Digital Imaging and Communications in Medicine (DICOM)

Supplement 117: Enhanced PET Image Storage SOP Class

DICOM Standards Committee, Working Group 3, Nuclear Medicine

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Foreword

The DICOM WG 3 has determined that it is necessary to create a new PET object to meet the needs of state of the art PET technology that has evolved substantially since the existing PET object was standardized in 1996.

This Supplement describes the Enhanced Positron Emission Tomography Storage SOP Class, which allows the PET Image generating system to store information on systems, which perform as a PET Storage SCP.

Due to practical considerations the present PET Image IOD will not be retired, however the use of the new IOD is encouraged.

The old concept of the Standalone PET Curve is not retained as a part of this new IOD. A new work item could be to investigate a more general method for encoding time/intensity information, but this is outside the scope of this document.

It is not proposed to add new services, messaging or encoding.

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

PS 3.2	-	Conformance
PS 3.3	-	Information Object Definitions
PS 3.4	-	Service Class Specifications
PS 3.6	-	Data Dictionary
PS 3.15	-	Security and System Management Profiles
PS 3.16	-	Content Mapping Resource

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Changes to NEMA Standards Publication PS 3.2-2007

128 ## Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

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

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

UID Value	UID NAME	Category
…		
1.2.840.10008.5.1.4.1.1.130	**Enhanced PET Image Storage**	**Transfer**
…		

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Changes to NEMA Standards Publication PS 3.3-2007

144 ## Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

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Item #2: Add in Section A.1.4, Table A.1-4

148 **A.1.4 Overview of the Composite IOD Module Content**

Add the following columns to table A.1-1.

IODs Modules	**Enh. PET**
Patient	**M**
Clinical Trial Subject	**U**
General Study	**M**
Patient Study	**U**
Clinical Trial Study	**U**
General Series	**M**
Enhanced PET Series	**M**
Clinical Trial Series	**U**
Frame Of Reference	**M**
Synchronization	**C**
General Equipment	**M**
Enhanced General Equipment	**M**
Image Pixel	**M**
Acquisition Context	**M**
Multi-frame Functional Groups	**M**
Multi-frame Dimension	**M**
Cardiac Synchronization	**C**
Respiratory Synchronization	**C**
Intervention	**U**
Enhanced PET Isotope Module	**M**
Enhanced PET Acquisition	**M**
Enhanced PET Image	**M**
SOP Common	**M**

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Item #3: Add in the following new section in Annex A

A.X ENHANCED POSITRON EMISSION TOMOGRAPHY IMAGE INFORMATION OBJECT DEFINITION

A.X.1 Enhanced PET Image Information Object Definition

A.X.1.1 Enhanced PET Image IOD Description

The Enhanced Positron Emission Tomography (PET) Image Information Object Definition (IOD) specifies an image that has been created by a positron emission tomography coincidence imaging device.

A.X.1.2 Enhanced PET Image IOD Entity-Relationship Model

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

A.X.1.3 Enhanced PET Image IOD Module Table

Table A.X-1
ENHANCED PET IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Enhanced PET Series	C.8.X.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	C- Required if time synchronization was applied.
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	Image Pixel	C.7.6.3	M
	Intervention	C.7.6.13	U
	Acquisition Context	C.7.6.14	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	M
	Cardiac Synchronization	C.7.6.18.1	C – Required if cardiac synchronization was applied.
	Respiratory Synchronization	C.7.6.18.2	C – Required if respiratory synchronization was applied.

	Enhanced PET Isotope Module	C.8.X.4	M
	Enhanced PET Acquisition	C.8.X.2	M
	Enhanced PET Image	C.8.X.3	M
	SOP Common	C.12.1	M

A.X.1.3.1 Enhanced PET Image IOD Content Constraints

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

The General Image Module, Overlay Plane Module, VOI LUT Module, Supplemental Palette Color Lookup Table Module, and the Softcopy Presentation LUT Module shall not be used in a Standard Extended SOP Class of the Enhanced PET Image.

Notes: 1.In order to annotate images, whether during acquisition or subsequently, SOP Instances of the Grayscale Softcopy Presentation State Storage, Color Softcopy Presentation State Storage, or the Structured Report Storage SOP Classes that reference the image SOP Instance, may be used.

2. No standard mechanism is provided for inclusion of annotations within the image SOP Instance itself, and implementers are discouraged from using private extensions to circumvent this restriction.

3. The Blending Softcopy Presentation State and Spatial Registration SOP Classes can be used to relate this SOP Instance to related image, registration, or fiducial SOP Instances.

4. If contrast was administered during a CT acquisition used for attenuation correction, this information can be obtained from the CT SOP Instances and is not encoded in the PET SOP Instances.

A.X.1.4 Enhanced PET Image Functional Group Macros

Table A.X-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Enhanced PET Image IOD.

Table A.X-2
ENHANCED PET IMAGE FUNCTIONAL GROUP MACROS

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Frame Content	C.7.6.16.2.2	M – May not be used as a Shared Functional Group.
Plane Position	C.7.6.16.2.3	M
Plane Orientation	C.7.6.16.2.4	M
Referenced Image	C.7.6.16.2.5	C – Required if the image or frame has been planned on another image or frame, may be present otherwise.
Derivation Image	C.7.6.16.2.6	C – Required if the image or frame has been derived from another SOP Instance.
Frame Anatomy	C.7.6.16.2.8	M

Pixel Value Transformation	C.7.6.16.2.9	M
Frame VOI LUT	C.7.6.16.2.10	M
Real World Value Mapping	C.7.6.16.2.11	M - The Defined Context ID for Measurement Units Code Sequence shall be CID 84.
Cardiac Trigger	C.7.6.16.2.7	C – Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE. May be present otherwise.
Respiratory Trigger	C.7.6.16.2.17	C – Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE. May be present otherwise.
Radiopharmaceutical Usage	C.7.6.16.2.X1	M
Patient Physiological State	C.7.6.16.2.X2	C – Required for cardiac rest and stress images.
PET Frame Type	C.8.X.5.1	M
PET Frame Acquisition	C.8.X.5.2	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL. May be present otherwise.
PET Detector Motion Details	C.8.X.5.3	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL and Type of Detector Motion (0054,0202) is not equal to STATIONARY.
PET Position Macro	C.8.X.5.4	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL. May be present otherwise.
PET Frame Correction Factors	C.8.X.5.5	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL. May be present otherwise.
PET Reconstruction	C.8.X.5.6	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL. May be present otherwise.
PET Table Dynamics	C.8.X.5.7	C – Required if Image Type (0008,0008) Value 1 equals ORIGINAL and Table Motion (0018,1134) is equal to DYNAMIC.

Item #4: Modify the Frame Content Macro, section C.7.6.16.2.2 as shown.

