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Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

NEMA

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NEMA Standards Publication PS 3.3-1993

Digital Imaging and Communications in Medicine (DICOM)
Part 3: Information Object Definitions

Approved by:
The American College of Radiology

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ACR-NEMA

Digital Imaging and Communications in Medicine
Part 3: Information Object Definitions

FOREWORD

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 DICOM Standard was developed according to the NEMA procedures.

This standard is developed in liaison with other standardization organizations including CEN TC251 in Europe 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 one part of the 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

These parts are related but independent documents.Their development level and approval status may differ. Additional parts may be added to this multi-part standard. PS 3.1 should be used as the base reference for the current parts of this standard.

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Digital Imaging and Communications in Medicine
Part 3: Information Object Definitions

1 Scope and field of application

This Part of the DICOM Standard specifies the set of information object definitions (IODs) which provide an abstract definition of real-world objects applicable to communication of digital medical information. For each IOD, this Part specifies:

— any necessary information for the semantic description of the IOD

— relationships to associated real-world objects relevant to the IOD

— Attributes which describe the characteristics of the IOD

For each IOD, this Part does not specify:

— the nature of any service class definition intended to reference the IOD

— the nature of any interactions which result in the usage of the IOD

This Part is related to other parts of the DICOM Standard in that:

— PS 3.4, Service Class Specifications, specifies application level services by grouping DIMSE services with IODs as defined in this part.

— PS 3.5, Data Structure and Semantics, defines the data encoding used in the DIMSE Protocol when applied to IODs defined in this Part.

— PS 3.6, Data Dictionary, contains an index by Tag of all IOD Attributes defined in this Part. This index includes the value representation and value multiplicity for each attribute.

— PS 3.7, Message Exchange Protocol, defines the DIMSE Services and Protocol which may be applied to IODs defined in this Part.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibilities of applying the most recent editions of the standards indicated below.

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

ISO 7498-1, Information Processing Systems - Open Systems Interconnection - Basic Reference Model

ISO/TR 8509, Information Processing Systems - Open Systems Interconnection - Service Conventions

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3 Definitions

For the purposes of this Standard the following definitions apply.

3.1 *Reference model definitions*

This Part of the Standard is based on the concepts developed in ISO 7498-1 and makes use of the following terms defined in it:

a) Application Entity

b) Service or Layer Service

3.2 *Service conventions definitions*

This Part of the Standard makes use of the following terms defined in ISO/TR 8509:

a) Primitive

3.3 *DICOM introduction and overview definitions*

This Part of the Standard makes use of the following terms defined in PS 3.1:

a) Attribute

b) Command

c) Data Dictionary

d) Message

3.4 *DICOM service class specifications*

This Part of the Standard makes use of the following terms defined in PS 3.4:

a) Real-World Activity

b) Real-World Object

c) Service Class

d) Service Class User

e) Service Class Provider

f) Service-Object Pair (SOP) Class

g) Service-Object Pair (SOP) Instance

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3.5 *DICOM data structures and encoding*

This Part of the Standard makes use of the following terms defined in PS 3.5:

a) Data Element

b) Data Element Tag

c) Data Element Type

d) Data Set

e) Defined Term

f) Enumerated Value

g) Sequence of Items

h) Unique Identifier (UID)

3.6 *DICOM message exchange*

This Part of the Standard makes use of the following terms defined in PS 3.7:

a) DICOM Message Service Element (DIMSE)

b) DIMSE-N Services

c) DIMSE-C Services

3.7 *DICOM upper layer service*

This Part of the Standard makes use of the following terms defined in PS 3.8:

a) DICOM Upper Layer Service

3.8 *DICOM information object*

The following definitions are commonly used in this part of the Standard:

3.8.1 attribute tag: A unique identifier for an attribute of an information object composed of an ordered pair of numbers (a group number followed by an element number).

3.8.1 composite IOD: an Information object definition which represents parts of several entities in the DICOM application model. Such an IOD includes attributes which are not inherent in the real-world object that the IOD represents but rather are inherent in related real-world objects.

3.8.2 derived image: an image in which the pixel data was constructed from pixel data of one or more other images (source images).

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3.8.3 DICOM information model: an entity-relationship diagram which is used to model the relationships between the information object definitions representing classes of real-world objects defined by the DICOM application model.

3.8.4 DICOM application model: an entity-relationship diagram used to model the relationships between real-world objects which are within the area of interest of this Standard.

3.8.5 information entity: that portion of information defined by a composite IOD which is related to one specific class of real-world object. There is a one-to-one correspondence between information entities and entities in the DICOM application model.

3.8.6 information object definition (IOD): a data abstraction of a class of similar real-world objects which defines the nature and attributes relevant to the class of real-world objects represented.

3.8.7 module: A set of attributes within an information entity or normalized IOD which are logically related to each other.

3.8.8 multi-frame image: Image that contains multiple two-dimensional pixel planes.

3.8.9 normalized IOD: an Information object definition which represents a single entity in the DICOM application model. Such an IOD includes attributes which are only inherent in the real-world object that the IOD represents.

4 Symbols and abbreviations

The following symbols and abbreviations are used in this Part of the Standard.

4.1 ACR American College of Radiology

4.2 ASCII American Standard Code for Information Interchange

4.3 AE Application Entity

4.4 ANSI American National Standards Institute

4.5 CEN TC251 Comite Europeen de Normalisation - Technical Committee 251 - Medical Informatics

4.6 DICOM Digital Imaging and Communications in Medicine

4.7 DIMSE DICOM Message Service Element

4.8 DIMSE-C DICOM Message Service Element-Composite

4.9 DIMSE-N DICOM Message Service Element-Normalized

4.10 HISPP Healthcare Information Standards Planning Panel

4.11 HL7 Health Level 7

4.12 IE Information Entity

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4.13 IEEE Institute of Electrical and Electronics Engineers

4.14 IOD Information Object Definition

4.15 ISO International Standards Organization

4.16 JIRA Japanese Industry Radiology Apparatus

4.17 MSDS Healthcare Message Standard Developers Sub-Committee

4.18 NEMA National Electrical Manufacturers Association

4.19 OSI Open Systems Interconnection

4.20 SCP Service Class Provider

4.21 SCU Service Class User

4.22 SOP Service-Object Pair

4.23 UID Unique Identifier

5 Conventions

5.1 *Entity-relationship model*

5.1.1 ENTITY

An entity is used in an entity-relationship (E-R) model to represent a real-world object, class of real-world objects, or DICOM data representation (such as an IOD or Module). An entity is depicted as shown in Figure 5.1-1.

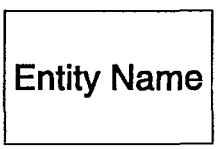

Figure 5.1-1—Entity convention

5.1.2 RELATIONSHIP

A relationship, which defines how entities are related, is depicted as a diamond within this Part of the DICOM Standard as shown in Figure 5.1-2.

