracted, time filtered, gamma corrected, convolved (spatially filtered).

C.8.X.3.1.4 Derivation Description

If an Image is identified to be a Derived image in Image Type (0008,0008), Derivation Description (0008,2111) is an optional and implementation specific text description of the way the image was derived from an original image. As applied to DX images, it may be used to describe derivation operations such as edge enhancement, temporal filtering, digital subtraction, or other linear and non-linear transformations.

C.8.X.3.1.5 VOI Attributes

The Attributes of the VOI LUT Module (C.11.2) are specialized in the DX Image Module.

Window Center (0028,1050) and Window Width (0028,1051) specify a linear conversion from the output of the (conceptual) Modality LUT values to the input to the (conceptual) Presentation LUT. Window Center contains the value that is the center of the window. Window Width contains the width of the window.

The application of the Window Center (0028,1050) and Window Width (0028,1051) shall not produce a signed result.

Note: If the Presentation LUT Shape (2050,0020) is IDENTITY, then the result of applying the Window Center (0028,1050) and Window Width (0028,1051) is P-Values.

If multiple values are present, both Attributes shall have the same number of values and shall be considered as pairs. Multiple values indicate that multiple alternative views should be presented.

The VOI LUT Sequence specifes a (potentially non-linear) conversion from the output of the (conceptual) Modality LUT values to the input to the (conceptual) Presentation LUT.

If multiple items are present in VOI LUT Sequence (0028,3010), only one shall be applied. Multiple items indicate that multiple alternative views should be presented.

If any VOI LUT Attributes are included by an Image, a Window Width and Window Center or the VOI LUT Table, but not both, shall be applied to the Image for display. Inclusion of both indicates that multiple alternative views should be presented.

The three values of the LUT Descriptor (0028,3002) describe the format of the LUT Data (0028,3006).

The first value is the number of entries in the lookup table.

The second value is the first stored pixel value mapped. This pixel value is mapped to the first entry in the LUT. All image pixel values less than the first value mapped are also mapped to the first entry in the LUT Data. An image pixel value one greater than the first value mapped is mapped to the second entry in the LUT Data. Subsequent image pixel values are mapped to the subsequent entries in the LUT Data up to an image pixel value equal to number of entries + first value mapped - 1 which is mapped to the last entry in the LUT Data. Image pixel values greater than number of entries + first value mapped are also mapped to the last entry in the LUT Data.

The third value specifies the number of bits for each entry in the LUT Data (analagous to “bits stored”). It shall be between 10-16. The LUT Data shall be stored in a format equivalent to 16 “bits allocated” and “high bit” equal to “bits stored” - 1. The third value conveys the range of LUT entry values. These unsigned LUT entry values shall range between 0 and 2^n-1, where n is the third value of the LUT Descriptor.

Notes: 1. The third value is restricted in the VOI LUT Module to 8 or 16 but is specialized here.

2. The first and second values are not specialized and are the same as in the VOI LUT Module.

The LUT Data (0028,3006) contains the LUT entry values.

C.8.X.4 DX Detector Module

Table C.8-N contains IOD Attributes that describe a DX detector.

Table C.8-N
DX DETECTOR MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Detector Type	(0018,7004)	2	The type of detector used to acquire this image. Defined Terms: DIRECT = X-Ray photoconductor SCINTILLATOR = Phosphor used STORAGE = Storage phosphor FILM = Scanned film/screen
Detector Configuration	(0018,7005)	3	The physical configuration of the detector. Defined Terms: AREA = single or tiled detector SLOT = scanned slot, slit or spot
Detector Description	(0018,7006)	3	Free text description of detector.
Detector Mode	(0018,7008)	3	Text description of operating mode of detector (implementation specific).

Detector ID	(0018,700A)	3	The ID or serial number of the detector used to acquire this image.
Date of Last Detector Calibration	(0018,700C)	3	The date on which the detector used to acquire this image as identified in Detector ID (0018,700A) was last calibrated.
Time of Last Detector Calibration	(0018,700E)	3	The time at which the detector used to acquire this image as identified in Detector ID (0018,700A) was last calibrated.
Exposures on Detector Since Last Calibration	(0018,7010)	3	Total number of X-Ray exposures that have been made on the detector used to acquire this image as identified in Detector ID (0018,700A) since it was calibrated.
Exposures on Detector Since Manufactured	(0018,7011)	3	Total number of X-Ray exposures that have been made on the detector used to acquire this image as identified in Detector ID (0018,700A) since it was manufactured.
Detector Time Since Last Exposure	(0018,7012)	3	Time in Seconds since an exposure was last made on this detector prior to the acquisition of this image.
Detector Active Time	(0018,7014)	3	Time in mSec that the detector is active during acquisition of this image. Note: This activation window overlaps the time of the X-Ray exposure as defined by Exposure Time (0018,1150) and Detector Activation Offset From Exposure (0018,7016).
Detector Activation Offset From Exposure	(0018,7016)	3	Offset time in mSec that the detector becomes active after the X-Ray beam is turned on during acquisition of this image. May be negative.
Detector Binning	(0018,701A)	3	Number of active detectors used to generate a single pixel. Specified as number of row detectors per pixel then column.
Detector Conditions Nominal Flag	(0018,7000)	3	Whether or not the detector is operating within normal tolerances during this image acquisition. Enumerated Values: YES NO Note: This flag is intended to indicate whether or not there may have been some compromise of the diagnostic quality of the image due to some condition such as over-temperature, etc.

Detector Temperature	(0018,7001)	3	Detector temperature during exposure in degrees Celsius.
Sensitivity	(0018,6000)	3	Detector sensitivity in manufacturer specific units. Note: This value is intended to provide a single location where manufacturer specific information can be found for annotation on a display or film, that has meaning to a knowledgeable observer.
Field of View Shape	(0018,1147)	3	Shape of the Field of View, that is the image pixels stored in Pixel Data (7FE0,0010). Enumerated Values: RECTANGLE ROUND HEXAGONAL
Field of View Dimension(s)	(0018,1149)	3	Dimensions in mm of the Field of View, that is the image pixels stored in Pixel Data (7FE0,0010). If Field of View Shape (0018,1147) is: RECTANGLE: row dimension followed by column. ROUND: diameter. HEXAGONAL: diameter of a circumscribed circle.
Field of View Origin	(0018,7030)	1C	Offset of the TLHC of a rectangle circumscribing the Field of View, that is the image pixels stored in Pixel Data (7FE0,0010), 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. Required if Field of View Rotation (0018,7032) or Field of View Horizontal Flip (0018,7034) is present. See C.8.X.4.1.1 for further explanation.
Field of View Rotation	(0018,7032)	1C	Clockwise rotation in degrees of Field of View, that is the image pixels stored in Pixel Data (7FE0,0010), relative to the physical detector. Enumerated Values: 0, 90, 180, 270 Required if Field of View Horizontal Flip (0018,7034) is present. See C.8.X.4.1.1 for further explanation.

Field of View Horizontal Flip	(0018,7034)	1C	Whether or not a horizontal flip has been applied to the Field of View, that is the image pixels stored in Pixel Data (7FE0,0010), after rotation relative to the physical detector as described in Field of View Rotation (0018,7032). Enumerated Values: NO YES Required if Field of View Rotation (0018,7032) is present. See C.8.X.4.1.1 for further explanation.
Imager Pixel Spacing	(0018,1164)	1	Physical distance measured at the front plane of the detector housing between the center of each image pixel specified by a numeric pair - row spacing value(delimiter) column spacing value in mm.
Detector Element Physical Size	(0018,7020)	3	Physical dimensions of each detector element that comprises the detector matrix, in mm. Expressed as row dimension followed by column. Note: This may not be the same as Detector Element Spacing (0018,7022) due to the presence of spacing material between detector elements.
Detector Element Spacing	(0018,7022)	3	Physical distance between the center of each detector element, specified by a numeric pair - row spacing value(delimiter) column spacing value in mm. Note: This may not be the same as the Imager Pixel Spacing (0018,1164), and should not be assumed to describe the stored image.
Detector Active Shape	(0018,7024)	3	Shape of the active area. Enumerated Value: RECTANGLE ROUND HEXAGONAL Note: This may be different from the Field of View Shape (0018,1147), and should not be assumed to describe the stored image.

Detector Active Dimension(s)	(0018,7026)	3	Dimensions in mm of the active area. If Detector Active Shape(0018,7024) is: RECTANGLE: row dimension followed by column. ROUND: diameter. HEXAGONAL: diameter of a circumscribed circle. Note: This may be different from the Field of View Dimensions (0018,1149), and should not be assumed to describe the stored image.
Detector Active Origin	(0018,7028)	3	Offset of the TLHC of a rectangle circumscribing the active detector area from the TLHC of a rectangle circumscribing the physical detector area, measured in physical detector pixels as a row offset followed by a column offset. See C.8.X.4.1.1 for further explanation.

C.8.X.4.1 DX Detector Attribute Descriptions

C.8.X.4.1.1 Physical, Active, Field of View, Exposed and Displayed Areas

The relationship between the Physical Detector Area, the Active Detector Area, the Field of View (what is stored in the Pixel Data (7FE0,0010)), the Exposed Area (after X-Ray Collimation) and the Displayed Area is illustrated in the following diagrams.

Note: Some of these Attributes relate the image data to manufacturer specific characteristics of the detector that may be used for quality control purposes, e.g. correlation of image artifacts with a detector defect map, analysis of noise performance, etc.

The Displayed Area is defined in pixel coordinates relative to the stored image pixel values by the Attributes of the Display Shutter Module (see section C.7.6.11). If this Module is not present or supported, then the Displayed Area is equal to the Field of View.

The Exposed Area is defined in pixel coordinates relative to the stored image pixel values by the Attributes of the X-Ray Collimator Module (see section C.8.7.3).