Table C.7.6.16-3
FRAME CONTENT MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Frame Content Sequence	(0020,9111)	1	Identifies general characteristics of this frame. Only a single Item shall be permitted in this sequence.
…			
>Temporal Position Index	(0020,9128)	~~3~~**1C**	Ordinal number (starting from 1) of the frame in the set of frames with different temporal positions. **Required if the value of SOP Class UID (0008,0016) equals "1.2.840.10008.5.1.4.1.1.130". May be present otherwise. See C.7.6.16.2.2.X1.**
>Stack ID	(0020,9056)	~~3~~**1C**	Identification of a group of frames, with different positions and/or orientations that belong together, within a dimension organization. See C.7.6.16.2.2.4 for further explanation. **Required if the value of SOP Class UID (0008,0016) equals "1.2.840.10008.5.1.4.1.1.130". May be present otherwise. See C.7.6.16.2.2.X2.**
…			

Item #5: Add to Section C.7.6.16.2.2.3

C.7.6.16.2.2.3 Frame Acquisition Duration

The Frame Acquisition Duration (0018,9220) is used to indicate the duration of the acquisition related to this frame.

For SOP Instances or Concatenations of the Enhanced PET Image Storage SOP Class (1.2.840.10008.5.1.4.1.1.130) the Frame Acquisition Duration is the sum of the portion of each cycle during which data contributing to this frame has actually been acquired for all of the cardiac or respiratory cycles of a gated acquisition (i.e. if Cardiac Synchronization Technique (0018,9037) equals other than NONE, and/or if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE).

Item #6: Add the following to section C.7.6.16.2.2.

C.7.6.16.2.2.X1 Temporal Position Index and Stack ID in PET images

For PET Dynamic images, i.e. images in which Image Type (0008,0008) Value 3 is DYNAMIC, Temporal Position Index is used to distinguish between the multiple acquisitions of the same anatomical area. Similarly, the frames that result from one acquisition over the anatomic area shall be contained in one stack. Thus, for Dynamic images, Temporal Position Index (0020,9128), Stack ID (0020,9056), and In-Stack Position Index (0020,9057) shall be used as three of the dimensions of the image, in that order.

Figure C.7.6.16-X describes the usage for a PET dynamic image.

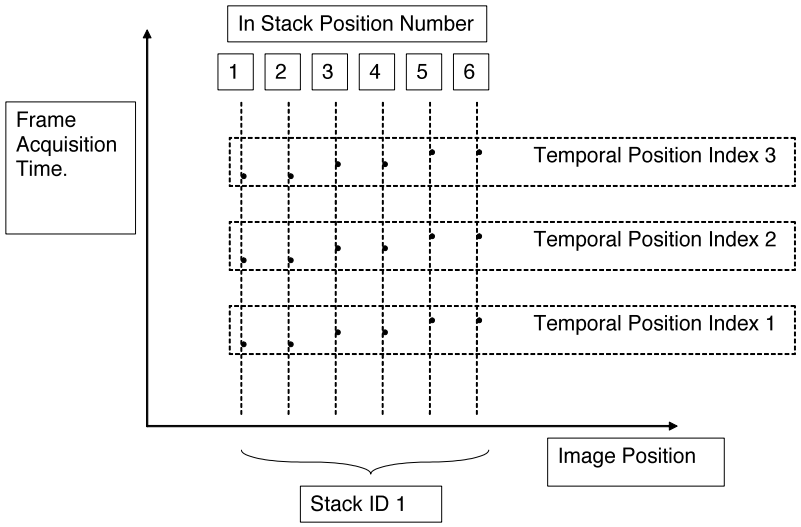

Figure C.7.6.16-X
PET dynamic frame organization

C.7.6.16.2.2.X2 Stack ID usage in PET static, whole body and gated images

For static and whole body PET images, a single Stack ID is used to group all of the transverse slices over the entire imaged volume together. That is, a single Stack ID is used no matter how many acquisition bed positions are involved. In-Stack Position is then used as the spatial dimension index. When rectangular sagittal, coronal or oblique images are created from these, a single Stack ID is again used.

Similarly, in cardiac or respiratory gated images, the entire volume is again identified by a single Stack ID, and In-Stack Position is the spatial dimension index. The time dimension is indicated by one of the timing attributes, such as trigger delay time or respiratory phase.

Item #7: Modify the Macro in Table C.7.6.16.10 in Section C.7.6.16.2.9.

Table C.7.6.16-10
PIXEL VALUE TRANSFORMATION MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Pixel Value Transformation Sequence	(0028,9145)	1	Contains the attributes involved in the transformation of stored pixel values. Only a single Item shall be permitted in this sequence.
>Rescale Intercept	(0028,1052)	1	The value b in relationship between stored values (SV) and the output units. Output units = m*SV + b.
>Rescale Slope	(0028,1053)	1	m in the equation specified by Rescale Intercept (0028,1052).
>Rescale Type	(0028,1054)	1	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). See C.11.1.1.2 for further explanation. Enumerated Value: US = Unspecified if Modality (0008,0060) equals MR **or PT**.

Note: Window Center (0028,1050) and Window Width (0028,1051) are applied after Rescale Slope (0028,1053) and Rescale Intercept (0028,1054) have been applied to Stored Pixel Values, see C.11.2.1.2.

Item #8: Add new sections to C.7.6.16.2

C.7.6.16.2.X1 Radiopharmaceutical Usage Macro

Table C.7.6.16.2-X1 specifies the attributes of the Radiopharmaceutical Usage Functional Group macro.

Table C.7.6.16.2-X1
RADIOPHARMACEUTICAL USAGE MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Radiopharmaceutical Usage Sequence	(0018,9737)	1	One or more Items shall be present in this sequence.
>Radiopharmaceutical Agent Number	(0018,9729)	1	Identifying number corresponding to the radiopharmaceutical described in the Enhanced PET Isotope Module.

240 **C.7.6.16.2.X2 Patient Physiological State Macro**

Table C.7.6.16.2-X2 specifies the attributes of the Patient Physiological State Functional Group
242 Macro, which describes the physiological state of the patient.