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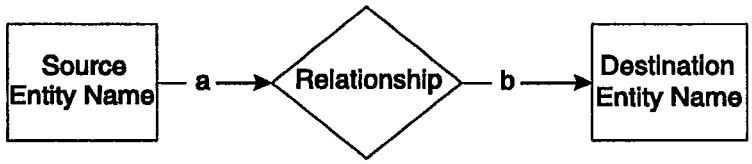

Figure 5.1-2—Relationship convention

The relationship is read from source to destination entity as indicated by the arrows. The a and b show the source and destination cardinality of the relationship respectively. The following cardinalities are permitted:

a) (a = 1, b = 1) - one source entity is related to one destination entity

b) (a = 1, b = 0-n) - one source entity is related to zero or more destination entities

c) (a = 1, b = 1-n) - one source entity is related to one or more destination entities

d) (a = 1-n, b = 1) - one or more source entities are related to one destination entity

e) (a = 1-n, b = 0-n) - one or more source entity is related to zero or more destination entities

f) (a = 1-n, b = 1-n) - one or more source entities are related to one or more destination entities

In a relationship where (a = 1-n, b = 1-n) the values of the source and destination cardinalities may be different. The value "n" simply denotes one or more.

NOTE— DICOM has added the use of arrows to the E-R diagramming conventions often used in other literature. This has been done to avoid the possibility of inferring an incorrect relationship which can result from reading a relationship in the reverse order of that intended. For example, a relationship "Cat Catches Mouse" could be read "Mouse Catches Cat" if the arrows were not present.

A relationship may be bi-directional (i.e. the relationship is true in both directions). In such a case, the convention used is arrows pointing toward both the source and the destination entities.

5.2 *Sequences*

Certain tables in this Standard describe sequences of Items by using the symbol: '>'. The symbol '>' precedes the Attribute (or Module) name of the members of an Item. All marked Attributes (or Modules) belong to the generic description of an Item which may be repeated to form a sequence of Items. This sequence of Items is nested in the Attribute (or Module) which precedes in the table the first member marked with a '>'.

NOTE— The following table describes the "Referenced Series Sequences" Attribute as a Sequence of one or more Items where each Item contains the three Attributes marked by a '>'. The Sequence of Items is nested inside the value of the Referenced Series Sequence Attribute. The following Attribute (not marked) is not part of the Items of the Sequence.

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.....	....
Referenced Series Sequence	.....
> Series Date	.....
> Series Time	.....
> Series Instance UID	.....
Modality	....

This notation may be used to create nested hierarchical structures by using '>>' at the second level of nesting and so on

6 DICOM information Model

The DICOM Information Model defines the structure and organization of information related to the communication of medical images. Figure 6-1 shows the relationships between the major structures of the DICOM Information Model.

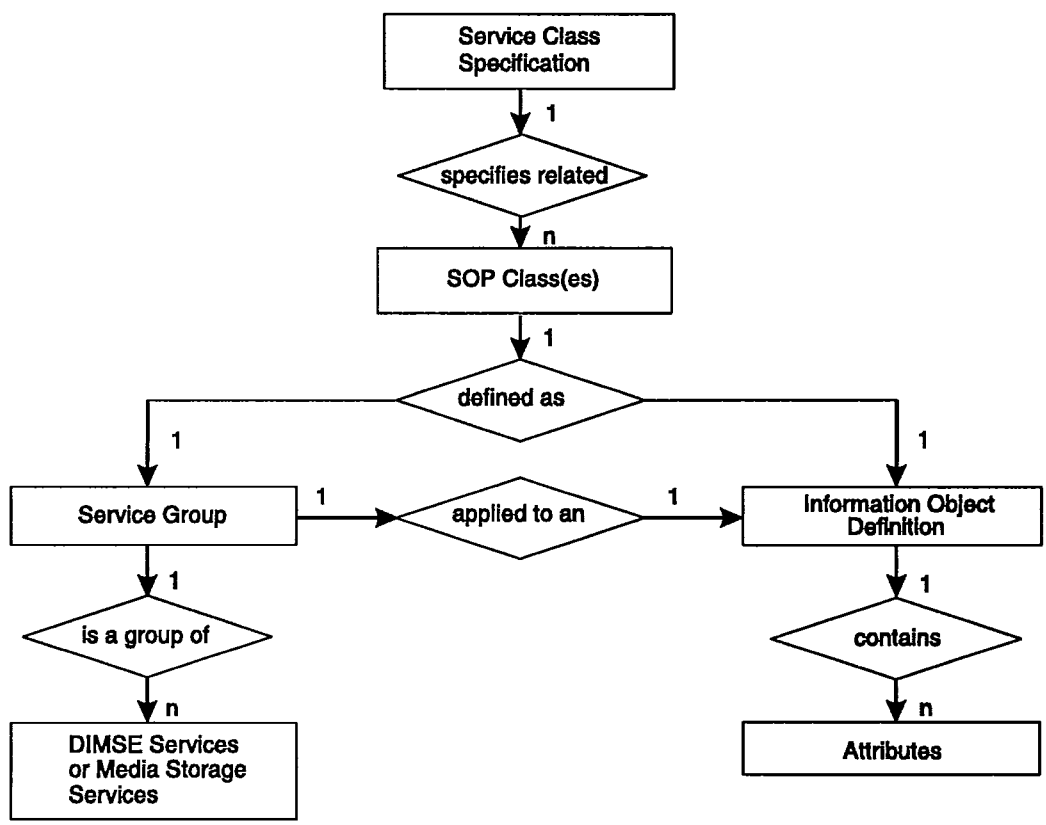

Figure 6-1—Major structures of DICOM information model

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6.1 *Information object definition*

An Information Object Definition (IOD) is an object-oriented abstract data model used to specify information about real-world objects. An IOD provides communicating Application Entities with a common view of the information to be exchanged.

An IOD does not represent a specific instance of a Real-World Object, but rather a class of Real-World Objects which share the same properties. An IOD used to represent a single class of Real-World Objects is called a Normalized Information Object. An IOD which includes information about related Real-World Objects it is called a Composite Information Object.

6.1.1 COMPOSITE IOD

A Composite IOD is an Information Object Definition which represents parts of several entities included in the DICOM model of the real-world. This model is introduced in Section 7. Such an IOD includes attributes which are not inherent in the Real-World Object that the IOD represents but rather are inherent in related Real-World Objects.

These related Real-World Objects provide a complete context for the exchanged information. When an instance of a Composite IOD is communicated, this entire context is exchanged between Application Entities. Relationships between Composite IOD instances shall be conveyed in this contextual information.