For the Digital X-Ray IODs, the Field of View is usually rectangular in shape and the same size as the stored Pixel Data (7FE0,0010). The shape and size of the Field of View and the spacing of the pixels are defined by the following Attributes:

- Field of View Shape (0018,1147),
- Field of View Dimensions (0018,1149),
- Imager Pixel Spacing (0018,1164),
- Rows (0028,0010),
- Columns (0028,0011)

The following Attributes define the relationship of the Field of View to the Physical Detector Area:

- Field of View Origin (0018,7030),
- Field of View Rotation (0018,7032),
- Field of View Horizontal Flip (0018,7034).

For the Digital X-Ray IODs, the Active Area, i.e. that part of the detector matrix that was activated for this exposure, is usually rectangular in shape. The shape and size of the Active Area and the size and spacing of the detectors are defined by the following Attributes:

- Detector Active Shape (0018,7024),
- Detector Active Dimensions (0018,7026),
- Detector Element Physical Size (0018,7020),
- Detector Element Spacing (0018,7022).

Notes: 1. The Detector Element Physical Size (0018,7020) and Detector Element Spacing (0018,7022) may be different if there are insensitive regions between each detector.

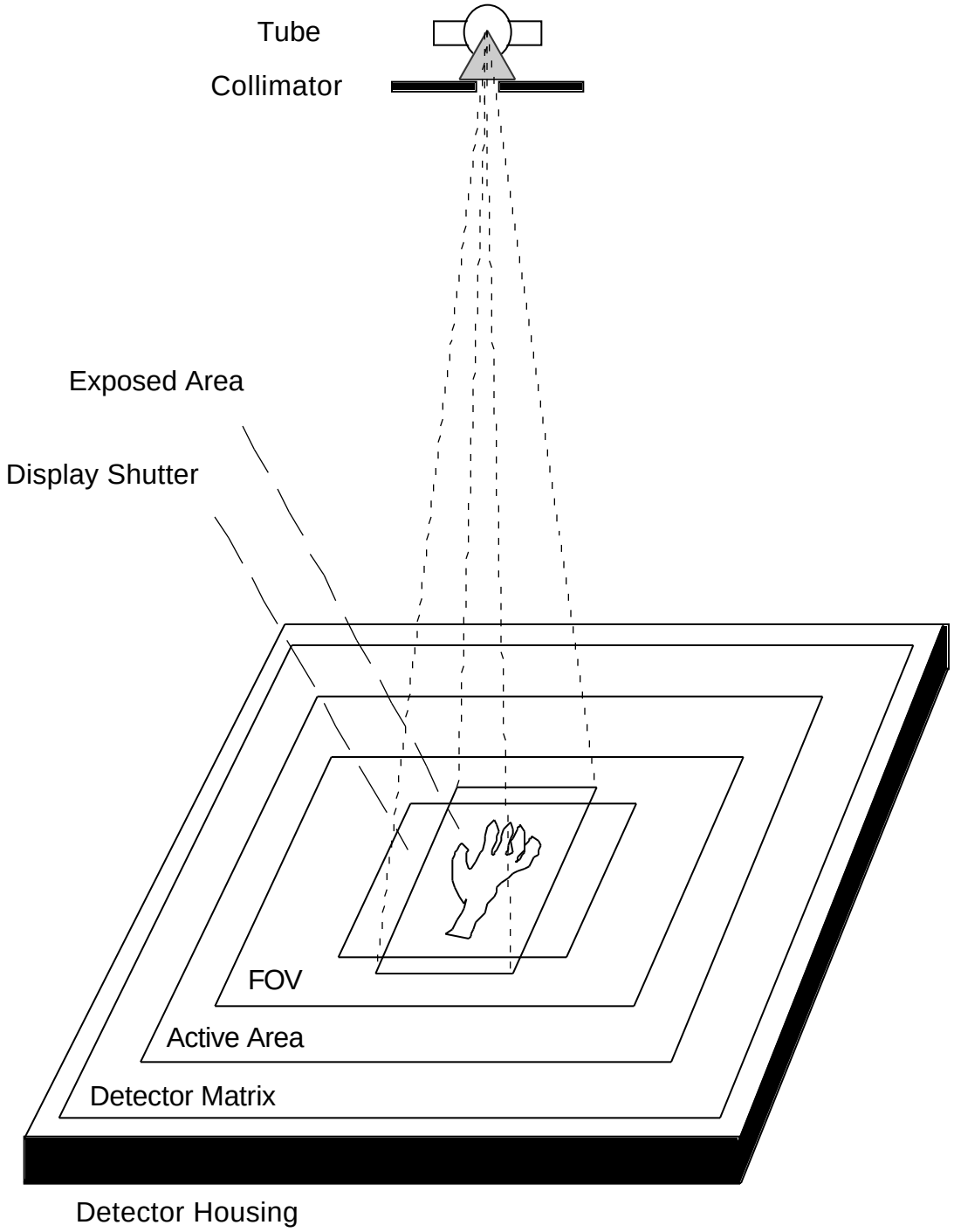
2. This model of description is not able to accurately describe multiple matrices of detectors that are “tiled” to produce a single image.

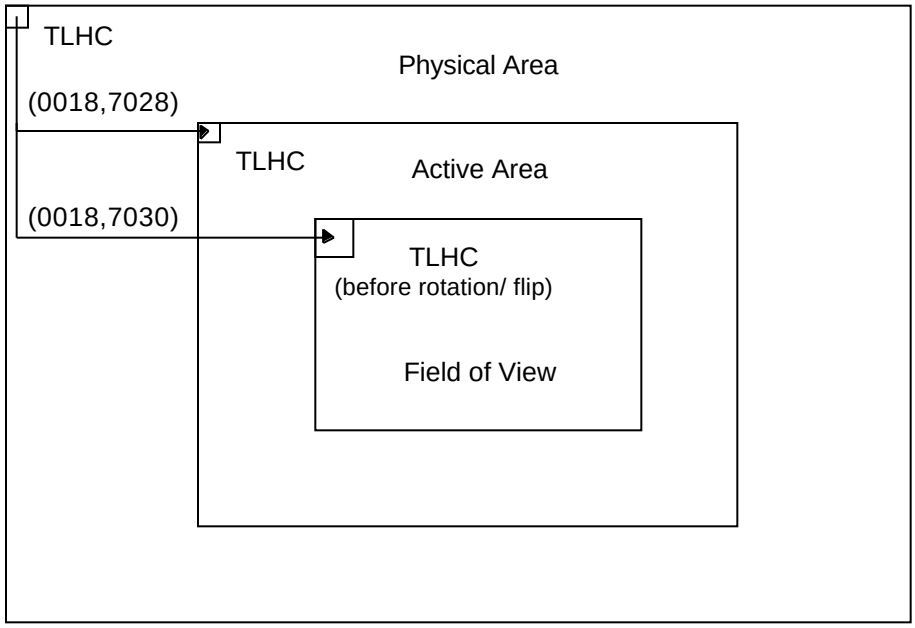
The following optional Attribute defines the relationship of the Active Area to the Physical Detector Area:

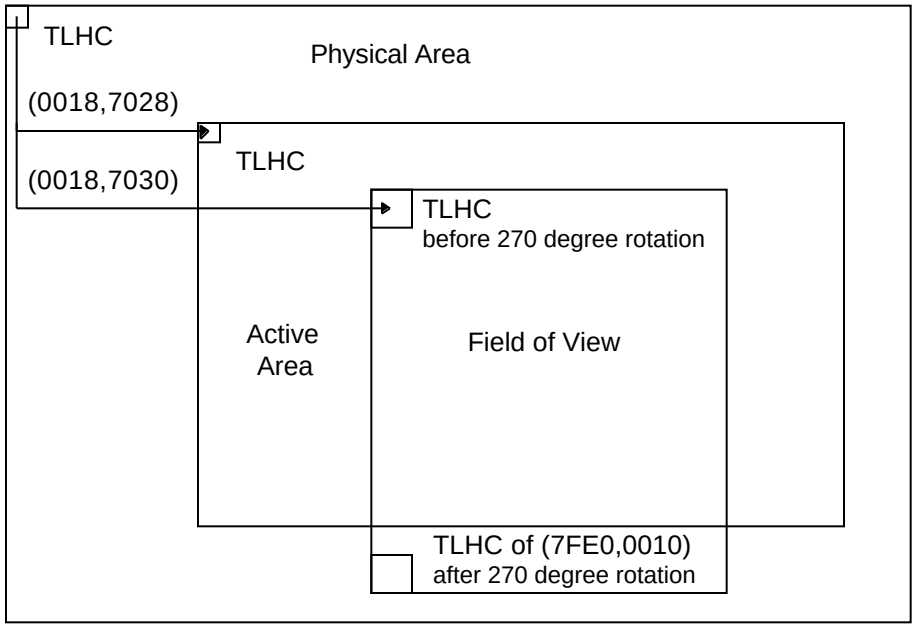
- Detector Active Origin (0018,7028).

The relationship between detectors and stored image pixels is defined by Detector Binning (0018,701A) which specifies how many detectors, in each of the row and column directions, contribute to (are pooled or averaged to form) a single stored image pixel.

Note: Detector Binning (0018,701A) may have values less than one if sub-sampling is used to derive an image with higher spatial resolution than the detector matrix.


Tube
Collimator
Exposed Area
Display Shutter
FOV
Active Area
Detector Matrix
Detector Housing


TLHC
Physical Area
(0018,7028)
TLHC
Active Area
(0018,7030)
TLHC
(before rotation/ flip)
Field of View


TLHC
Physical Area
(0018,7028)
TLHC
(0018,7030)
TLHC
before 270 degree rotation
Active
Area
Field of View
TLHC of (7FE0,0010)
after 270 degree rotation

C.8.X.5 DX Positioning Module

Table C.8-N contains IOD Attributes that describe the positioning used in acquiring Digital X-Ray Images.