Table C.7.6.16.2-X2
244 **PATIENT PHYSIOLOGICAL STATE MACRO**

Attribute Name	Tag	Type	Attribute Description
Patient Physiological State Sequence	(0018,9771)	1	Contains the attributes describing the physiological sate of the patient for this frame. Only a single Item shall be permitted in this sequence.
>Patient Physiological State Code Sequence	(0018,9772)	1	The physiological state of the patient. Only a single Item shall be permitted in this sequence.
>>Include 'Code Sequence Macro' Table 8.8-1			*Defined Context ID is 3101*

246 ***Item #9: Add the following terms to Table C.8-129 in section C.8.16.1.3***

Table C.8-129
248 **IMAGE TYPE AND FRAME TYPE VALUE 3 COMMON**

Defined Term Name	Defined Term Description
ANGIO	Collected for the purpose of angiography
CARDIAC	Images of the heart
CARDIAC_GATED	Cardiac gated images, other than of the heart
CARDRESP_GATED	Cardiac and respiratory gated images
DYNAMIC	**An image in which the same anatomical volume is imaged at multiple times in order to capture images of a non-cyclic, time varying event. For example, imaging of the uptake of a tracer or contrast in a specific organ over time.** **Note: This is different from gating techniques, in which the same anatomical volume is imaged during some portion of a cyclic event , e.g. inspiration or R-R Interval.**
FLUOROSCOPY	Real-time collection of single slices (e.g. CT or MR Fluoroscopy)
LOCALIZER	Collected for the purpose of planning other images.
MOTION	Collected for looking at body motion
PERFUSION	Collected for the purposes of perfusion calculations.
PRE_CONTRAST	Collected before contrast was administered
POST_CONTRAST	Collected during or after contrast was administered

RESP_GATED	Respiratory gated images
REST	Cardiac rest image set
STATIC	**A group of frames at varying spatial locations acquired at the same time.**
STRESS	Cardiac stress image set
VOLUME	Set of frames that define a regularly sampled volume
NON_PARALLEL	Set of frames that are not parallel
PARALLEL	Set of frames that are parallel but do not constitute a regularly sampled volume
WHOLE_BODY	**A group of frames of the whole body; the frames may be acquired at various times (as distinct from STATIC).**

Item #10: Add new sections C.8.X for Enhanced PET IOD

C.8.X Enhanced PET Modules

This section describes the specific modules for the Enhanced PET Image IOD.

C.8.X.1 Enhanced PET Series Module

The Enhanced PET IODs use the General Series module described in section C.7.3.1, specialized by the Enhanced PET 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 PET device.

Table C.8-X1 specifies the Attributes that identify and describe general information about the Enhanced PET Series.

Table C.8-X1
ENHANCED PET 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: PT See section C.7.3.1.1.1 for further explanation.
Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related (e.g. a Modality or General-Purpose Performed Procedure Step SOP Instance). The Sequence shall have one Item. Required if the Modality Performed Procedure Step SOP Class or General Purpose Performed Procedure Step SOP Class is supported.
>Include 'SOP Instance Reference Macro' Table10-11			

Related Series Sequence	(0008,1250)	1C	Identifying the series that was used for attenuation purposes. See C.7.3.1 Required if another series was used to perform attenuation correction. Zero or more Items may be present.
>Study Instance UID	(0020,000D)	1	Instance UID of Study to which the related Series belongs
>Series Instance UID	(0020,000E)	1	Instance UID of Related Series
>Purpose of Reference Code Sequence	(0040,A170)	2	Describes the purpose for which the reference is made. Zero or more Items may be present. When absent, implies that the reason for the reference is unknown.
>>Include Code Sequence Macro Table 8.8-1			*Defined Context ID is 7210.*

262 **C.8.X.2 Enhanced PET Acquisition Module**

Table C.8-X2 specifies the Attributes that describe PET Acquisitions.

264 **Table C.8-X2**
ENHANCED PET ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Acquisition Start Condition	(0018,0073)	1C	Description of how the data collection was started. See C.8.X.2.1.1 for Defined Terms. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Start Density Threshold	(0018,9715)	1C	The count density that triggered the start of the acquisition, in counts/sec. Required if Acquisition Start Condition (0018,0073) equals DENS.
Start Relative Density Difference Threshold	(0018,9716)	1C	The relative count density that triggered the start of the acquisition, in counts/sec. Required if Acquisition Start Condition (0018,0073) equals RDD.
Start Cardiac Trigger Count Threshold	(0018,9717)	1C	The number of cardiac triggers that occurred before starting the acquisition. Required if Acquisition Start Condition (0018,0073) equals CARD_TRIG.
Start Respiratory Trigger Count Threshold	(0018,9718)	1C	The number of respiratory triggers that occurred before starting the acquisition. Required if AcquisitionStart Condition (0018,0073) equals RESP_TRIG.

Acquisition Termination Condition	(0018,0071)	1C	Description of how the data collection for the series was stopped. See C.8.X.2.1.2 for Defined Terms. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Termination Counts Threshold	(0018,9719)	1C	The count value that triggered the termination of the acquisition. Required if Acquisition Termination Condition (0018,0071) equals CNTS.
Termination Density Threshold	(0018,9720)	1C	The count density that triggered the termination of the acquisition, in counts/sec. Required if Acquisition Termination Condition (0018,0071) equals DENS.
Termination Relative Density Threshold	(0018,9721)	1C	The count relative density that triggered the termination of the acquisition, in counts/sec. Required if Acquisition Termination Condition (0018,0071) equals RDD.
Termination Time Threshold	(0018,9722)	1C	The time duration after which the acquisition was terminated, in sec. Required if Acquisition Termination Condition (0018,0071) equals TIME
Termination Cardiac Trigger Count Threshold	(0018,9723)	1C	The number of cardiac triggers that triggered the termination of the acquisition. Required if Acquisition Termination Condition (0018,0071) equals CARD_TRIG
Termination Respiratory Trigger Count Threshold	(0018,9724)	1C	The number of respiratory triggers that triggered the termination of the acquisition. Required if Acquisition Termination Condition (0018,0071) equals RESP_TRIG

Type of Detector Motion	(0054,0202)	1C	Describes the type of detector motion during acquisition. Defined Terms: STATIONARY = No motion STEP AND SHOOT = Interrupted motion, acquire only while detectors are stationary CONTINUOUS = Gantry motion and acquisition are simultaneous and continuous WOBBLE = wobble motion CLAMSHELL = clamshell motion Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Detector Geometry	(0018,9725)	1C	Physical arrangement of the detectors in the acquisition system. The radiation entrance surface of a detector may be curved or flat. A curved surface is referred to as cylindrical. Detectors may simultaneously subtend all possible transverse angles from the center of the field of view. Detectors that do not are referred to as partial. Defined Terms: CYLINDRICAL_RING CYL_RING_PARTIAL MULTIPLE_PLANAR MUL_PLAN_PARTIAL Required if Image Type (0008,0008) Value 1 is ORIGINAL and Type of Detector Motion (0054,0202) equals STATIONARY. May be present otherwise, if Image Type (0008,0008) Value 1 is DERIVED and Type of Detector Motion (0054,0202) equals STATIONARY.
Transverse Detector Separation	(0018,9726)	1C	Distance between opposing detectors, in mm. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.