The Composite IODs are specified in Annex A.

6.1.2 NORMALIZED IOD

A Normalized IOD is an Information Object Definition which represents a single entity in the DICOM model of the real-world. Such an IOD includes Attributes which are only inherent in the Real-World Object that the IOD represents.

When an instance of a Normalized IOD is communicated, the context for that instance is not actually exchanged. Instead, the context is provided through the use of pointers to related Normalized IOD Instances.

The Normalized IODs are specified in Annex B.

6.2 *Attributes*

The Attributes of an IOD describe the properties of a Real-World Object Instance. Related Attributes are grouped into Modules which represent a higher level of semantics documented in the Module Specifications found in Annex C.

Attributes are encoded as Data Elements using the rules, the Value Representation and the Value Multiplicity concepts specified in PS 3.5. For specific Data Elements, the Value Representation and Value Multiplicity are specified in the Data Dictionary in PS 3.6.

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6.3 *On-line communication and media storage services*

For on-line communication the DIMSE Services allow a DICOM Application Entity to invoke an operation or notification across a network or a point-to-point interface. DIMSE Services are defined in PS 3.7.

For media storage interchange, Media Storage Services allow a DICOM Application Entity to invoke media storage related operations.

NOTE— These Media Storage Services are discussed in PS 3.10.

6.3.1 DIMSE-C SERVICES

DIMSE-C Services are services applicable only to a Composite IOD. DIMSE-C Services provide only operation services.

6.3.2 DIMSE-N SERVICES

DIMSE-N Services are services applicable only to a Normalized IOD. DIMSE-N Services provide both operation and notification services.

6.4 *DIMSE service group*

A DIMSE Service Group specifies one or more operations/notifications defined in PS 3.7 which are applicable to an IOD.

DIMSE Service Groups are defined in PS 3.4, in the specification of a Service-Object Pair Class.

6.5 *Service-object pair (SOP) class*

A Service-Object Pair (SOP) Class is defined by the union of an IOD and a DIMSE Service Group. The SOP Class definition contains the rules and semantics which may restrict the use of the services in the DIMSE Service Group and/or the Attributes of the IOD.

The selection of SOP Classes is used by Application Entities to establish an agreed set of capabilities to support their interaction. This negotiation is performed at Association establishment time as described in PS 3.7. An extended negotiation allows Application Entities to further agree on specific options within a SOP Class.

NOTE— The SOP Class as defined in the DICOM Information Model is equivalent in ISO/OSI terminology to the Managed Object Class. Readers familiar with object oriented terminology will recognize the SOP Class operations (and notifications) as comprising the methods of an object class.

6.5.1 NORMALIZED AND COMPOSITE SOP CLASSES

DICOM defines two types of SOP Classes, Normalized and Composite. Normalized SOP Classes are defined as the union of a Normalized IOD and a set of DIMSE-N Services. Composite SOP Classes are defined as the union of a Composite IOD and a set of DIMSE-C Services.

NOTE— SOP Class Specifications play a central role for defining DICOM conformance requirements. They allow DICOM Application Entities to select a well-defined application level subset of the Standard to which they may claim conformance. See PS 3.2.

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6.6 *Association negotiation*

Association establishment is the first phase of communication between peer DICOM compliant Application Entities. The Application Entities shall use association establishment to negotiate which SOP Classes can be exchanged and how this data will be encoded.

Association Negotiation is defined in PS 3.7.

6.7 *Service class specification*

A Service Class Specification defines a group of one or more SOP Classes related to a specific function which is to be accomplished by communicating Application Entities. A Service Class Specification also defines rules which allow implementations to state some pre-defined level of conformance to one or more SOP Classes. Applications may conform to SOP Classes as either a Service Class User (SCU) or Service Class Provider (SCP).

Service Class Specifications are defined in PS 3.4.

NOTE— Such interaction between peer Application Entities work on a 'client/server model'. The SCU acts as the 'client', while the SCP acts as the 'server'. The SCU/SCP roles are determined during association establishment.

7 DICOM model of the real-world

Figure 7-1 depicts the DICOM view of the real-world which identifies the relevant Real-World Objects and their relationships within the scope of the DICOM Standard. It provides a common framework to ensure consistency between the various Information Objects defined by the DICOM Standard.

7.1 *DICOM information model*

The DICOM Information Model is derived from the DICOM model of the Real-World. The DICOM Information Model presented by Figure 7-2 identifies the various IODs specified by this Standard and their relationships. There is not always a one-to-one correspondence between DICOM Information Object Definitions and Real-World Objects. For example a Composite IOD contains Attributes of multiple Real-World Objects such as series, equipment, frame of reference, study and patient.

The entities in Figure 7-2 correspond to IODs defined in Annexes A through C.

7.2 *Organization of Annexes A, B and C*

Annex A defines Composite IOD's (e.g. Images, Curves, Overlays) acquired on a number of Modalities (e.g. CT, MR, NM, US, CR, Secondary Capture). These Composite IOD's reference Modules found in Annex C.

Annex B defines Normalized IODs (e.g. Patient, Study, Results, Film Session, Print Job) for a number of Service Classes specified in PS 3.4. These Normalized IODs reference Module definitions found in Annex C.