Table C.8-N
DX POSITIONING MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Projection Eponymous Name Code Sequence	(0018,5104)	3	A Sequence that describes the radiographic method of patient, tube and detector positioning to achieve a well described projection or view. Only a single Item shall be permitted in this Sequence. Shall be consistent with the other Attributes in this Module, if present, but may more specifically describe the image acquisition. See C.8.X.5.1.6 for further explanation.
>Include 'Code Sequence Macro' Table 8.8-1.		Baseline Context ID 4012	
Patient Position	(0018,5100)	3	Description of imaging subject's position relative to the equipment. See C.7.3.1.1.2. for Defined Terms and further explanation. If present, shall be consistent with Patient Gantry Relationship Code Sequence (0054,0414) and Patient Orientation Modifier Code Sequence (0054,0412).
View Position	(0018,5101)	3	Radiographic view of the image relative to the imaging subject's orientation. Shall be consistent with View Code Sequence (0054,0220). See C.8.X.5.1.1 for further explanation.
View Code Sequence	(0054,0220)	3	Sequence that describes the projection of the anatomic region of interest on the image receptor. Note: It is strongly recommended that this Attribute be present, in order to ensure that images may be positioned correctly relative to one another for display. Shall be consistent with View Position (0018,5101). See C.8.X.5.1.1 for further explanation. Only a single Item shall be permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1.		Baseline Context ID 4010	

>View Modifier Code Sequence	(0054,0222)	3	View modifier. See C.8.X.5.1.2 for further explanation. Zero or more Items may be included in this Sequence.
>>*Include 'Code Sequence Macro' Table 8.8-1*.		Baseline Context ID 4011	
Patient Orientation Code Sequence	(0054,0410)	3	Sequence that describes the orientation of the patient with respect to gravity. See C.8.X.5.1.3 for further explanation. Only a single Item shall be permitted in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.		Baseline Context ID 19	
> Patient Orientation Modifier Code Sequence	(0054,0412)	3	Patient Orientation Modifier. Required if needed to fully specify the orientation of the patient with respect to gravity. See C.8.X.5.1.4 for further explanation. 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 which describes the orientation of the patient with respect to the gantry. See C.8.X.5.1.5 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	

Distance Source to Patient	(0018,1111)	3	Distance in mm from source to the table, support or bucky side that is closest to the Imaging Subject, as measured along the central ray of the X-Ray beam. Note: 1. This definition is less useful in terms of estimating geometric magnification than a measurement to a defined point within the Imaging Subject, but accounts for what is realistically measurable in an automated fashion in a clinical setting. 2. This measurement does not take into account any air gap between the Imaging Subject and the "front" of the table or bucky. 3. If the detector is not mounted in a table or bucky, then the actual position relative to the patient is implementation or operator defined. 4. This value is traditionally referred to as Source Object Distance (SOD).
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center. Note: This value is traditionally referred to as Source Image Distance (SID).
Estimated Radiographic Magnification Factor	(0018,1114)	3	Ratio of Source Image Distance (SID) over Source Object Distance (SOD).
Positioner Type	(0018,1508)	2	Defined Terms: CARM COLUMN MAMMOGRAPHIC PANORAMIC CEPHALOSTAT RIGID NONE Notes: 1. The term CARM can apply to any positioner with 2 degrees of freedom of rotation of the X-Ray beam about the Imaging Subject. 2. The term COLUMN can apply to any positioner with 1 degree of freedom of rotation of the X-Ray beam about the Imaging Subject.

Positioner Primary Angle	(0018,1510)	3	Position of the X-Ray beam about the patient from the RAO to LAO direction where movement from RAO to vertical is positive, if Positioner Type (0018,1508) is CARM. See C.8.7.5 XA Positioner Module for further explanation if Positioner Type (0018,1508) is CARM. See C.8.X.6 Mammography Image Module for explanation if Positioner Type (0018,1508) is MAMMOGRAPHIC.
Positioner Secondary Angle	(0018,1511)	3	Position of the X-Ray beam about the patient from the CAU to CRA direction where movement from CAU to vertical is positive, if Positioner Type (0018,1508) is CARM. See C.8.7.5 XA Positioner Module for further explanation if Positioner Type (0018,1508) is CARM. See C.8.X.6 Mammography Image Module for explanation if Positioner Type (0018,1508) is MAMMOGRAPHIC.
Detector Primary Angle	(0018,1530)	3	Angle of the X-Ray beam in the row direction in degrees relative to the normal to the detector plane. Positive values indicate that the X-Ray beam is tilted toward higher numbered columns. Negative values indicate that the X-Ray beam is tilted toward lower numbered columns. See C.8.7.5 XA Positioner Module for further explanation.
Detector Secondary Angle	(0018,1531)	3	Angle of the X-Ray beam in the column direction in degrees relative to the normal to the detector plane. Positive values indicate that the X-Ray beam is tilted toward lower numbered rows. Negative values indicate that the X-Ray beam is tilted toward higher numbered rows. See C.8.7.5 XA Positioner Module for further explanation.

Column Angulation	(0018,1450)	3	Angle of the X-Ray beam in degree relative to an orthogonal axis to the detector plane. Positive values indicate that the tilt is toward the head of the table. Note: The detector plane is assumed to be parallel to the table plane. Only meaningful if Positioner Type (0018,1508) is COLUMN.
Table Type	(0018,113A)	3	Defined Terms: FIXED TILTING NONE
Table Angle	(0018,1138)	3	Angle of table plane in degrees relative to horizontal plane [Gravity plane]. Positive values indicate that the head of the table is upward. Only meaningful if Table Type (0018,113A) is TILTING.
Body Part Thickness	(0018,11A0)	3	The average thickness in mm of the body part examined when compressed, if compression has been applied during exposure.
Compression Force	(0018,11A2)	3	The compression force applied to the body part during exposure, measured in Newtons.

C.8.X.5.1.1 View Code Sequence

View Code Sequence (0054,0220) replaces the function of View Position (0018,5101), and describes the radiographic view of the image relative to the real-world patient orientation as described in Annex E.

Notes: 1. The Coding Scheme Designator (0008,0102) may be SNM3.

2. The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 4010, or another context which is the same or a superset of, the following terms:

View Code Sequence(0054,0220) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 4010 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note 1)	View Position (0018,0051) (see note 2)
R-10202	frontal	
R-10204	frontal oblique	
R-10206	antero-posterior	AP
R-10208	antero-posterior oblique	
R-10210	right posterior oblique	
R-10212	left posterior oblique	
R-10214	postero-anterior	PA
R-10216	postero-anterior oblique	
R-10218	right anterior oblique	
R-10220	left anterior oblique	
R-10222	sagittal	
R-10224	medial-lateral	
R-10226	lateral oblique	
R-10228	lateral-medial	
R-10230	medial oblique	
R-10232	right lateral	RL or RLD (see note 3)
R-10234	right oblique	RLO
R-10236	left lateral	LL or LLD (see note 3)
R-10238	left oblique	LLO
R-10241	axial	
R-10242	cranio-caudal	
R-10244	caudo-cranial	
R-10246	oblique axial	
R-10248	oblique cranio-caudal	
R-10250	oblique caudo-cranial	
R-10252	frontal-oblique axial	
R-10254	sagittal-oblique axial	
R-102C1	oblique	
R-102CD	lateral	
R-102C2	tangential	
R-10256	submentovertical	
R-10257	verticosubmental	

R-102C3	plantodorsal	
R-102C4	dorsoplantar	
R-102C5	parietoacanthal	
R-102C6	acanthoparietal	
R-102C7	orbitoparietal	
R-102C8	parieto-orbital	

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. Not all Defined Terms specified in the other modules for these Attributes have equivalent values from this context.

3. The decubitus LLD and RLD Defined Terms for View Position (0018,0051) convey two concepts, both the view and the imaging subject's position with respect to gravity. In the DX IOD, the concept of decubitus position is conveyed in Patient Orientation Code Modifier Sequence (0054,0412).

C.8.X.5.1.2 View Modifier Code Sequence (Informative)

The Coding Scheme Designator (0008,0102) may be SNM3.

The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 4011, or another context which is the same or a superset of, the following terms:

View Modifier Code Sequence(0054,0222) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 4011 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note)
R-10244	cephalad
R-10242	caudad
R-102C9	transthoracic
R-102CA	lordotic
R-102CB	transforamenal
R-102CC	transoral
R-102CE	transorbital

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

C.8.X.5.1.3 Patient Orientation Code Sequence

This Attribute is not related to Patient Orientation (0020,0020) and conveys a different concept entirely.

Notes: 1. The Coding Scheme Designator (0008,0102) may be SNM3.

2, The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 19, or another context which is the same or a superset of, the following terms:

Patient Orientation Code Sequence(0054,0410) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 19 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note)
F-10440	erect
F-10450	recumbent
F-10460	semi-erect

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

C.8.X.5.1.4 Patient Orientation Modifier Code Sequence (Informative)

The Coding Scheme Designator (0008,0102) may be SNM3.

The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 20, or another context which is the same or a superset of, the following terms:

Patient Orientation Modifier Code Sequence(0054,0412) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 20 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note 1)	View Position (0018,0051) (see note 2)	Patient Position (0018,5100) (see notes 2 and 4)
F-10310	prone		HFP or FFP
F-10316	semi-prone		
F-10318	lateral decubitus		HFDR, FFDR, HFDL or FFDL
F-10320	standing		
F-10326	anatomical		
F-10330	kneeling		
F-10336	knee-chest		
F-10340	supine		HFS or FFS

F-10346	lithotomy		
F-10348	Trendelenburg		
F-10349	inverse Trendelenburg		
F-10380	frog		
F-10390	stooped-over		
F-103A0	sitting		
F-10410	curled-up		
F-10317	right lateral decubitus	RLD (see note 3)	HFDR or FFDR
F-10319	left lateral decubitus	LLD (see note 3)	HFDL or FFDL

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. Not all Defined Terms specified in the other modules for these Attributes have equivalent values from this context.