Axial Detector Dimension	(0018,9727)	1C	Axial detector size in mm. Size of the detector along the table axis. Required if Image Type (0008,0008) Value 1 is ORIGINAL May be present otherwise.
Collimator Type	(0018,1181)	1C	Collimator Type. Defined Terms: NONE = no collimator RING = transverse septa Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Coincidence Window Width	(0054,1210)	1C	The width of the coincidence-timing window, in nanoseconds. The maximum time difference between two single events in two opposing detectors that will be accepted as a coincidence event. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Energy Window Range Sequence	(0054,0013)	1C	Sequence of Items that describes the energy windows used for this Image. This sequence may contain one or more items. See C.8.X.2.1.3 for explanation. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
>Energy Window Lower Limit	(0054,0014)	1	The lower limit of the energy window, in KeV.
>Energy Window Upper Limit	(0054,0015)	1	The upper limit of the energy window, in KeV.
Table Motion	(0018,1134)	1	Enumerated Values: STATIC = Table is stationary during data acquisition. DYNAMIC = Table is moving during data acquisition.
Time of Flight Information Used	(0018,9755)	1	Specifies whether or not Time-of-Flight information was used in creation of the image. Enumerated Values: TRUE FALSE
View Code Sequence	(0054,0220)	1	Sequence that describes the projection of the anatomic region of interest. Only a single Item shall be permitted in this sequence.

>Include 'Code Sequence Macro' Table 8.8-1		*Baseline Context ID is 26.*	
>View Modifier Code Sequence	(0054,0222)	2C	View Modifier. Required if needed to fully specify the View. Only a single Item shall be permitted in this sequence.
>>Include 'Code Sequence Macro' Table 8.8-1		*Baseline Context ID is 23.*	
Slice Progression Direction	**(0054,0500)**	**1C**	**Describes the anatomical direction that a set of slices, identified by the same Stack ID (0020,9056), are progressing, as the slices are considered in order by In Stack Position Number (0020,9057). Meaningful only for cardiac images.** **Enumerated are:** **APEX_TO_BASE** **BASE_TO_APEX** **ANT_TO_INF = Anterior to Inferior** **INF_TO_ANT = Inferior to Anterior** **SEPTUM_TO_WALL = Septum to Lateral Wall** **WALL_TO_SEPTUM = Lateral Wall to Septum** **Required if View Code Sequence (0054,0220) equals (G-A186, SNM3,"Short Axis").** **May be present otherwise.**

C.8.X.2.1 Enhanced PET Acquisition Module Attribute Descriptions

C.8.X.2.1.1 Acquisition Start Condition

Acquisition Start Condition (0018,0073) is the method of starting acquisition data collection. The Defined Terms and definitions are:

DENS = preset count density (counts/sec) was reached
RDD = preset relative count density difference (change in counts/sec) was reached
MANU = acquisition was started manually
AUTO = start automatically, when ready
CARD_TRIG = preset number of cardiac triggers was reached
RESP_TRIG = preset number of respiratory triggers was reached.

C.8.X.2.1.2 Acquisition Termination Condition

Acquisition Termination Condition (0018,0071) is the method of acquisition termination which has actually applied to the data collection. The Defined Terms and definitions are:

CNTS = preset counts was reached.
DENS = preset count density (counts/sec) was reached

RDD = preset relative count density difference (change in counts/sec) was reached
MANU = acquisition was terminated manually
OVFL = data overflow occurred.
TIME = preset time limit was reached
CARD_TRIG = preset number of cardiac triggers was reached
RESP_TRIG = preset number of respiratory triggers was reached

C.8.X.2.1.3 Energy Window Range Sequence

Multiple energy windows are allowed in order to allow coincidence events based on additional Energy Windows (e.g. Compton events scattered in the detector). All energy windows are assumed to contribute to all frames in this image.

C.8.X.3 Enhanced PET Image Module

Table C.8-X3 specifies the attributes of the Enhanced PET Image Module.

Table C.8-X3
ENHANCED PET IMAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image characteristics. See sections C.8.X.3.1.1.
Include 'Common CT/MR Image Description Macro' Table C.8-131			
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time that resulted in this image, which may include multiple bed positions. Note: This number is not required to be unique across SOP Instances in a series. See also the description of the Referenced Raw Data Sequence (0008,9121).
Acquisition Datetime	(0008,002A)	1C	The date and time that the acquisition of data started. Notes: 1. The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800) . 2. See C.7.6.16.2.2.1 for an overview of all acquisition related timing attributes. Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL, may be present otherwise.
Acquisition Duration	(0018,9073)	1C	The time in seconds needed to complete the acquisition of data. See C.7.6.16.2.2.1 for further explanation. Required if Image Type (0008,0008) Value 1 of this frame is ORIGINAL, may be present otherwise.

Counts Source	(0054,1002)	1	The primary source of counts. Enumerated Values: EMISSION TRANSMISSION
Decay Corrected	(0018,9758)	1	Decay (DECY) correction has been applied to image. Enumerate Values: YES NO
Attenuation Corrected	(0018,9759)	1	Attenuation (ATTN) correction has been applied to image. Enumerate Values: YES NO
Scatter Corrected	(0018,9760)	1	Scatter (SCAT) correction has been applied to image. Enumerate Values: YES NO
Dead Time Corrected	(0018,9761)	1	Dead time (DTIM) correction has been applied to image. Enumerate Values: YES NO
Gantry Motion Corrected	(0018,9762)	1	Gantry motion (MOTN) correction has been applied to image. Enumerate Values: YES NO
Patient Motion Corrected	(0018,9763)	1	Patient motion (PMOT) correction has been applied to image. Enumerate Values: YES NO
Count Loss Normalization Corrected	(0018,9764)	1	Count loss (CLN) normalization correction has been applied to image. Enumerate Values: YES NO
Randoms Corrected	(0018,9765)	1	Randoms (RAN) correction has been applied to image. Enumerate Values: YES NO
Non-uniform Radial Sampling Corrected	(0018,9766)	1	Non-uniform radial sampling (RADL) correction has been applied to image. Enumerate Values: YES NO

Sensitivity Calibrated	(0018,9767)	1	Image is sensitivity calibrated using a dose calibrator (DCAL). Enumerate Values: YES NO
Detector Normalization Correction	(0018,9768)	1	Detector normalization (NORM) correction has been applied to image. Enumerate Values: YES NO
Randoms Correction Method	(0054,1100)	1C	Type of randoms correction processing. Defined terms: DLYD = delayed event subtraction SING = singles estimation PDDL = Processed Delays, which is a correction based on a processed (filtered) version of the data acquired from the delayed coincidence channel. Required if Randoms Corrected (0018,9765) includes RAN.
Attenuation Correction Source	(0018,9738)	1C	Contains the source of the attenuation map information used for attenuation correction. See C.8.X.3.1.2 Required if Attenuation Corrected (0018,9759) equals YES.
Attenuation Correction Temporal Relationship	(0018,9770)	1C	Contains the temporal relationship between the attenuation correction source image and the PET image data. See C.8.X.3.1.3 Required if Attenuation Corrected (0018,9759) equals YES.
Scatter Correction Method	(0054,1105)	1C	A textual description of the scatter correction processing. e.g. convolution-subtraction, dual energy window, model-based, use of attenuation data. Required if Scatter Corrected (0018,9760) equals YES.
Decay Correction DateTime	(0018,9701)	1C	The date and time to which all frames in this Image were decay corrected. Required if Decay Corrected (0018,9758) equals YES.