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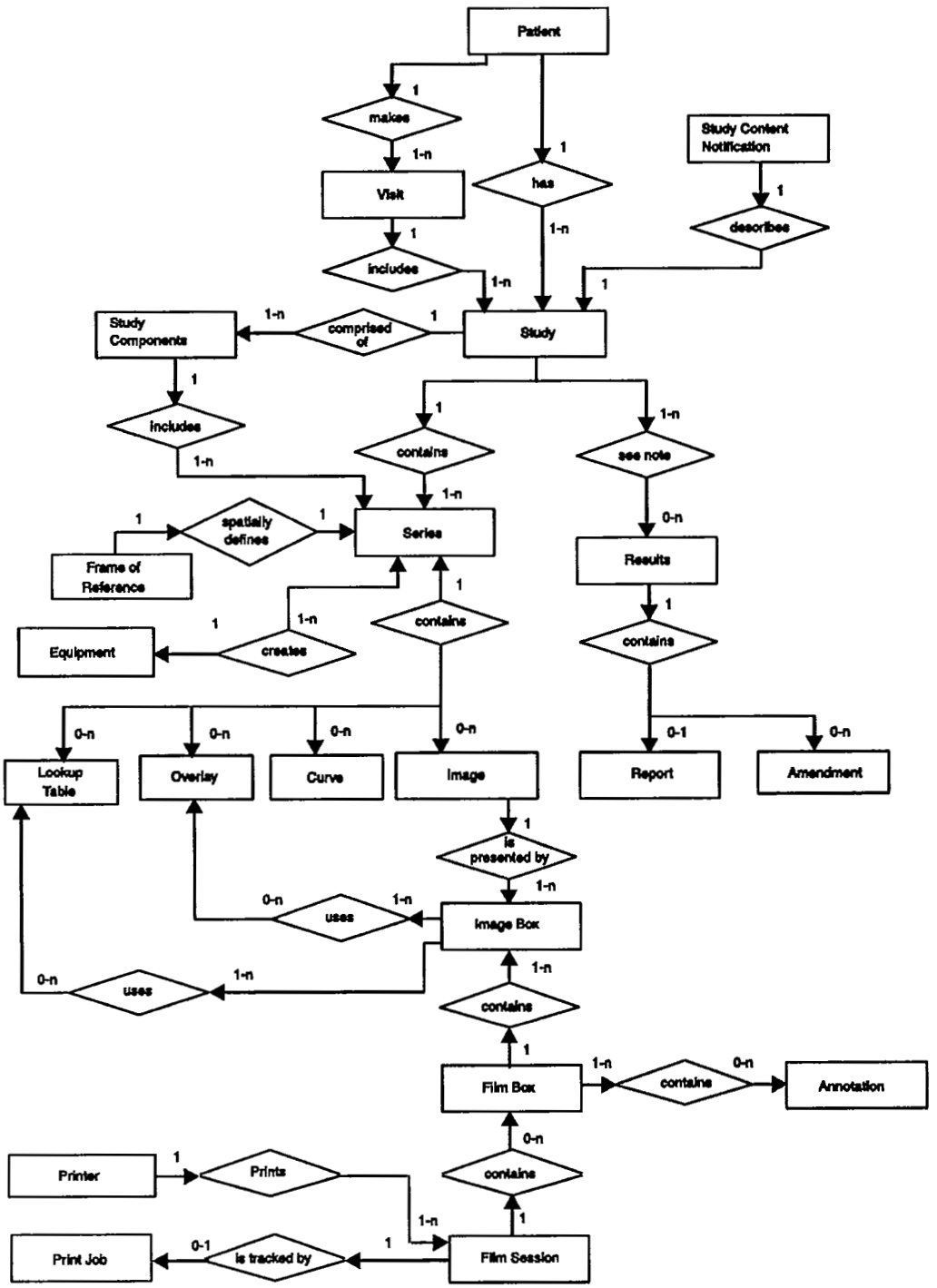

Figure 7-1—DICOM model of the real-world

NOTE— The relationship between study and result is complex, involving other Real-World Objects (e.g. the interpreting physician). This Standard does not model these objects.

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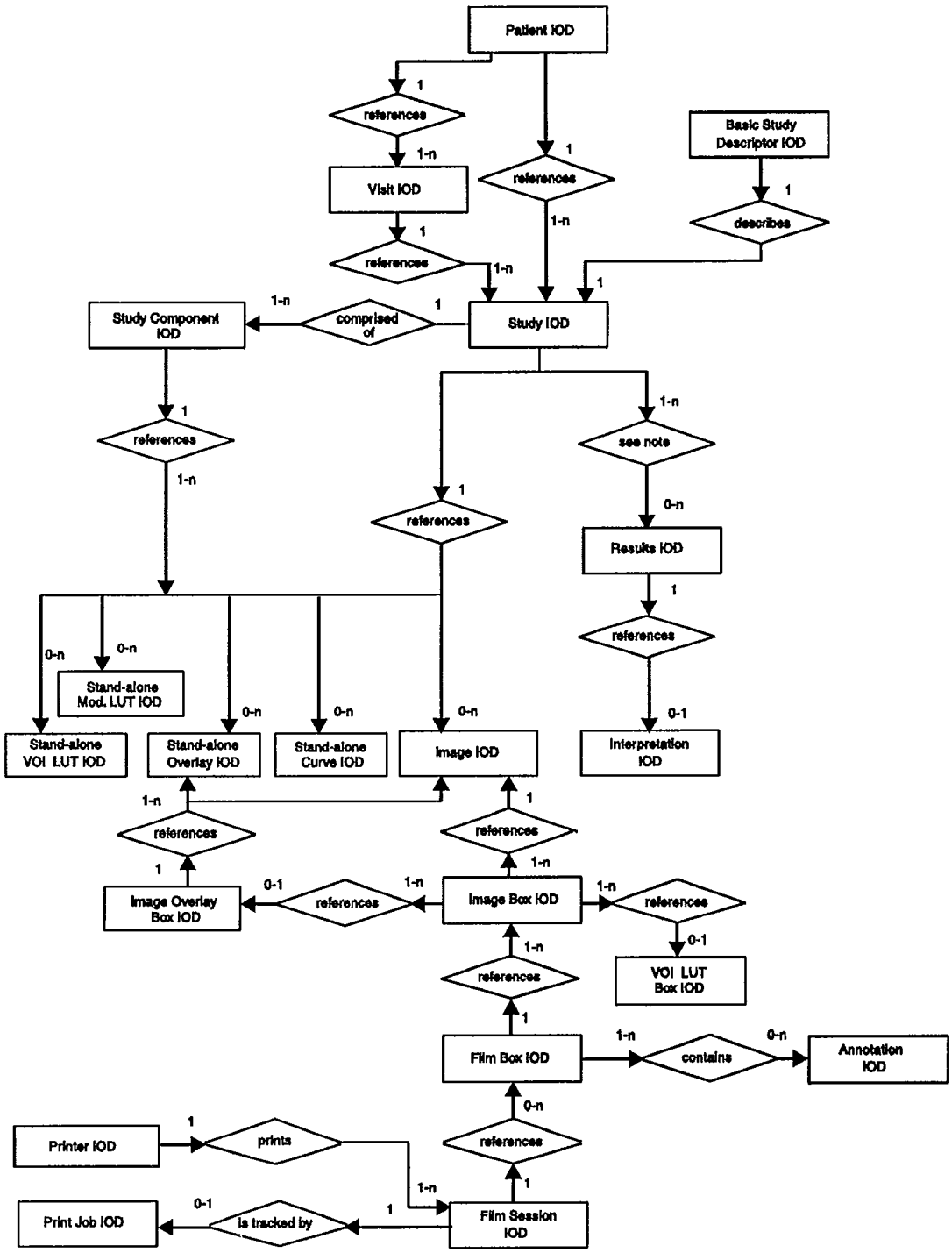

Figure 7-2—DICOM information model

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Annex A
(Normative)
Composite information object definitions

A.1 Elements of an information object definition

Each composite information object definition is composed of the following sections

a) IOD Description

b) IOD Entity-Relationship Model

c) IOD Module Table

Sections A.1.1 through A.1.3 of this document define the requirements of a) through c) above.