3. The decubitus LLD and RLD Defined Terms for View Position (0018,0051) convey two concepts, both the view and the imaging subject's position with respect to gravity. In the DX IOD, the concept of view is conveyed in View Code Sequence (0054,0220).

4. The Defined Terms for Patient Position (0018,1500) convey two concepts, both erect/supine and head/feet first. In the DX IOD, the concept of head/feet first is conveyed in Patient Gantry Relationship Code Sequence (0054,0414).

C.8.X.5.1.5 Patient Gantry Relationship Code Sequence (Informative)

The Coding Scheme Designator (0008,0102) may be SNM3.

The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 21, or another context which is the same or a superset of, the following terms:

Patient Gantry Relationship Code Sequence(0054,0414) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 21 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note 1)	Patient Position (0018,5100) (see notes 2 and 3)
R-10516	oblique	
F-10470	headfirst	HFP, HFS, HFDL or HFDR
F-10480	feet-first	FFP, FFS, FFDL or FFDR
R-10515	transverse	

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be

used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. Not all Defined Terms specified in the other modules for these Attributes have equivalent values from this context.

3. The Defined Terms for Patient Position (0018,1500) convey two concepts, both erect/supine and head/feet first. In the DX IOD, the concept of erect/supine is conveyed in Patient Orientation Modifier Code Sequence (0054,0414).

C.8.X.5.1.6 Projection Eponymous Name Code Sequence (Informative)

The Coding Scheme Designator (0008,0102) may be SNM3.

The Code Value (0008,0100) may be drawn from the SNOMED DICOM Microglossary Context ID 4012, or another context which is the same or a superset of, the following terms:

Patient Gantry Relationship Code Sequence(0018,5104) for DX Positioning Module from the SNOMED DICOM Microglossary Context ID 4012 (Informative)

Code Value (0008,0100)	Code Meaning (0008,0104) (see note)
R-10261	Albers-Schonberg
R-10262	Alexander
R-10263	Arcelin
R-10264	Beclere
R-10265	Bertel
R-10266	Blackett-Healy
R-10267	Broden
R-10268	Cahoon
R-10269	Caldwell
R-1026A	Camp-Coventry
R-1026B	Causton
R-1026C	Chamberlain
R-1026D	Chassard-Lapine
R-1026E	Chausse
R-1026F	Cleaves
R-10270	Clements
R-10271	Clements-Nakayama
R-10272	Dunlap
R-10273	Ferguson
R-10274	Fleischner
R-10275	Friedman
R-10276	Fuchs

R-10277	Gaynor-Hart
R-10278	Grandy
R-10279	Grashey
R-1027A	Haas
R-1027B	Henschen
R-1027C	Hickey
R-1027D	Holly
R-1027E	Holmblad
R-1027F	Hough
R-10280	Hsieh
R-10281	Hughston
R-10282	Isherwood
R-10283	Judd
R-10284	Kandel
R-10285	Kasabach
R-10286	Kemp Harper
R-10287	Kovacs
R-10288	Kuchendorf
R-10289	Kurzbauer
R-1028A	Laquerriere-Pierquin
R-1028B	Lauenstein
R-1028C	Law
R-1028D	Lawrence
R-1028E	Leonard-George
R-1028F	Lewis
R-10290	Lilienfeld
R-10291	Lindblom
R-10292	Lorenz
R-10293	Low-Beer
R-10294	Lysholm
R-10295	May
R-10296	Mayer
R-10297	Merchant
R-10298	Miller
R-10299	Nolke
R-1029A	Norgaard

R-1029B	Ottonello
R-1029C	Pawlow
R-1029D	Pearson
R-1029E	Penner
R-1029F	Pirie
R-102A0	Rhese
R-102A1	Schuller
R-102A2	Settegast
R-102A3	Staunig
R-102A4	Stecher
R-102A5	Stenvers
R-102A6	Swanson
R-102A7	Tarrant
R-102A8	Taylor
R-102A9	Teufel
R-102AA	Titterington
R-102AB	Towne
R-102AC	Twining
R-102AD	Valdini
R-102AE	Waters
R-102AF	West Point
R-102B0	Wigby-Taylor
R-102B1	Zanelli

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

Item: The following mammographic specific sections specialize existing (non-DX) and DX modules. Some of the annotations that may be required to meet regulatory requirements such as the US Mammography Quality Standards Act (MQSA) Final Rule are specified here, and others may be encoded in Attributes that are contained in more general modules. These include:

Patient Module:	*Patient Name and another disambiguating identifier*
General Study Module:	*Date of Study*
General Equipment Module:	*Facility Name and Location, Mammography Unit ID*
General Series Module:	*Technologist ID*
DX Acquisition Module:	*Image Receptor ID, kVp and mAs*
DX Anatomy Imaged Module:	*Laterality*
Mammography Image Module:	*View (using standardized codes)*

A requirement to place view and laterality on the image in the axilla can be met since Laterality and View are Mandatory Attributes, as is Patient Orientation, hence the position of the axilla can always be determined.

C.8.X.6 Mammography Series Module

Table C.8-N specifies the Attributes which identify and describe general information about a Digital Mammography Series.

Table C.8-N
MAMMOGRAPHY SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Enumerated Value: MG See section C.7.3.1.1.1 for further explanation.

C.8.X.7 Mammography Image Module

Table C.8-N contains IOD Attributes that describe a Digital Mammography X-Ray Image including its acquisition and positioning.

Table C.8-N
MAMMOGRAPHY IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Positioner Type	(0018,1508)	1	Enumerated Values: MAMMOGRAPHIC NONE

Positioner Primary Angle	(0018,1510)	3	Position in degrees of the X-Ray beam in the coronal anatomical plane as if the patient were standing where movement of the X-Ray source from right to vertical is positive, and vertical is zero.
Positioner Secondary Angle	(0018,1511)	3	Position in degrees of the X-Ray beam in the sagittal anatomical plane as if the patient were standing where movement of the X-Ray source from anterior to posterior is positive, and vertical is zero.
Image Laterality	(0020,0062)	1	Laterality of the region examined. Enumerated Values: R = right L = left B = both (e.g. cleavage)
Organ Exposed	(0040,0318)	1	Organ to which Organ Dose (0040,0316) applies. Enumerated Value: BREAST Note: In the Mammography IOD, Organ Dose (0040,0316) refers to the mean glandular dose.
Implant Present	(0028,1300)	3	Whether or not an implant is present. Enumerated Values: YES NO
Anatomic Region Sequence	(0008,2218)	1	Sequence that identifies the anatomic region of interest in this image. See C.X.8.7.1.1 for further explanation. Only a single Item shall be permitted in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.		Enumerated Value for Context ID is 4013.	
View Code Sequence	(0054,0220)	1	Sequence that describes the projection of the anatomic region of interest on the image receptor. See C.X.8.7.1.2 for further explanation. Only a single Item shall be permitted in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.		Enumerated Value for Context ID is 4014.	
>View Modifier Code Sequence	(0054,0222)	2	View modifier. See C.X.8.7.1.3 for further explanation. Zero or more Items may be included in this Sequence.
>>*Include 'Code Sequence Macro' Table 8.8-1*.		Enumerated Value for Context ID is 4015.	

C.8.X.7.1 Mammography Image Attribute Descriptions

C.8.X.7.1.1 Anatomic Region

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary Context ID 4013, which consists of the following term:

Anatomic Region Sequence (0008,2218) for Mammography Image from the SNOMED DICOM Microglossary Context ID 4013

Code Value (0008,0100)	Code Meaning (0008,0104) (see Notes)
T-04000	Breast

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

C.8.X.7.1.2 View Code Sequence

View Code Sequence (0054,0220) describes the mammographic view of the image relative to the real-world patient orientation.

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary Context ID 4014, which consists of the following terms:

View Code Sequence (0054,0220) for Mammography Image from the SNOMED DICOM Microglossary Context ID 4014

Code Value (0008,0100)	Code Meaning (0008,0104) (see notes 1 and 3)	ACR BI-RADS Equivalent (see note 2)
R-10224	medio-lateral	ML
R-10226	medio-lateral oblique	MLO
R-10228	latero-medial	LM
R-10230	latero-medial oblique	LMO
R-10242	cranio-caudal	CC
R-10244	caudo-cranial (from below)	FB
R-102D0	superolateral to inferomedial oblique	SIO

R-102CF	exaggerated cranio-caudal	XCC
Y-X1770	cranio-caudal exaggerated laterally	XCCL
Y-X1771	cranio-caudal exaggerated medially	XCCM

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. These terms are described in the ACR Breast Imaging Reporting and Data System (BI-RADS) as Mammography Labeling Codes.

3. The presence of a general code for XCC is to be compatible with BI-RADS version 3. In earlier versions of BI-RADS, separate codes are defined for XCCM and XCCL. It is recommended that the more specific codes for XCCM and XCCL always be used.

C.8.X.7.1.3 View Modifier Code Sequence

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary Context ID 4015 which consists of the following terms:

View Modifier Code Sequence (0054,0222) for Mammography Image from the SNOMED DICOM Microglossary Context ID 4015

Code Value (0008,0100)	Code Meaning (0008,0104) (see note 1)	Applies only when view is:	ACR BI-RADS Equivalent (see note 2)
R-102D2	Cleavage	CC	CV
R-102D1	Axillary Tail	MLO	AT
R-102D3	Rolled Lateral	any	...RL
R-102D4	Rolled Medial	any	...RM
R-102D5	Implant Displaced	any	ID
R-102D6	Magnification	any	M...
R-102D7	Spot Compression	any	S
R-102C2	Tangential	any	TAN

Notes: 1. The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

2. These terms are described in the ACR Breast Imaging Reporting and Data System (BI-RADS) as Mammography Labeling Codes.

Item: The following Intra-oral radiography specific sections specialize existing non-DX and DX modules.