Referenced Raw Data Sequence	(0008,9121)	3	A sequence that identifies the set of Raw Data SOP Class/Instance pairs of the Raw data that were used to derive this Image. One or more Items may be included in this Sequence. Note: The items of in this sequence may identify raw data that has not been stored or encoded as a DICOM object. This allows recognition that images and spectra in different instances have been reconstructed from the same raw data. For such items the SOP Class UID would be "1.2.840.10008.5.1.4.1.1.20" (Raw Data SOP Class) and the SOP Instance UID would be any appropriate UID.
>Include 'Image SOP Instance Reference Macro' Table 10-3			
Referenced Waveform Sequence	(0008,113A)	3	References to waveforms acquired in conjunction with this image. These Waveforms may or may not be temporally synchronized with this image. One or more Items may be included in this sequence.
>Include 'SOP Instance Reference Macro' Table C.17-3			*Defined Context ID is 7004.*
Referenced Image Evidence Sequence	(0008,9092)	1C	Full set of Composite SOP Instances referring to image SOP Instances inside the frames of this Enhanced PET Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items may be included in this sequence. Required if the Referenced Image Sequence (0008,1140) is present.
>Include 'SOP Instance Reference Macro' Table C.17-3			
Source Image Evidence Sequence	(0008,9154)	1C	Full set of Composite SOP Instances used as source image SOP Instances inside the frames of this Enhanced PET Image SOP Instance. See C.8.13.2.1.2 for further explanation. One or more Items may be included in this sequence. Required if the Source Image Sequence (0008,2112) is present.
>Include 'SOP Instance Reference Macro' Table C.17-3			

Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. This value shall be 1.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. Enumerated Value: MONOCHROME2. See C.7.6.3.1.2 for definition of this term.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. This value shall be 16.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. This value shall be 16.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101).
Content Qualification	(0018,9004)	1	Content Qualification Indicator Enumerated Values: PRODUCT RESEARCH SERVICE See C.8.13.2.1.1 for further explanation.
Image Comments	(0020,4000)	3	User-defined comments about the image
Burned in Annotation	(0028,0301)	1	Indicates that the image does not contain burned in annotations. Enumerated Values: NO This means that images that contain this Module shall not contain burned in annotations.
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	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. Note: For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. Required if Lossy Image Compression (0028,2110) equals 01.
Lossy Image Compression Method	(0028,2114)	1C	A label for the lossy compression method(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multi-valued if successive lossy compression steps have been applied; the value order shall correspond to the values of the Lossy Compression Ratio (0028,2112). Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111). Required if Lossy Image Compression (0028,2110) equals 01.
Presentation LUT Shape	(2050,0020)	1	Specifies an identity transformation for the Presentation LUT, 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.
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image.
>Include ' Image Pixel Macro' Table C.7-11b			See C.7.6.1.1.6 for further explanation.

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C.8.X.3.1 Enhanced PET Image Description Attribute Description

300 #### C.8.X.3.1.1 Image Type and Frame Type

The Image Type Attribute (0008,0008) and Frame Type (0008,9007) identifies important image
302 characteristics in a multiple valued data element. In addition to the requirements specified in C.8.16.1 Image Type and Frame Type, the following additional requirements and Defined Terms
304 are specified:

C.8.X.3.1.1.1 Pixel Data Characteristics

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

C.8.X.3.1.1.2 Patient Examination Characteristics

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

C.8.X.3.1.1.3 Image Flavor

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

C.8.X.3.1.1.4 Derived Pixel Contrast

Value 4 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.4. No additional requirements or Defined Terms.

C.8.X.3.1.2 Attenuation Correction Source

The attribute Attenuation Correction Source (0018,9738) contains the source of the attenuation map information used for attenuation correction.

Defined Terms:

CT	
MR	
POSITRON SOURCE	
SINGLE PHOTON	
CALCULATED	Emission data is used to calculate the correction map.

C.8.X.3.1.3 Attenuation Correction Temporal Relationship

The attribute Attenuation Correction Temporal Relationship (0018,9770)specifies the temporal relationship between the attenuation correction source image and the PET image data.

Defined Terms:

CONCURRENT	The attenuation correction source image is acquired at approximately the same time and with the patient in the same body position as the PET image. For example, as acquired on a hybrid scanner.
SEPARATE	The attenuation correction source image is acquired at a different time, on a different system, or the patient has been moved significantly enough to cause soft tissue movement. For example, an attenuation correction source image acquired on a separate CT scanner, so that the patient must move from one bed to another.
SIMULTANEOUS	The attenuation correction source image is acquired at the same time and with the patient in the same body position as the PET image.

340 **C.8.X.4 Enhanced PET Isotope Module**

Table C.8-X9 contains IOD Attributes that describe a PET Isotope.

342 **Table C.8-X9**
ENHANCED PET ISOTOPE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Radiopharmaceutical Information Sequence	(0054,0016)	1	Sequence of Items that describe isotope information. This sequence may contain one or more items.
>Radiopharmaceutical Agent Number	(0018,9729)	1	Identifying number, unique within this SOP Instance, of the agent administered. Used to reference this particular agent from the Radiopharmaceutical Functional Group Macro. The number shall be 1 for the first item and increase by 1 for each subsequent Item.
>Radionuclide Code Sequence	(0054,0300)	1	Sequence that identifies the radionuclide. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' Table 8.8-1		*Baseline Context ID is 4020*	
>Administration Route Code Sequence	(0054,0302)	1	Sequence that identifies the administration route of the radiopharmaceutical. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' Table 8.8-1		*Baseline Context ID is 11*	
>Radiopharmaceutical Volume	(0018,1071)	3	Volume of administered radiopharmaceutical in cubic cm.
>Radiopharmaceutical Start Datetime	(0018,1078)	1	Time of start of administration. The actual time of radiopharmaceutical administration to the patient for imaging purposes.
>Radiopharmaceutical Stop Datetime	(0018,1079)	3	Time of end of administration. The actual ending time of radiopharmaceutical administration to the patient for imaging purposes.
>Radionuclide Total Dose	(0018,1074)	2	The radiopharmaceutical dose administered to the patient measured in MegaBecquerels (MBq) at the Radiopharmaceutical Start Datetime (0018,1078).
>Radionuclide Half Life	(0018,1075)	1	The radionuclide half life, in seconds, that was used in the correction of this image.
>Radionuclide Positron Fraction	(0018,1076)	1	The radionuclide positron fraction (fraction of decays that are by positron emission) that was used in the correction of this image.