A.1.1 *IOD description*

This section provides a brief description of the IOD. Specifically, this description includes:

— The Real-World Object which is represented by the IOD

— Information as to the scope of the represented object if appropriate

A.1.2 *IOD entity-relationship model*

This section of an IOD provides the entity-relationship (E-R) model which depicts the relationships of the components or Information Entities (IE) of the specified IOD. It forms an IOD specific information model. This E-R model provides the complete context of how the image information shall be interpreted when an image is exchanged between two DICOM Application Entities.

Even though images are sent as discrete individual components, each Composite Image IOD E-R model requires that all images which are part of a specific study shall share the same context. That is, all images within a specific patient study share the same patient and study information; all images within the same series share the same series information; etc.

Figure A.1-1 is the DICOM Composite Image IOD information model. It applies to all of the composite image IODs defined in Annex A. However, a subset of this model may be specified by each individual Composite Image IOD to accurately define the context for specific modality image exchange.

Sections A.1.2.1 through A.1.210 describe the Information Entities (IE) which comprise the Composite Image IODs defined in this Annex.

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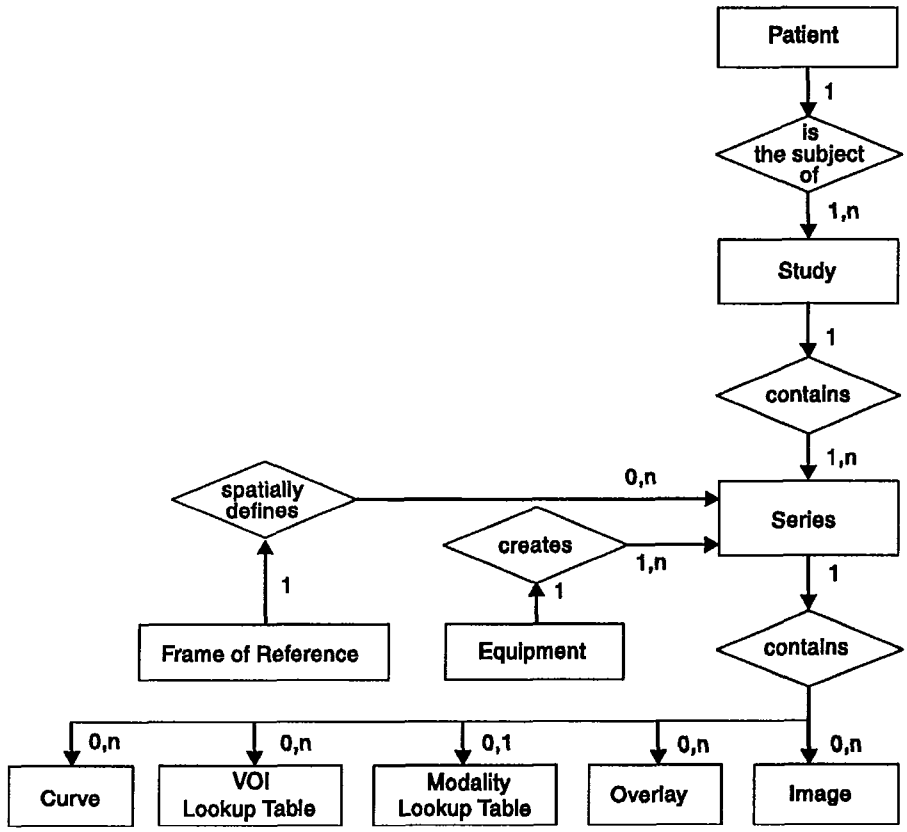

Figure A.1-1—DICOM composite image IOD information model

Each series shall contain at least one curve IE, VOI lookup table, overlay IE, or image IE.

A.1.2.1 PATIENT IE

The patient IE defines the characteristics of a patient who is the subject of one or more medical studies which produce medical images.

The patient IE is modality independent.

A.1.2.2 STUDY IE

The study IE defines the characteristics of a medical study performed on a patient. A study is a collection of one or more series of medical images, overlays and/or curves which are logically related for the purpose of diagnosing a patient. Each study is associated with exactly one patient.

A study may include images that are created by a single modality, multiple modalities or by multiple devices of the same modality.

The study IE is modality independent.

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A.1.2.3 SERIES iE

The series IE defines the Attributes which are used to group images, overlays and/or curves into distinct logical sets. Each series is associated with exactly one study.

The following criteria group images into a specific series:

a) All images within a series must be of the same modality

b) If a specific Composite Image IOD specifies the support of a frame of reference IE, all images within the series shall be spatially related to each other; therefore, each series is associated with exactly one frame of reference IE

c) If a specific image IOD specifies the support of the equipment IE, all images within the series shall be created by the same equipment; therefore, each series is associated with exactly one Equipment IE

d) All images within a series shall have the same series information

Overlays and curves may be grouped into a series with or without images. The equipment IE and frame of reference IE are irrelevant to the overlay IE and curve IE.

A.1.2.4 EQUIPMENT IE

The equipment IE describes the particular imaging device which produced the series of images. An imaging device may produce one or more series within a study. The equipment IE does not describe the data acquisition or image creation Attributes used to generate the images within a series. These Attributes are described in the Image IE.

A.1.2.5 FRAME OF REFERENCE IE

The frame of reference IE identifies the coordinate system which conveys spatial and/or temporal information of images in a series.

A frame of reference IE may be related to one or more series. In this case, it provides the ability to spatially or temporally relate multiple series to each other.

A.1.2.6 IMAGE IE

The image IE defines the Attributes which describe the pixel data of an image. The pixel data may be generated as a direct result of patient scanning (termed an original image) or the pixel data may be derived from the pixel data of one or more other images (termed a Derived Image). An image is defined by its image plane, pixel data characteristics, gray scale and/or color mapping characteristics, overlay planes and modality specific characteristics (acquisition parameters and image creation information).

An image is related to a single series within a single study.

The pixel data within an image IE may be represented as a single frame of pixels or as multiple frames of pixel data. The frames of a multi-frame image (a cine run or the slices of a volume) are sequentially

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ordered and share a number of common properties. A few Attributes may vary between frames (e.g., time, angular displacement, slice increment). All common image IE Attributes refer to the first frame of a multiple frame image.

Overlay, lookup table and curve data may be included within an image IE only if this information is directly associated with the image.

A.1.2.7 OVERLAY IE

The overlay IE defines the attributes which describe an independent set of overlay planes. The overlay IE may represent in a bit-map format, graphics or text and is used to indicate such items as region of interest, reference marks and annotations. These overlay planes may or may not be coincident with an image. If the overlay plane is coincident with an image, sufficient information shall be available to allow an overlay to be presented at a display station superimposed on a particular image with which it is associated. An overlay IE shall be related to only one Series IE.

An overlay plane may be represented as a single frame (when associated with a single frame image) or as multiple frames of overlay planes (when associated with a multi-frame image).