C.8.X.8 Intra-oral Series Module

Table C.8-N specifies the Attributes which identify and describe general information about a Digital Intra-oral X-Ray Series.

Table C.8-N
INTRA-ORAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Enumerated Values: IO See section C.7.3.1.1.1 for further explanation.

C.8.X.9 Intra-oral Image Module

Table C.8-N contains IOD Attributes that describe a Digital Intra-oral X-Ray Image including its acquisition and positioning.

Table C.8-N
INTRA-ORAL IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Positioner Type	(0018,1508)	1	Enumerated Values: NONE CEPHALOSTAT RIGID
Image Laterality	(0020,0062)	1	Laterality of the region examined. Enumerated Values: R = right L = left B = both (i.e. midline)
Anatomic Region Sequence	(0008,2218)	1	Sequence that identifies the anatomic region of interest in this image. See C.X.8.9.1.1 for further explanation. Only a single Item shall be permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1.		Enumerated Value for Context ID is 4016.	

Anatomic Region Modifier Sequence	(0008,2220)	1C	Sequence that refines the anatomic region of interest in this image. See C.X.8.9.1.2 for further explanation. Required if Primary Anatomic Structure Sequence (0008,2228) is not sent. Only a single Item shall be permitted in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.		Enumerated Value for Context ID is 4017.	
Primary Anatomic Structure Sequence	(0008,2228)	1C	Sequence that describes the primary anatomic structures of interest in this image. See C.X.8.9.1.3 for further explanation. Required if Anatomic Region Modifier Sequence (0008,2220) is not sent. One or more Items may be included in this Sequence.
>*Include 'Code Sequence Macro' Table 8.8-1*.		Enumerated Value for Context ID is 4018 or 4019.	

C.8.X.9.1 Intra-oral Image Attribute Descriptions

C.8.X.9.1.1 Anatomic Region

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary Context ID 4016, which consists of the following terms:

Anatomic Region Sequence (0008,2218) for Intra-oral Image from the SNOMED DICOM Microglossary Context ID 4016

Code Value (0008,0100)	Code Meaning (0008,0104) (see Note)
T-D1217	Maxilla and mandible
T-11170	Maxilla
T-11180	Mandible

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

C.8.X.9.1.2 Anatomic Region Modifier

Anatomic Region Modifier Sequence (0008,2220) is used in this Module to refine the specificity of the region described in Anatomic Region Sequence (0008,2218).

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary Context ID 4017, which consists of the following terms:

Anatomic Region Modifier Sequence (0008,2220) for Intra-oral Image from the SNOMED DICOM Microglossary Context ID 4017

Code Value (0008,0100)	Code Meaning (0008,0104) (see note)
T-51005	Anterior 1
T-51006	Anterior 2
T-51007	Anterior 3
T-51008	Premolar 1
T-51009	Premolar 2
T-5100A	Molar 1
T-5100B	Molar 2
T-5100C	Molar 3
T-5100D	Occlusal

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

C.8.X.9.1.3 Primary Anatomic Structure Sequence

The Coding Scheme Designator (0008,0102) shall be SNM3.

The Code Value (0008,0100) shall be drawn from the SNOMED DICOM Microglossary, Context ID 4018, for permanent dentition, or Context ID 4019 for deciduous dentition.

These Context Groups correspond to ISO 3950-1984 which describes a designation of permanent and deciduous dentition using a two digit code, the first digit of which designates a quadrant, and the second digit a tooth.

The teeth imaged shall be listed as multiple Items in the Primary Anatomic Structure Sequence (0008,2228).

C.8.X.9.1.3.1 Designation of Permanent Dentition

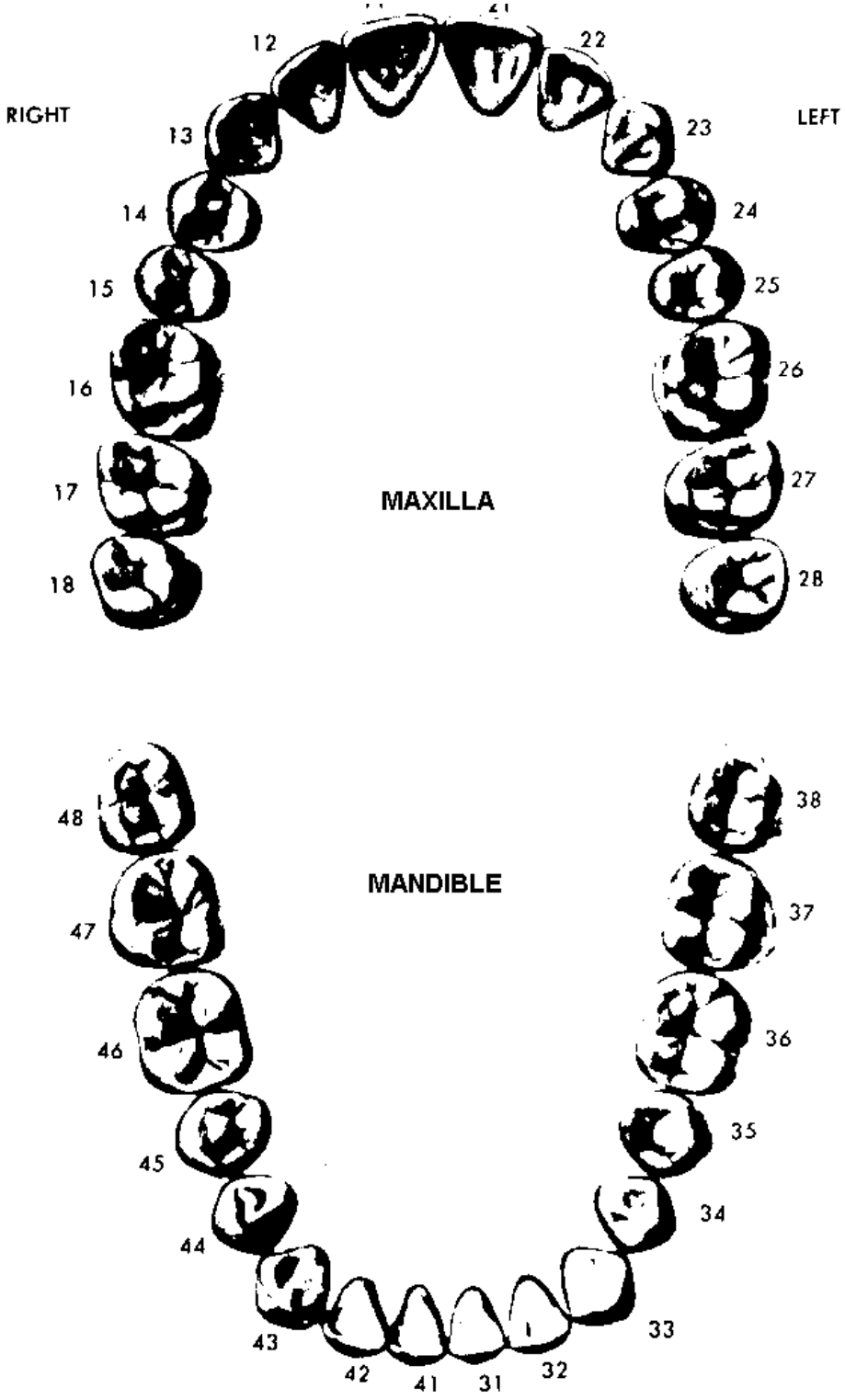
The designation of permanent dentition is described in the following table and illustrated in figure C.8-X.

Primary Anatomic Structure Sequence (0008,2228) from the SNOMED DICOM Microglossary Context ID 4018 Permanent Dentition - Designation of Teeth

Code Value (0008,0100)	Code Meaning (0008,0104) (see Note)	ISO 3950 Designation of Quadrant	ISO 3950 Designation of Tooth
T-54210	Maxillary right third molar tooth	1	8
T-54220	Maxillary right second molar tooth	1	7
T-54230	Maxillary right first molar tooth	1	6
T-54240	Maxillary right second premolar tooth	1	5
T-54250	Maxillary right first premolar tooth	1	4
T-54260	Maxillary right canine tooth	1	3
T-54270	Maxillary right lateral incisor tooth	1	2
T-54280	Maxillary right central incisor tooth	1	1
T-54290	Maxillary left central incisor tooth	2	1
T-54300	Maxillary left lateral incisor tooth	2	2
T-54310	Maxillary left canine tooth	2	3
T-54320	Maxillary left first premolar tooth	2	4
T-54330	Maxillary left second premolar tooth	2	5
T-54340	Maxillary left first molar tooth	2	6
T-54350	Maxillary left second molar tooth	2	7
T-54360	Maxillary left third molar tooth	2	8
T-54370	Mandibular left third molar tooth	3	8
T-54380	Mandibular left second molar tooth	3	7
T-54390	Mandibular left first molar tooth	3	6
T-54400	Mandibular left second premolar tooth	3	5
T-54410	Mandibular left first premolar tooth	3	4
T-54420	Mandibular left canine tooth	3	3
T-54430	Mandibular left lateral tooth	3	2
T-54440	Mandibular left central incisor tooth	3	1
T-54450	Mandibular right central incisor tooth	4	1
T-54460	Mandibular right lateral incisor tooth	4	2
T-54470	Mandibular right canine tooth	4	3
T-54480	Mandibular right first premolar tooth	4	4
T-54490	Mandibular right second premolar tooth	4	5
T-54500	Mandibular right first molar tooth	4	6
T-54510	Mandibular right second molar tooth	4	7
T-54520	Mandibular right third molar tooth	4	8

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

Figure C.8-X
ISO 3950-1984 Designation of Permanent Dentition



C.8.X.9.1.3.2 Designation of Deciduous Dentition

Primary Anatomic Structure Sequence (0008,2228) from the SNOMED DICOM Microglossary Context ID 4019 Deciduous Dentition - Designation of Teeth