>Radiopharmaceutical Specific Activity	(0018,1077)	3	The activity per unit mass of the radiopharmaceutical, in Bq/micromole, at the Radiopharmaceutical Start Datetime (0018,1078).
>Radiopharmaceutical Code Sequence	(0054,0304)	1	Sequence that identifies the radiopharmaceutical. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' Table 8.8-1		*Baseline Context ID is 4021*	

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C.8.X.5 Enhanced PET Image Functional Group Macros

346 The following sections contain Functional Group macros specific to the Enhanced PET Image IOD.

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

354 #### C.8.X.5.1 PET Frame Type Macro

Table C.8-X10 specifies the attributes of the PET Frame Type Functional Group macro.

356 **Table C.8-X10**
PET FRAME TYPE MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
PET Frame Type Sequence	(0018,9751)	1	A sequence that describes general characteristics of this frame. Only a single Item shall be permitted in this sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed. See C.8.16.1 and C.8.X.3.1.
>Include 'Common CT/MR Image Description Macro' Table C.8-131			

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C.8.X.5.2 PET Frame Acquisition Macro

360 Table C.8-X11 specifies the attributes of the PET Frame Acquisition Functional Group macro.

Table C.8-X11
362 **PET FRAME ACQUISITION MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
PET Frame Acquisition Sequence	(0018,9732)	1	Contains the attributes defining the PET acquisition mode. Only a single Item shall be permitted in this sequence.
>Table Height	(0018,1130)	1	The distance in mm from the top of the patient table to the data collection center . The distance is positive when the table is below the data collection center.
>Gantry/Detector Tilt	(0018,1120)	1	Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations. Zero degrees means the gantry is not tilted, negative degrees are when the top of the gantry is tilted away from where the table enters the gantry.
>Gantry/Detector Slew	(0018,1121)	1	Nominal angle of slew in degrees of the gantry. Not intended for mathematical computations. Zero degrees means the gantry is no slewed. Positive slew is moving the gantry on the patient's left toward the patient's superior, when the patient is supine.
>Data Collection Diameter	(0018,0090)	1	The diameter in mm of the region over which data were collected. See C.8.X.5.4.1.

364 C.8.X.5.3 PET Detector Motion Details Macro

Table C.8-X12 specifies the attributes of the PET Detector Motion Details Functional Group
366 macro.

Table C.8-X12
368 **PET DETECTOR MOTION DETAILS MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
PET Detector Motion Details Sequence	(0018,9733)	1	Contains the attributes defining the details of the motion of the Detector. Only a single Item shall be permitted in this sequence.

>Rotation Direction	(0018,1140)	1	Direction of rotation of the detector about the gantry, as viewed while facing the gantry where the table enters the gantry. Enumerated Values: CW = clockwise CC = counter clockwise
>Revolution Time	(0018,9305)	1	The time in seconds of a complete revolution of the detector around the gantry orbit.

370 **C.8.X.5.4 PET Position Macro**

Table C.8-X14 specifies the attributes of the PET Position Functional Group macro.

372 **Table C.8-X14**
PET POSITION MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
PET Position Sequence	(0018,9735)	1	Contains the attributes defining the PET geometry. Only a single Item shall be permitted in this sequence.
>Table Position	(0018,9327)	1C	Relative longitudinal position of acquisition location of this frame in mm from an implementation specific reference point. Shall be relative to the same reference point for all frames in this SOP Instance, but may be different from the reference point in other SOP Instances. Positions as the table moves into the gantry viewed from the front are more negative. Notes: 1. For contiguous slices reconstructed from multiple detectors one would expect different values for adjacent slices. 2. Lateral positioning or tilting or swiveling are not described. Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL. May be present otherwise.
>Data Collection Center (Patient)	(0018,9313)	1C	The x, y, and z coordinates (in the patient coordinate system) in mm of the center of the region in which data were collected. See C.8.X.5.4.1. Required if Frame Type (0008,9007) Value 1 equals ORIGINAL. May be present otherwise.

>Reconstruction Target Center (Patient)	(0018,9318)	1C	The x, y, and z coordinates (in the patient coordinate system) of the reconstruction center target point as used for reconstruction in mm. See C.8.X.5.4.1. Note: If the reconstructed image is not magnified or panned the value corresponds with the Data Collection Center (0018,9313) attribute. Required if Frame Type (0008,9007) Value 1 equals ORIGINAL. May be present otherwise.

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C.8.X.5.4.1 Relationships Between PET Geometric Attributes (Informative)

In Figure C.8.X-1 the relationship of the Geometric Attributes within the PET Geometry and PET Reconstruction functional groups is shown. The figure, viewed from the front of the gantry (where the table enters the gantry), is informative only and is not meant to represent a standardization of an equipment-based frame of reference.