NOTES— 1. Examples of independent overlay planes are:
a) line drawings which illustrate the equipment and patient setup prescribed
b) line drawings which represent anatomy, pointers and text
c) drawings showing the layout of images and text fields for filming formats
2. The Overlay IE is similar in concept to the 'Graphics Data Set' defined by earlier versions of this Standard.

A.1.2.8 CURVE IE

A curve is used to represent graphical data that can be specified as a series of connected points. Curve data may or may not be superimposed on a coincident image. An independent curve, like an independent overlay, can exist as would an image without any pixel data. Curves can be used to specify multi-dimensional graphs, regions of interest, and annotation. Curve data is not compressed in any of the DICOM standard Transfer Syntaxes specified in PS 3.5.

Each curve is specified as a series of connected points. One or more curves shall be described by using one or more even numbered repeating groups (5000-501E,eeee) whose Attributes are described in the Curve Module. The type of data (50xx,0020) contained in the curve shall be specified. For independent curves, the Curve Identification Module is used to identify the curve.

A.1.2.9 MODALITY LUT IE

The modality LUT IE defines the Attributes which describe the transformation of manufacturer dependent pixel values into pixel values which are manufacturer independent (e.g. Hounsfield units for CT, optical density for film digitizers, etc.). The modality LUT may be contained within an image or as a standalone modality LUT which references an image. When the transformation is linear, the modality LUT is described by Rescale Slope (0028,1053) and Rescale Intercept (0028,1052). When the transformation is non-linear, the modality LUT is described by Modality LUT Sequence (0028,3000).

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A.1.2.10 VOI LUT IE

The VOI LUT IE defines the Attributes which describe the transformation of the modality pixel values into pixel values which are meaningful for print, display, etc. This transformation is applied after any modality LUT. The VOI LUT may be contained within an image or as a standalone VOI LUT which references an image. When the transformation is linear, the VOI LUT is described by the Window Center (0028,1050) and Window Width (0028,1051). When the transformation is non-linear, the VOI LUT is described by VOI LUT Sequence (0028,3010).

A.1.3 *IOD module table*

This section of each IOD defines in a tabular form the Modules comprising the IOD. The following information must be specified for each Module in the table:

— The name of the Module

— A reference to the section in Annex C which defines the Module

— The usage of the Module; whether it is:

— Mandatory (see A.1.3.1)

— Conditional (see A.1.3.2)

— User Option (see A.1.3.3)

The Modules referenced are defined in Annex C.

A.1.3.1 MANDATORY MODULES

For each IOD, mandatory Modules shall be supported per the definitions, semantics and requirements defined in Annex C.

A.1.3.2 CONDITIONAL MODULES

Conditional modules are mandatory Modules if specific conditions are met. If the specified conditions are not met, this Module shall not be supported; that is, no information defined in the Module shall be sent.

A.1.3.3 USER OPTION MODULES

User option Modules may or may not be supported. If an optional Module is supported, the Attribute types specified in the Modules in Annex C shall be supported.

A.1.4 *Overview of the composite IOD module content*

Table A.1-1 provides an overview of the Modules used throughout the Composite IODs. This table is for informative purposes only. It is based on the IOD definitions found in the remaining sections of Annex A which are normative.

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Table A.1-1—Composite information object modules overview

IODs Modules	CR	CT	MR	NM	US	US-mf	Sec. Capt.	St. Over-lay	St. Curve	Study Descr.	St. Mod LUT	St. VOI LUT
Patient	M	M	M	M	M	M	M	M	M		M	M
Patient Summary										M		
General Study	M	M	M	M	M	M	M	M	M		M	M
Patient Study	U	U	U	U	U	U	U	U	U		U	U
Study Content										M		
General Series	M	M	M	M	M	M	M	M	M		M	M
CR Series	M											
NM Series				M								
Frame Of Reference		M	M	U	U	U						
U S Frame of Ref.					C	C						
General Equipment	M	M	M	M	M	M	U	M	M		M	M
NM Equipment				U								
SC Equipment							M					
General Image	M	M	M	M*	M*	M	M					
Image Plane		M	M	U*								
Image Pixel	M	M	M	M*	M*	M	M					
Contrast/ Bolus	C	C	C		C*	C						
Cine				C		C						
Multi-frame				C		M						
CR Image	M											
CT Image		M										

Table continued on next page

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Table A.1-1 continued

MR Image			M									
NM Image				M*								
NM SPECT				C								
NM Multi-Gated				C								
US Region Calibration					U*	U						
US Image					M*	M						
SC Image							M					
Overlay Identification				M*				M				
Overlay Plane	U	U	U	M*	U*		U	M				
Multi-frame Overlay				U								
Curve Identification				M*	M*	M*			M			
Curve				M*	M*	M*			M			
Audio					U	U						
Modality LUT	U						U				M	
VOI LUT	U	U	U	U*	U*	U	U					M
LUT Identification											M	M
SOP Common	M	M	M	M*	M*	M*	M	M	M	M	M	M

* The notation next to M and U indicates a special condition for these modules. Refer to the corresponding Information Object Definitions in this Annex for details.

A.2 Computed radiography image information object definition

A.2.1 *CR image IOD description*

The Computed Radiography (CR) Image Information Object Definition specifies an image which has been created by a computed radiography imaging device.

NOTE— Digital Luminescence Radiography is an equivalent term for computed Radiography.

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A.2.2 *CR 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 CR image IOD. The frame of reference IE, overlay IE, modality LUT IE, VOI LUT IE and curve IE are not components of the CR image IOD.

A.2.3 *CR image IOD module table*

Table A.2-1—CR image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
	CR Series	C.8.1.1	M
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	C-Required if contrast media was used in this image
	CR Image	C.8.1.2	M
	Overlay Plane	C.9.2	U
	Curve	C.10.2	U
	Modality LUT	C.11.1	U
	VOILUT	C.11.2	U
	SOP Common	C.12.1	M

A.3 Computed tomography image information object definition

A.3.1 *CT image IOD description*

The Computed Tomography (CT) image Information Object Definition specifies an image which has been created by a computed tomography imaging device.

A.3.2 *CT 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 CT image IOD. The overlay IE, modality LUT IE, VOI LUT IE and curve IE are not components of the CT Image IOD.

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A.3.3 *CT image IOD module table*

Table A.3-1—CT image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Plane	C.7.6.2	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C-Required if contrast media was used in this image
	CT Image	C.8.2.1	M
	Overlay Plane	C.9.2	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

A.4 Magnetic resonance image information object definition

A.4.1 *MR image IOD description*

The Magnetic Resonance (MR) image Information Object Definition specifies an image which has been created by a magnetic resonance imaging device.