Code Value (0008,0100)	Code Meaning (0008,0104) (see Note)	ISO 3950 Designation of Quadrant	ISO 3950 Designation of Tooth
T-54610	Deciduous maxillary right central incisor tooth	5	1
T-54620	Deciduous maxillary right lateral incisor tooth	5	2
T-54630	Deciduous maxillary right canine tooth	5	3
T-54640	Deciduous maxillary right first molar tooth	5	4
T-54650	Deciduous maxillary right second molar tooth	5	5
T-54660	Deciduous maxillary left central incisor tooth	6	1
T-54670	Deciduous maxillary left lateral incisor tooth	6	2
T-54680	Deciduous maxillary left canine tooth	6	3
T-54690	Deciduous maxillary left first molar tooth	6	4
T-54700	Deciduous maxillary left second molar tooth	6	5
T-54760	Deciduous mandibular left central incisor tooth	7	1
T-54770	Deciduous mandibular left lateral incisor tooth	7	2
T-54780	Deciduous mandibular left canine tooth	7	3
T-54790	Deciduous mandibular left first molar tooth	7	4
T-54800	Deciduous mandibular left second molar tooth	7	5
T-54710	Deciduous mandibular right central incisor tooth	8	1
T-54720	Deciduous mandibular right lateral incisor tooth	8	2
T-54730	Deciduous mandibular right canine tooth	8	3
T-54740	Deciduous mandibular right first molar tooth	8	4
T-54750	Deciduous mandibular right second molar tooth	8	5

Note: The value of the code is determined by Code Value (0008,0100). The text of Code Meaning (0008,0104) may vary for different instances of the same Code Value (0008,0100), and should not be used to determine which code is in use. It is provided only for annotative purposes when the code lexicon is absent.

Item: Amend PS 3.3 C.9.2 Overlay Plane Module by adding C.9.2.1.3 and reference to it.

C.9.2 Overlay plane module

Table C.9-2 contains Attributes that describe characteristics of an Overlay Plane.

Table C.9-2
OVERLAY PLANE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
...	...	...	...
Overlay Subtype	(60xx,0045)	3	Defined term which identifies the intended purpose of the ~~**ROI**~~ Overlay Type. **See C.9.2.1.3 for further explanation.**
...	...	...	...

C.9.2.1.3 Overlay Subtype

Two Defined Terms are specified:

USER - User created graphic annotation (e.g. operator)

AUTOMATED - Machine or algorithm generated graphic annotation, such as output of a Computer Assisted Diagnosis algorithm.

Note: Additional or alternative Defined Terms may be specified in modality specific Modules, such as in the Ultrasound Image Module, C.8.5.6.1.11.

Item: Amend PS 3.3 C.11.2 VOI LUT, consistent with Sup 33.

C.11.2 VOI LUT module

Table C.11-2 specifies the Attributes that describe the VOI LUT.

Table C.11-2
VOI LUT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	3	Defines a sequence of VOI LUTs.
>LUT Descriptor	(0028,3002)	1C	Specifies the format of the LUT Data in this Sequence. See C.11.1.1 for further explanation. Required if the VOI LUT Sequence (0028,3010) is sent.
>LUT Explanation	(0028,3003)	3	Free form text explanation of the meaning of the LUT.
>LUT Data	(0028,3006)	1C	LUT Data in this Sequence. Required if the VOI LUT Sequence (0028,3010) is sent.
Window Center	(0028,1050)	3	Window Center for display. See C.11.2.1.1 for further explanation.
Window Width	(0028,1051)	1C	Window Width for display. See C.11.2.1.1 for further explanation. Required if Window Center (0028,1050) is sent.
Window Center & Width Explanation	(0028,1055)	3	Free form explanation of the meaning of the Window Center and Width. Multiple values correspond to multiple Window Center and Width values.

C.11.2.1 LUT Attribute Descriptions

C.11.2.1.1 Window center and window width

Window Center (0028,1050) and Window Width (0028,1051) specify a linear conversion from stored pixel values to values to be displayed. Window Center contains the pixel value that is the center of the window. Window Width contains the width of the window.

These Attributes shall be used only for Images with Photometric Interpretation (0028,0004) values of MONOCHROME1 and MONOCHROME2. They have no meaning for other Images.

If multiple values are present, both Attributes shall have the same number of values and shall be considered as pairs. Multiple values indicate that multiple ~~**viewing**~~ **alternative views** should be presented.

This transformation of pixel values shall be applied after any Modality LUT.

If any VOI LUT Table is included ~~**or referenced**~~ by an Image, a Window Width and Window Center or the VOI LUT Table, but not both, ~~**it**~~ shall be applied to the Image for display. Inclusion of both indicates that multiple ~~**viewing**~~ **alternative views** should be presented.

If multiple items are present in VOI LUT Sequence (0028,3010), only one shall be applied to the Image for display. Multiple items indicate that multiple alternative views should be presented.

Item: Add an Image Histogram Module.

C.11.5 Image Histogram Module

Table C.11.5-1
IMAGE HISTOGRAM MODULE ATTRIBUTES

Attribute name	Tag	Type	Description
Histogram Sequence	(0060,3000)	1	Defines a sequence of Histograms. One or more Items may be included in this Sequence.
>Histogram Number of Bins	(0060,3002)	1C	The number of "bins" (entries) in the histogram. Required if a Sequence Item is present.
>Histogram First Bin Value	(0060,3004)	1C	The stored pixel value corresponding to the lowest pixel value counted in the first bin. All image pixel values less than this value are not included in the histogram. Required if a Sequence Item is present. Note: The Value Representation of this Attribute is determined by the value of Pixel Representation (0028,0103).
>Histogram Last Bin Value	(0060,3006)	1C	The stored pixel value corresponding to the highest pixel value counted in the last bin. All image pixel values greater than this value are not included in the histogram. Required if a Sequence Item is present. Note: The Value Representation of this Attribute is determined by the value of Pixel Representation (0028,0103).
>Histogram Bin Width	(0060,3008)	1C	The number of consecutive stored pixel values included in a bin. All bins shall be of equal width. Required if a Sequence Item is present.
>Histogram Explanation	(0060,3010)	3	Free form text explanation of the meaning of the LUT.
>Histogram Data	(0060,3020)	1C	Histogram Data encoded as 32 bit unsigned counts of the number of pixel values in each bin. Required if a Sequence Item is present.

C.11.5.1 Image Histogram Attribute Descriptions

The Image Histogram is a multi-valued sequence representing a sequential count of binned stored image pixel values in ascending order.

Note: One reason to include a histogram with an image is as an aid to image processing applications. For applications that use them, computations of histograms for very large images can be a significant burden on computer resources and can seriously degrade the response time to the user.

The Image Histogram is multi-valued to support multiple histograms per image. One or more regions of interest or value ranges may be separately computed. A description of the region(s) of interest and value range may be included in the Histogram Explanation (0060,3010). The Image Histogram may be related to parts or all of a specific image.

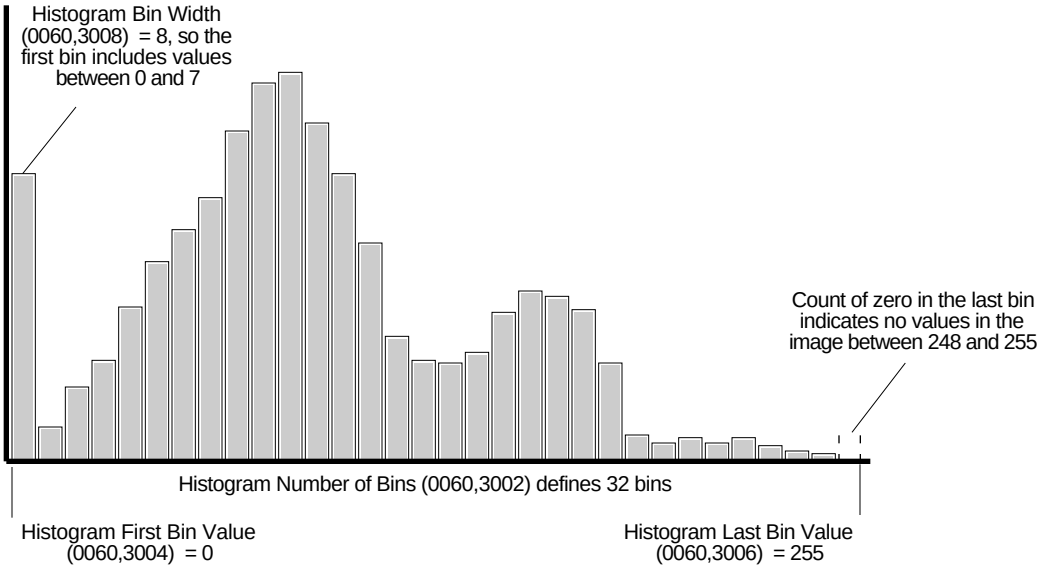
The Attributes describing the parameters of the histogram are in image pixel value space, as stored in Pixel Data (7FE0,0010), before the application of any transformation such as Rescale Slope and Intercept or Modality LUT.

The range of stored image pixel value instances is described by the Histogram First Bin Value (0060,3004) and Histogram Last Bin Value (0060,3006). All values outside of this range shall be ignored. The number of histogram bins shall be large enough to contain all of the pixels in the range from the smallest to the largest stored image pixel value in that region of the image from which the histogram has been derived (which may or may not be the whole image).

The Histogram Bin Width (0060,3008) describes how many consecutive stored image pixel values are counted as one. All bins shall be of equal width.