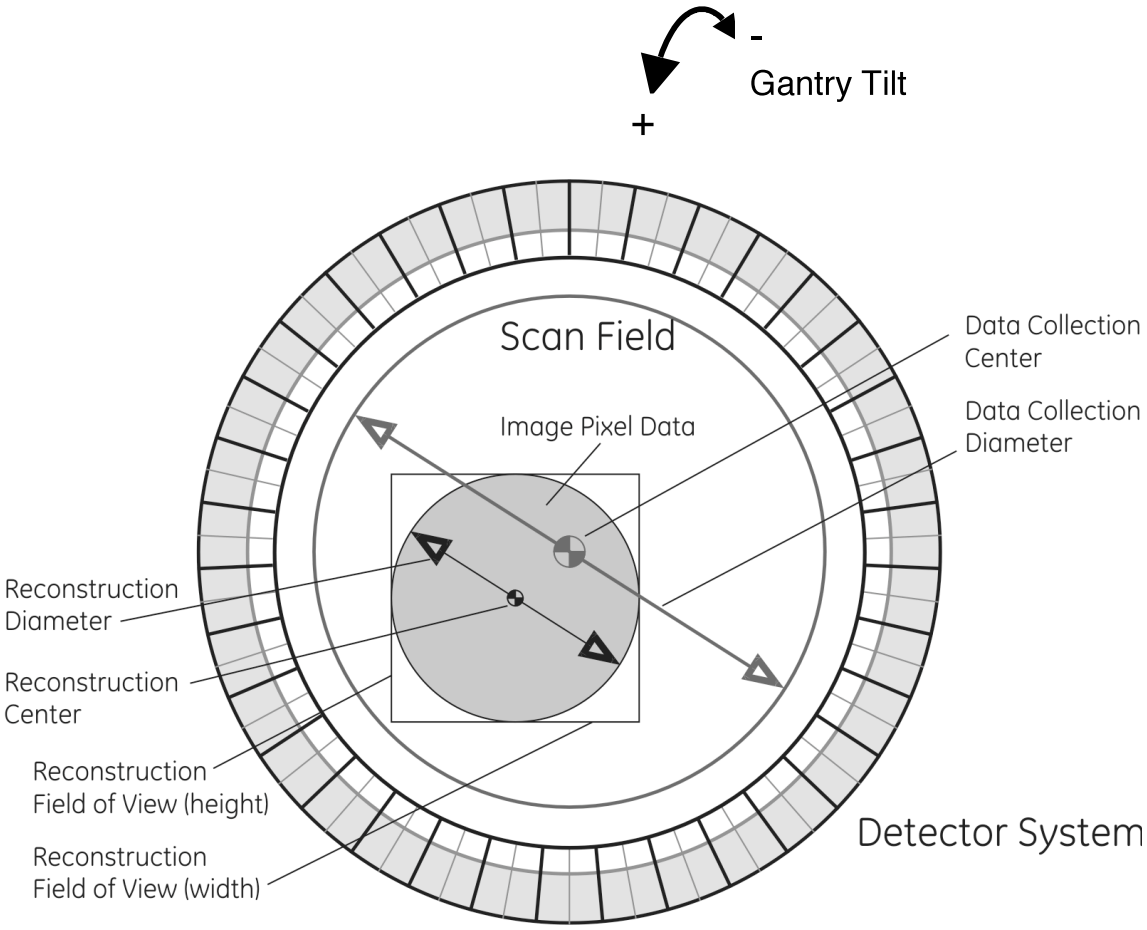

Figure C.8.X-1: Geometry of PET Acquisition System

C.8.X.5.5 PET Frame Correction Factors Macro

Table C.8-X15 specifies the attributes of the PET Frame Correction Factors Functional Group macro.

Table C.8-X15
PET FRAME CORRECTION FACTORS MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
PET Frame Correction Factors Sequence	(0018,9736)	1	Contains the attributes that describe the correction factors applied to this frame. Only a single Item shall be permitted in this sequence.
>Primary (Prompts) Counts Accumulated	(0054,1310)	1C	The sum of events that occur in the primary event channel. The counts include Trues +Scatter+ Randoms if Corrected Image (0028,0051) includes RAN; otherwise the counts are Trues +Scatter. Required if Frame Type (0008,9007) Value 1 is ORIGINAL. May be present otherwise.
>Slice Sensitivity Factor	(0054,1320)	1C	The slice-to-slice sensitivity correction factor that was used to correct this frame. The value shall be one if no slice sensitivity correction was applied. Required if Frame Type (0008,9007) Value 1 is ORIGINAL. May be present otherwise.
>Decay Factor	(0054,1321)	1C	The decay factor that was used to scale this frame. Required if Decay Corrected (0018,9758) equals YES.
>Scatter Fraction Factor	(0054,1323)	1C	An estimate of the fraction of acquired counts that were due to scatter and were corrected in this frame. The value shall be zero if no scatter correction was applied. Required if Frame Type (0008,9007 Value 1 is ORIGINAL. May be present otherwise.
>Dead Time Factor	(0054,1324)	1C	The average dead time correction factor that was applied to this frame. The value shall be one if no dead time correction was applied. Required if Frame Type (0008,9007) Value 1 is ORIGINAL. May be present otherwise.

388 **C.8.X.5.6 PET Reconstruction Macro**

Table C.8-X17 specifies the attributes of the PET Reconstruction Functional Group Macro, which
390 describe the method used to reconstruct this image.

Table C.8-X17
392 **PET RECONSTRUCTION MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
PET Reconstruction Sequence	(0018,9749)	1	Contains the attributes describing the reconstruction process for this frame. Only a single Item shall be permitted in this sequence.
>Reconstruction Type	(0018,9756)	1C	Description of the type of algorithm used when reconstructing the image from the data acquired during the acquisition process. Defined Terms: 2D 3D 3D_REBINNED Required if Frame Type (0008,9007) Value 1 equals ORIGINAL. May be present otherwise.
>Reconstruction Algorithm	(0018,9315)	1C	Description of the algorithm used when reconstructing the image from the data acquired during the acquisition process. Defined Terms: FILTER_BACK_PROJ REPROJECTION RAMLA MLEM Required if Frame Type (0008,9007) Value 1 of this frame is ORIGINAL. May be present otherwise.
>Iterative Reconstruction Method	(0018,9769)		Iterative Reconstruction Method used. Enumerate Values: YES NO
>Number of Iterations	(0018,9739)	1C	Number of iterations. Required if Frame Type (0008,9007) Value 1 equals ORIGINAL and Iterative Reconstruction Method (0018,9769) equals YES. May be present otherwise.
>Number of Subsets	(0018,9740)	1C	Number of subsets. Required if Frame Type (0008,9007)) Value 1 equals ORIGINAL and Iterative Reconstruction Method (0018,9769) equals YES. May be present otherwise.

>Reconstruction Diameter	(0018,1100)	1C	The diameter in mm of the region from which data were used in creating the reconstruction of the image. Data may exist outside this region and portions of the patient may exist outside this region. See C.8.X.5.4.1. Required if Frame Type (0008,9007) Value 1 equals ORIGINAL and Reconstruction Field of View (0018,9317) is not present. Otherwise may be present if Frame Type (0008,9007) Value 1 equals DERIVED and Reconstruction Field of View (0018,9317) is not present.
>Reconstruction Field of View	(0018,9317)	1C	The field of view width (x-dimension) followed by height (y-dimension) as used for reconstruction in mm. Required if Image Type (0008,9007) Value 1 equals ORIGINAL and Reconstruction Diameter (0018,1100) is not present. Otherwise may be present if Frame Type (0008,9007) Value 1 equals DERIVED and Reconstruction Diameter (0018,1100) is not present.

C.8.X.5.7 PET Table Dynamics Macro

Table C.8-X18 specifies the attributes of the PET Table Dynamics Functional Group Macro, which describes the table motion during acquisition of the data.

Table C.8-X18
PET TABLE DYNAMICS MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
PET Table Dynamics Sequence	(0018,9734)	1	Contains the attributes describing the movement of the PET Table. Only a single Item shall be permitted in this sequence.
>Table Speed	(0018,9309)	1	The distance in mm that the Table moves in one second during the gathering of data that resulted in this frame.