A.4.2 *MR 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 MR image IOD. The overlay IE, modality LUT IE, VOI LUT IE and curve IE are not components of the MR image IOD.

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A.4.3 *MR image IOD module table*

Table A.4-1—MR image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Image Plane	C.7.6.2	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C-Required if contrast media was used in this image
	MR Image	C.8.3.1	M
	Overlay Plane	C.9.2	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

A.5 Nuclear medicine image information object definition

A.5.1 *NM image IOD description*

The Nuclear Medicine (NM) image Information Object Definition specifies an image which has been created by a nuclear medicine imaging device. This includes data created by external detection devices which create images of the distribution of administered radioactive materials in the body. Depending on the specific radio pharmaceutical administered and the particular imaging procedure performed, problems involving changes in metabolism, function, or physiology can be investigated and various regional pathologies can be studied.

A.5.2 *NM image IOD entity-relationship model*

The E-R model in section A.1.2 of this part depicts those components of the DICOM Information Model which directly reference the NM image IOD. The modality LUT IE and VOI LUT IE are not components of the NM image IOD.

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A.5.3 *NM image IOD module table*

Table A.5-1—NM image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
	NM Series	C.8.4.1	M
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
	NM Equipment	C.8.4.2	U
Image (see A.5.3.1)	General Image	C.7.6.1	M
	Image Plane	C.7.6.2	U
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	C-Required if pixel data is Multi-frame cine data.
	Multi-frame	C.7.6.6	C-Required if pixel data is Multi-frame data.
	NM Image	C.8.4.3	M
	NM SPECT Acquisition Image	C.8.4.4	C-Required if this is a NM SPECT Acquisition Image
	NM Multi-gated Acquisition Image	C.8.4.5	C-Required if this is a NM Multi-gated Acquisition Image.
	Overlay Plane	C.9.2	U
	Multi-frame Overlay	C.9.3	U
	Curve	C.10.2	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M
Overlay (see A.5.3.1)	Overlay Identification	C.9.1	M
	Overlay Plane	C.9.2	M
	Multi-frame Overlay	C.9.3	M
	SOP Common	C.12.1	M
Curve (see A.5.3.1)	Curve Identification	C.10.1	M
	Curve	C.10.2	M
	SOP Common	C.12.1	M

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A.5.3.1 MUTUALLY EXCLUSIVE IES

The image, overlay and curve IEs are mutually exclusive. Each SOP instance using this IOD shall contain exactly one of these IEs.

A.6 Ultrasound image information object definition

A.6.1 *US image IOD description*

The ultrasound (US) image Information Object Definition specifies an image which has been created by an ultrasound imaging device.

A.6.2 *US 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 US image IOD. The overlay IE, modality LUT IE and VOI LUT IE are not components of the US image IOD.

A.6.3 *US image IOD module table*

Table A.6-1—US image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Frame of Reference	Frame of Reference	C.7.4.1	U
	US Frame of Reference	C.8.5.1	C-Required if images are spatially related
Equipment	General Equipment	C.7.5.1	M
Image (See A.6.3.1)	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C-Required if contrast media was used in this image
	US Region Calibration	C.8.5.2	U
	US Image	C.8.5.3	M
	Overlay Plane	C.9.2	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

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Talbe A.6-1 continued

Curve (See A.6.3.1)	Curve Identification	C.10.1	M
	Curve	C.10.2	M
	Audio	C.10.3	U
	SOP Common	C.12.1	M

A.6.3.1 MUTUALLY EXCLUSIVE IES

The image and curve IEs are mutually exclusive. Each SOP Instance using this IOD shall contain exactly one of these IEs.

A.7 Ultrasound multi-frame image information object definition

A.7.1 *US image IOD description*

The ultrasound (US) Multi-frame image Information Object Definition specifies a Multi-frame image which has been created by an ultrasound imaging device.

A.7.2 *US multi-frame image IOD entity-relationship model*

The E-R model in A.1.2 depicts those components of the DICOM Information Model which directly reference the US Multi-frame image IOD. The overlay IE, modality LUT IE and VOI LUT IE are not components of the US Multi-frame Image IOD.

A.7.3 *US multi-frame image IOD module table*

Table A.7-1—US multi-frame image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Frame of Reference	Frame of Reference	C.7.4.1	U
	US Frame of Reference	C.8.5.1	C-Required if images are spatially related
Equipment	General Equipment	C.7.5.1	M

Table continued on next page

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Table A.7-1 continued

Image (see A.7.3.1)	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	Contrast/bolus	C.7.6.4	C-Required if contrast media was used in this image.
	Cine	C.7.6.5	C-Required if pixel data is Multi-frame cine data.
	Multi-frame	C.7.6.6	M
	US Region Calibration	C.8.5.2	U
	US Image	C.8.5.3	M
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M
Curve (see A.7.3.1)	Curve Identification	C.10.1	M
	Curve	C.10.2	M
	Audio	C.10.3	U
	SOP Common	C.12.1	M

A.7.3.1 MUTUALLY EXCLUSIVE IES

The image and curve IEs are mutually exclusive. Each SOP instance using this IOD shall contain exactly one of these IEs.

A.8 Secondary capture image information object definition

A.8.1 *SC image IOD description*

The Secondary Capture (SC) image Information Object Definition specifies images that are converted from a non-DICOM format to a modality independent DICOM format.

Examples of types of equipment that create secondary capture images include:

— Video interfaces that convert an analog video signal into a digital image

— Digital interfaces that are commonly used to transfer non-DICOM digital images from an imaging device to a laser printer

— Film digitizers that convert an analog film image to digital data

— Workstations that construct images that are sent out as a screen dump

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A.8.2 *SC image IOD entity-relationship model*

The E-R model in A.1.2 depicts those components of the DICOM Information Model which directly reference the Secondary Capture image IOD. The frame of reference IE, overlay IE, modality LUT IE, VOI LUT IE and curve IE are not components of the Secondary Capture IOD.

A.8.3 *SC image IOD module table*

Table A.8-1—SC Image IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	U
	SC Equipment	C.8.6.1	M
Image	General Image	C.7.6.1	M
	Image Pixel	C.7.6.3	M
	SC Image	C.8.6.2	M
	Overlay Plane	C.9.2	U
	Modality LUT	C.11.1	U
	VOI LUT	C.11.2	U
	SOP Common	C.12.1	M

A.9 Standalone overlay information object definition

A.9.1 *Standalone overlay IOD description*

A standalone overlay IOD is the specification of an overlay which may be related to an image, but also may have its own existence within a series. The standalone overlay IOD is modality independent. It provides a mechanism to convey bit-mapped text, graphical information, etc. included in a series.