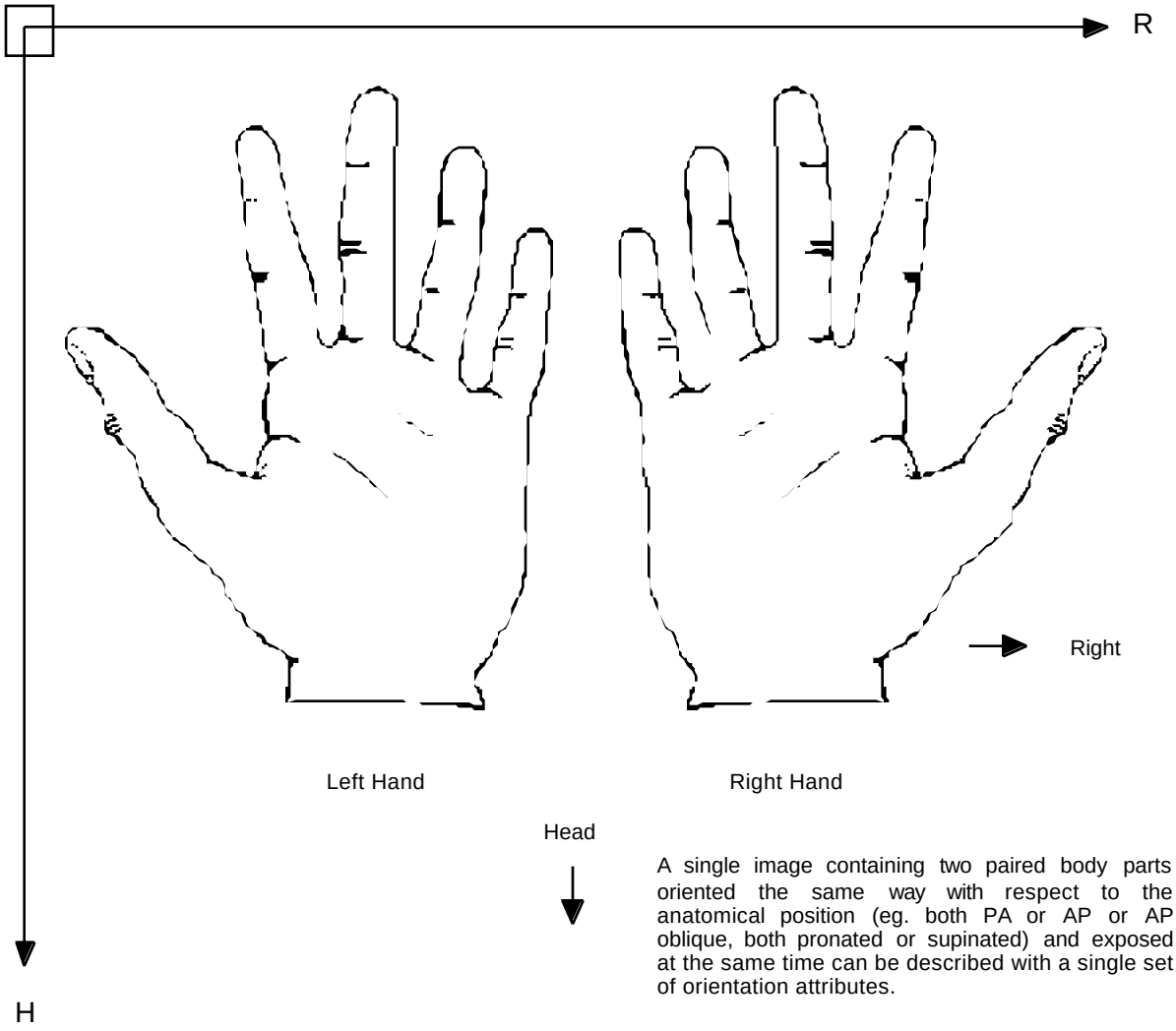
Note: For example, a Histogram Bin Width (0060,3008) of 8 means that counts of pixel values in ascending groups of 8 are added together. If Histogram First Bin Value (0060,3004) were 0, then the first bin would contain the count of pixel values in the range of 0-7, the second bin the count of pixel values in the range of 8-15, etc. If Histogram Number of Bins (0060,3002) were 32, then the last bin would contain the count of pixel values in the range of 248-255 and Histogram Last Bin Value (0060,3006) would be 255 (not 248).

This example is illustrated in the following figure, in which the vertical axis represents the count within each bin and the horizontal axis represents each bin in ascending order.

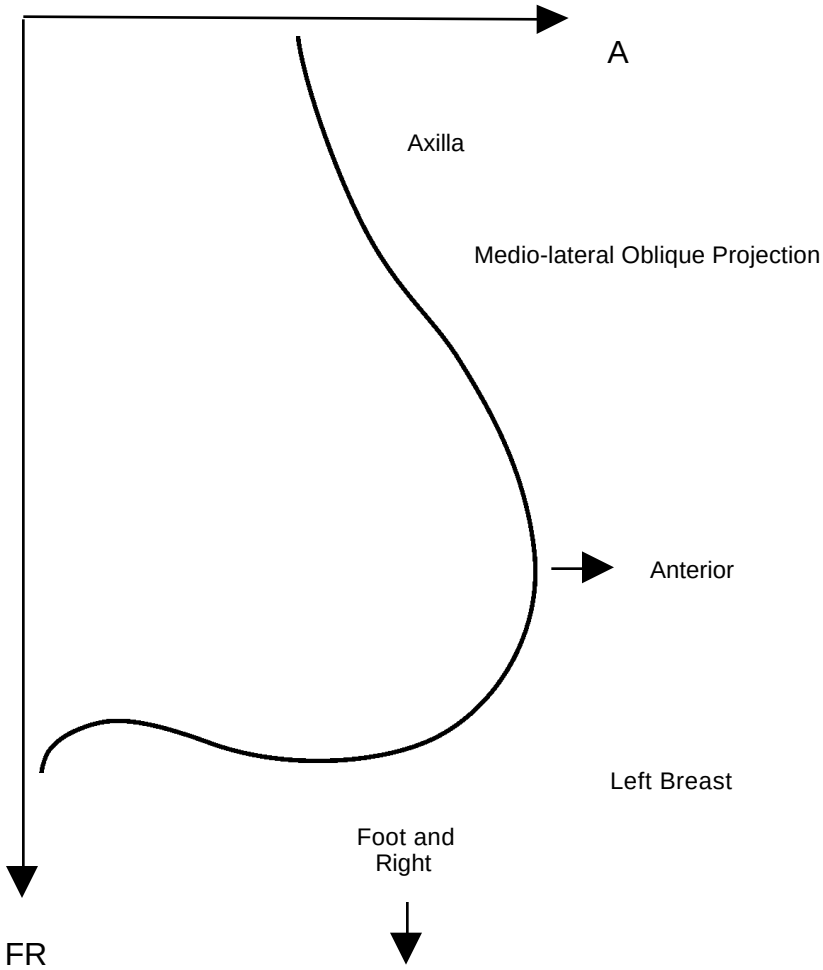


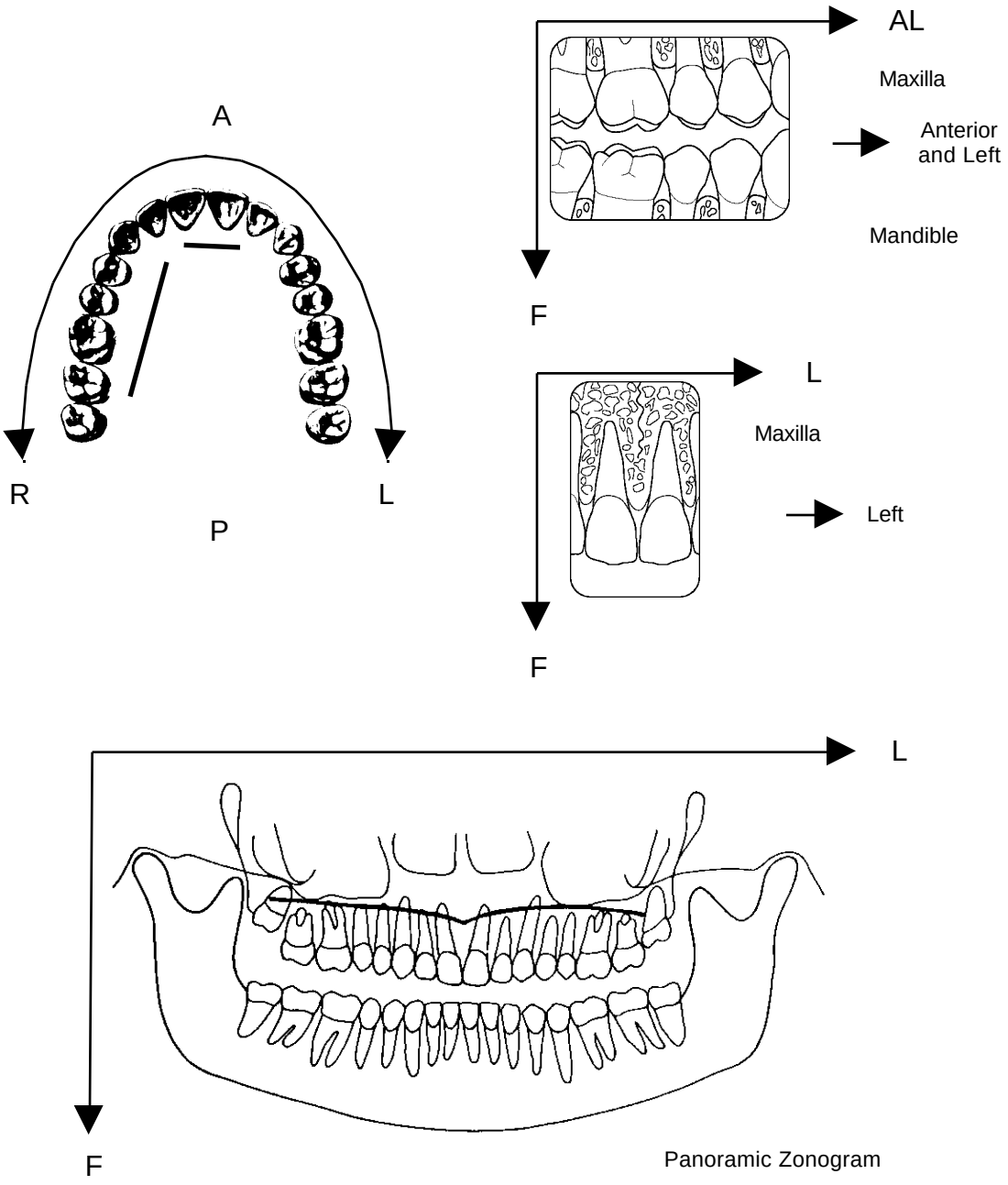
Item: Add further illustrations to Annex E to describe more varieties of image orientation for paired body parts, mammography, and dental radiography.