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Changes to NEMA Standards Publication PS 3.4-2007

410 ## Digital Imaging and Communications in Medicine (DICOM)

Part 4: Service Class Specifications

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Item #11: Add the following to Table B.5-1

B.5 STANDARD SOP CLASSES

Table B.5-1
STANDARD SOP CLASSES

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	Enhanced PET Image

Item #12: Add the following to Table I.4-1

I.4 MEDIA STORAGE STANDARD SOP CLASSES

Table I.4-1
Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	IOD defined in PS 3.3

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Changes to NEMA Standards Publication PS 3.6-2007

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Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

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436 ***Item #13: Add the following Data Elements to Part 6 Section 6:***

6 Registry of DICOM data elements

Tag	Name	VR	VM
(0018,9701)	Decay Correction DateTime	DT	1
(0018,9715)	Start Density Threshold	FD	1
(0018,9716)	Start Relative Density Difference Threshold	FD	1
(0018,9717)	Start Cardiac Trigger Count Threshold	FD	1
(0018,9718)	Start Respiratory Trigger Count Threshold	FD	1
(0018,9719)	Termination Counts Threshold	FD	1
(0018,9720)	Termination Density Threshold	FD	1
(0018,9721)	Termination Relative Density Threshold	FD	1
(0018,9722)	Termination Time Threshold	FD	1
(0018,9723)	Termination Cardiac Trigger Count Threshold	FD	1
(0018,9724)	Termination Respiratory Trigger Count Threshold	FD	1
(0018,9725)	Detector Geometry	CS	1
(0018,9726)	Transverse Detector Separation	FD	1
(0018,9727)	Axial Detector Dimension	FD	1
(0018,9729)	Radiopharmaceutical Agent Number	US	1
(0018,9732)	PET Frame Acquisition Sequence	SQ	1
(0018,9733)	PET Detector Motion Details Sequence	SQ	1
(0018,9734)	PET Table Dynamics Sequence	SQ	1
(0018,9735)	PET Position Sequence	SQ	1
(0018,9736)	PET Frame Correction Factors Sequence	SQ	1
(0018,9737)	Radiopharmaceutical Usage Sequence	SQ	1
(0018,9738)	Attenuation Correction Source	CS	1
(0018,9739)	Number of Iterations	US	1
(0018,9740)	Number of Subsets	US	1
(0018,9749)	PET Reconstruction Sequence	SQ	1
(0018,9751)	PET Frame Type Sequence	SQ	1
(0018,9755)	Time of Flight Information Used	CS	1
(0018,9756)	Reconstruction Type	CS	1
(0018,9758)	Decay Corrected	CS	1
(0018,9759)	Attenuation Corrected	CS	1
(0018,9760)	Scatter Corrected	CS	1
(0018,9761)	Dead Time Corrected	CS	1

Tag	Name	VR	VM
(0018,9762)	Gantry Motion Corrected	CS	1
(0018,9763)	Patient Motion Corrected	CS	1
(0018,9764)	Count Loss Normalization Corrected	CS	1
(0018,9765)	Randoms Corrected	CS	1
(0018,9766)	Non-uniform Radial Sampling Corrected	CS	1
(0018,9767)	Sensitivity Calibrated	CS	1
(0018,9768)	Detector Normalization Correction	CS	1
(0018,9769)	Iterative Reconstruction Method	CS	1
(0018,9770)	Attenuation Correction Temporal Relationship	CS	1
(0018,9771)	Patient Physiological State Sequence	SQ	1
(0018,9772)	Patient Physiological State Code Sequence	SQ	1

Item #14: Add the following UID to Part 6 Annex A:

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

Table A-1
UID VALUES

UID Value	UID NAME	UID TYPE	Part
1.2.840.10008.5.1.4.1.1.130	Enhanced PET Image Storage	SOP Class	PS 3.4

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Changes to NEMA Standards Publication PS 3.15-2007

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Digital Imaging and Communications in Medicine (DICOM)

Part 15: Security and Systems Management Profiles

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Item #15: Add to Section C2 and C3

C.2 CREATOR RSA DIGITAL SIGNATURE PROFILE

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x. **any attributes of the Enhanced PET Image module that are present**

C.3 AUTHORIZATION RSA DIGITAL SIGNATURE PROFILE

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x. any attributes of the Enhanced PET Image module that are present

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476 **Changes to NEMA Standards Publication PS 3.16-2007**

Digital Imaging and Communications in Medicine (DICOM)

478 **Part 16: Content Mapping Resource**

Item #16: Make the following changes to Part 16 Annex B, CID 83:

Annex B DCMR Context Groups (Normative)

CID 83 Units for Real World Value Mapping

CID 83
Units for Real World Value Mapping

Type: Extensible Version: ~~20050822~~20080123

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
INCLUDE CID 8x PET Units for Real World Value Mapping		
UCUM	[hnsf'U]	Hounsfield unit
UCUM	{counts}	Counts
UCUM	{counts}/s	Counts per second
UCUM	{SUVbw}g/ml	Standardized Uptake Value body weight
UCUM	{SUVlbm}g/ml	Standardized Uptake Value lean body mass
UCUM	{SUVbsa}cm2/ml	Standardized Uptake Value body surface area

Item #17 Add to PS3.16, Annex B.

CID 84 PET Units for Real World Value Mapping

Context ID 84
PET Units for Real World Value Mapping

Type: Extensible Version: 20080123

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
UCUM	{counts}	Counts
UCUM	{counts}/s	Counts per second
UCUM	{SUVbw}g/ml	Standardized Uptake Value body weight
UCUM	{SUVlbm}g/ml	Standardized Uptake Value lean body mass
UCUM	{SUVbsa}cm2/ml	Standardized Uptake Value body surface area
UCUM	{propcounts}	Proportional to counts
UCUM	{propcounts}/s	Proportional to counts per second
UCUM	cm^2	Centimeter**2
UCUM	%	Percent
UCUM	Bq/ml	Becquerels/milliliter
UCUM	mg/min/ml	Milligrams/minute/milliliter
UCUM	umol/min/ml	Micromole/minute/milliliter
UCUM	ml/min/g	Milliliter/minute/gram
UCUM	ml/g	Milliliter/gram
UCUM	/cm	/Centimeter
UCUM	umol/ml	Micromole/milliliter

Item #18 Make the following changes, to CID 7004 in PS3.16, Annex B.

CID 7004 Waveform Purposes of Reference

Context ID 7004
Waveform Purposes of Reference

Type: Extensible Version: ~~20020904~~20080123

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
…		
DCM	121304	Simultaneous Voice Narrative
DCM	**121305**	**Simultaneous Respiratory Waveform**

Item #19: Modify the title of CID 4030 in PS3.16, Annex B.

CID 4030 CT, MR and PET Anatomy Imaged

Context ID 4030
CT, MR and PET Anatomy Imaged

Type: Extensible Version: 20040114

Item #20: Add definition to PS 3.16 Annex D

Annex D DICOM Controlled Terminology Definitions (Normative)

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DICOM Code Definitions (Coding Scheme Designator “DCM” Coding Scheme Version “01”)

Code Value	Code Meaning	Definition	Notes
121305	Simultaneous Respiratory Waveform	A waveform representing chest expansion and contraction due to respiratory activity, measured simultaneously with the acquisition of this Image.	

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