Annex E Explanation of patient orientation (Normative)



A single image containing two paired body parts oriented the same way with respect to the anatomical position (eg. both PA or AP or AP oblique, both pronated or supinated) and exposed at the same time can be described with a single set of orientation attributes.


A
Axilla
Medio-lateral Oblique Projection
Anterior
Left Breast
Foot and
Right
FR



Panoramic Zonogram

Changes to:

NEMA Standards Publication PS 3.4

Digital Imaging and Communications in Medicine (DICOM)
Part 4: Service Class Specifications

Item: Add new SOP Classes to PS 3.4 B.5

Also add a new column specifying the IOD from PS 3.3 used to build the SOP Class

Note that the UIDs were chosen by adding a digit to the CR SOP Class 1.2.840.10008.5.1.4.1.1.1

B.5 STANDARD SOP CLASSES

The SOP Classes in the Storage Service Class identify the Composite IODs to be stored. Table B.5-1 identifies Standard SOP Classes.

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	**DX IOD (see B.5.1.1)**
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	**DX IOD (see B.5.1.1)**
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	**Digital Mammography IOD (see B.5.1.2)**
Digital Mammography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	**Digital Mammography IOD (see B.5.1.2)**
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	**Digital Intra-oral X-Ray IOD (see B.5.1.3)**
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	**Digital Intra-oral X-Ray IOD (see B.5.1.3)**

Item: Add a new section B.5.1 to specialize the IOD for processed/unprocessed SOP Classes and specify a baseline.

B.5.1 SPECIALIZATION FOR STANDARD SOP CLASSES

B.5.1.1 Digital X-Ray Image Storage SOP Classes

The Digital X-Ray Image Storage - For Presentation SOP Class shall use the DX IOD with an Enumerated Value of FOR PRESENTATION for Presentation Intent Type (0008,0068).

The Digital X-Ray Image Storage - For Processing SOP Class shall use the DX IOD with an Enumerated Value of FOR PROCESSING for Presentation Intent Type (0008,0068).

An SCU or SCP of the Digital X-Ray Image Storage - For Processing SOP Class shall also support the Digital X-Ray Image Storage - For Presentation SOP Class.

Note: The intent of this requirement is to ensure a useful level of interoperability by avoiding the situation where an SCU might support only the Digital X-Ray Image Storage - For Processing SOP Class and an SCP only the Digital X-Ray Image Storage - For Presentation SOP Class, or vice versa. The burden is therefore to support the Digital X-Ray Image Storage - For Presentation SOP Class as a "baseline".

B.5.1.2 Digital Mammography Image Storage SOP Classes

The Digital Mammography Image Storage - For Presentation SOP Class shall use the Digital Mammography IOD with an Enumerated Value of FOR PRESENTATION for Presentation Intent Type (0008,0068).

The Digital Mammography Image Storage - For Processing SOP Class shall use the Digital Mammography IOD with an Enumerated Value of FOR PROCESSING for Presentation Intent Type (0008,0068).

An SCU or SCP of the Digital Mammography Image Storage - For Processing SOP Class shall also support the Digital Mammography Image Storage - For Presentation SOP Class.

B.5.1.3 Digital Intra-oral X-Ray Image Storage SOP Classes

The Digital Intra-oral X-Ray Image Storage - For Presentation SOP Class shall use the Digital Intra-oral X-Ray IOD with an Enumerated Value of FOR PRESENTATION for Presentation Intent Type (0008,0068).

The Digital Intra-oral X-Ray Image Storage - For Processing SOP Class shall use the Digital Intra-oral X-Ray IOD with an Enumerated Value of FOR PROCESSING for Presentation Intent Type (0008,0068).

An SCU or SCP of the Digital Intra-oral X-Ray Image Storage - For Processing SOP Class shall also support the Digital Intra-oral X-Ray Image Storage - For Presentation SOP Class.

Item: Add new SOP Classes to PS 3.4 I.4

I.4 MEDIA STORAGE STANDARD SOP CLASSES

The SOP Classes in the Media Storage Service Class identify the Composite and Normalized IODs to be stored. Table I.4-1 identifies Standard SOP Classes.

Table I.4-1
MEDIA STORAGE STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	DX IOD

Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	DX IOD
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography IOD
Digital Mammography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography IOD
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray IOD
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray IOD

Digital Imaging and Communications in Medicine

PART 6 Addendum

Digital X-Ray Data Dictionary

Section 6 : Append or amend the following entries in the table

Tag	Name	VR	VM
(0008,0068)	Presentation Intent Type	CS	1
(0018,113A)	Table Type	CS	1
(0018,1156)	Rectification Type	CS	1
(0018,1191)	Anode Target Material	CS	1
(0018,11A0)	Body Part Thickness	DS	1
(0018,11A2)	Compression Force	DS	1
(0018,1490)	Tomo Type	CS	1
(0018,1491)	Tomo Class	CS	1
(0018,1495)	Number of Tomosynthesis Source Images	IS	1
(0018,1508)	Positioner Type	CS	1
(0018,5104)	Projection Eponymous Name Code Sequence	SQ	1
(0018,7000)	Detector Conditions Nominal Flag	CS	1
(0018,7001)	Detector Temperature	DS	1
(0018,7004)	Detector Type	CS	1
(0018,7005)	Detector Configuration	CS	1
(0018,7006)	Detector Description	LT	1
(0018,7008)	Detector Mode	LT	1
(0018,700A)	Detector ID	SH	1
(0018,700C)	Date of Last Detector Calibration	DA	1
(0018,700E)	Time of Last Detector Calibration	TM	1
(0018,7010)	Exposures on Detector Since Last Calibration	IS	1

(0018,7011)	Exposures on Detector Since Manufactured	IS	1
(0018,7012)	Detector Time Since Last Exposure	DS	1
(0018,7014)	Detector Active Time	DS	1
(0018,7016)	Detector Activation Offset From Exposure	DS	1
(0018,701A)	Detector Binning	DS	2
(0018,7020)	Detector Element Physical Size	DS	2
(0018,7022)	Detector Element Spacing	DS	2
(0018,7024)	Detector Active Shape	CS	1
(0018,7026)	Detector Active Dimension(s)	DS	1-2
(0018,7028)	Detector Active Origin	DS	2
(0018,7030)	Field of View Origin	DS	2
(0018,7032)	Field of View Rotation	DS	1
(0018,7034)	Field of View Horizontal Flip	CS	1
(0018,7040)	Grid Absorbing Material	LT	1
(0018,7041)	Grid Spacing Material	LT	1
(0018,7042)	Grid Thickness	DS	1
(0018,7044)	Grid Pitch	DS	1
(0018,7046)	Grid Aspect Ratio	IS	2
(0018,7048)	Grid Period	DS	1
(0018,704C)	Grid Focal Distance	DS	1
(0018,7050)	Filter Material	LT	1-n
(0018,7052)	Filter Thickness Minimum	DS	1-n
(0018,7054)	Filter Thickness Maximum	DS	1-n
(0018,7060)	Exposure Control Mode	CS	1
(0018,7062)	Exposure Control Mode Description	LT	1
(0018,7064)	Exposure Status	CS	1
(0018,7065)	Phototimer Setting	DS	1
(0020,0062)	Image Laterality	CS	1
(0028,0300)	Quality Control Image	CS	1

(0028,0301)	Burned In Annotation	CS	1
(0028,1041)	Pixel Intensity Relationship Sign	SS	1
(0028,1300)	Implant Present	CS	1
(0028,2112)	Lossy Image Compression Ratio	DS	1-n
(0040,0306)	Distance Source to Entrance	DS	1
(0040,0307)	Distance Source to Support	DS	1
(0040,0312)	X-Ray Output	DS	1
(0040,0314)	Half Value Layer	DS	1
(0040,0316)	Organ Dose	DS	1
(0040,0318)	Organ Exposed	CS	1
(0040,0555)	Acquisition Context Sequence	SQ	1
(0040,0556)	Acquisition Context Description	ST	1
(0040,08EA)	Measurement Units Code Sequence	SQ	1
(0040,A043)	Concept-name Code Sequence	SQ	1
(0040,A121)	Date	DA	1
(0040,A122)	Time	TM	1
(0040,A123)	Person Name	PN	1
(0040,A136)	Referenced Frame Numbers	US	1-n
(0040,A160)	Text Value	UT	1
(0040,A168)	Concept Code Sequence	SQ	1
(0040,A30A)	Numeric Value	DS	1-n
(0054,0222)	View ~~**Angulation**~~ Modifier Code Sequence	SQ	1
(0060,3000)	Histogram Sequence	SQ	1
(0060,3002)	Histogram Number of Bins	US	1
(0060,3004)	Histogram First Bin Value	US or SS	1
(0060,3006)	Histogram Last Bin Value	US or SS	1
(0060,3008)	Histogram Bin Width	US	1
(0060,3010)	Histogram Explanation	LO	1
(0060,3020)	Histogram Data	UL	1-n

Annex A : append the following entries to the table

UID Name	UID Value	UID Type	Part
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SOP Class	Part 4
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	SOP Class	Part 4
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	SOP Class	Part 4
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	SOP Class	Part 4
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SOP Class	Part 4
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	SOP Class	Part 4

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