A.9.2 *Standalone overlay IOD entity-relationship model*

The E-R model in A.1.2 depicts those components of the DICOM Information Model which directly reference the standalone overlay IOD. The frame of reference IE, image IE, modality LUT IE, VOI LUT IE and curve IE are not components of the standalone overlay IOD.

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A.9.3 *Standalone overlay IOD module table*

Table A.9-1—Standalone overlay IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	M
Overlay	Overlay Identification	C.9.1	M
	Overlay Plane (see note)	C.9.2	M
	SOP Common	C.12.1	M

NOTE— The Attribute Overlay Data (60xx,3000) allows for overlay data to be encoded in the pixel data in Group 7FE0H. For this standalone overlay IOD, Group 7FE0H does not exist and therefore the overlay data is contained in the Overlay Data Attribute.

A.10 Standalone curve information object definition

A.10.1 *Standalone curve IOD description*

A standalone curve IOD is the specification of an curve which may be related to an image, but also may have its own existence within a series. The standalone curve IOD is modality independent.

A.10.2 *Standalone curve IOD entity-relationship model*

The E-R model in section A.1.2 of this part depicts those components of the DICOM Information Model which directly reference the standalone curve IOD. The frame of reference IE, overlay IE, modality LUT IE, VOI LUT IE and Image IE are not components of the standalone curve IOD.

A.10.3 *Standalone curve IOD module table*

Table A.10-1—Standalone curve IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U

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Table A.10-1 continued

Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	M
Curve	Curve Identification	C.10.1	M
	Curve	C.10.2	M
	SOP Common	C.12.1	M

A.11 Basic study descriptor information object definition

A.11.1 *Basic study descriptor IOD description*

A Basic Study Descriptor IOD is the specification of an abstract information model of summary information for a Study, which may be exchanged between connecting devices which claim conformance to the DICOM Standard. This Basic Study Descriptor is intended to be modality independent. It is intended to provide a simple "directory" for a study to explicitly convey references to the content of a study.

A.11.2 *Basic study descriptor entity-relationship model*

The ER model for the Basic Study Descriptor Information Object Definition is shown in Figure A.11-1.

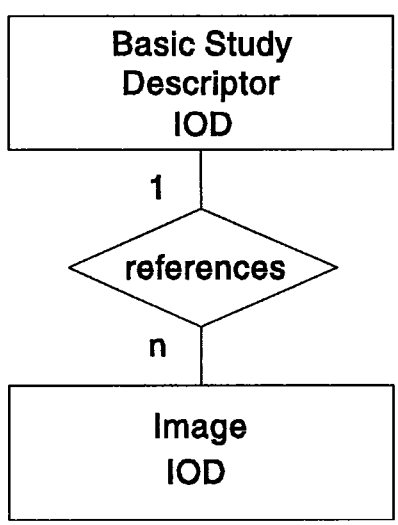

Figure A.11-1–Basic study descriptor information object definition E-R model

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A.11.3 *Basic study descriptor IOD module table*

Table A.11-1—Basic study descriptor IOD module table

Module	Reference	Usage
Patient Summary	C.7.7	M
Study Content	C.7.8	M
SOP Common	C.12.1	M

A.12 Standalone modality LUT information object definition

A.12.1 *Standalone modality LUT IOD description*

The Standalone Modality LUT IOD specifies one or more Modality LUTs that are related to an image.

A.12.2 *Standalone modality LUT IOD entity-relationship model*

The E-R Model in A.1.2 depicts those components of the DICOM Information Model which directly reference the standalone modality LUT IOD. The frame of reference IE, overlay IE, curve IE, VOI LUT IE and image IE are not components of the standalone modality LUT IOD.

A.12.3 *Standalone modality LUT IOD module table*

Table A.12-1—Standalone modality LUT IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	M
Modality LUT	Modality LUT Module	C.11.1	M
	LUT Identification	C.11.3	M
	SOP Common	C.12.1	M

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A.13 Standalone VOI LUT information object definition

A.13.1 *Standalone VOI LUT IOD description*

The standalone VOI LUT IOD specifies one or more VOI LUTs that are related to an image.

A.13.2 *Standalone VOI LUT IOD entity-relationship model*

The E-R model in section A.1.2 of this part depicts those components of the DICOM Information Model which directly reference the standalone VOI LUT IOD. The frame of reference IE, overlay IE, curve IE, modality LUT IE and image IE are not components of the standalone VOI LUT IOD.

A.13.3 *Standalone VOI LUT IOD module table*

Table A.13-1—Standalone VOI LUT IOD modules

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
Series	General Series	C.7.3.1	M
Equipment	General Equipment	C.7.5.1	M
VOI LUT	VOI LUT Module	C.11.2	M
	LUT Identification	C.11.3	M
	SOP Common	C.12.1	M

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Annex B
(Normative)
Normalized information object definitions

B.1 Patient information object definition

B.1.1 *IOD description*

The Patient Information Object Definition is an abstraction of the information describing a patient upon whom medical imaging services are performed. The Patient IOD is tailored by Service Class Definitions that use services which facilitate the exchange of patient-related information between DICOM Application Entities.

A Patient SOP Instance uses the Patient IOD as a basis to describe a real world patient. Each Patient SOP Instance references related Visit SOP Instances and Study SOP Instances as described by the entity relation diagram in section 7.

B.1.2 *Patient IOD modules*

Table B.1-1 identifies and defines the modules that comprise this IOD. Modules listed are either mandatory or optional as specified in PS 3.4. Mandatory modules contain attributes that are included in all SOP Instances employing this IOD.

Table B.1-1—Patient IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP common information
Patient Relationship	C.2.1	References to related SOPs
Patient Indentification	C.2.2	Identifies the real world patient
Patient Demographic	C.2.3	Describe the patient
Patient Medical	C.2.4	Medical information about patient

B.2 Visit information object definition

B.2.1 *IOD description*

The Visit Information Object Definition is an abstraction of the information that describes a patient attendance to a healthcare provider. Because it is defined generically, this IOD may be used in applications ranging from inpatient hospital to outpatient radiological attendances. It includes such information as the admitting date and time, the admitting diagnosis, and the physician who referred the patient. The Visit IOD is tailored by Service Class Definitions that use services which facilitate the exchange of visit-related information between DICOM Application Entities.

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A Visit SOP Instance uses the Visit Information Object Definition as a basis to describe a real world patient visit. Each visit SOP instance references related patient SOP Instances and Study SOP Instances as described by the entity relation diagram in section 7.

B.2.2 *IOD modules*

Table B.2-1 identifies and defines the Modules that comprise this IOD. Modules listed are either mandatory or optional as specified in PS 3.4. Mandatory modules contain Attributes that are included in all SOP Instances employing this IOD.

Table B.2-1—Visit IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP common information
Visit Relationship	C.3.1	Reference to related SOPs
Visit Identification	C.3.2	Identifies the real world visit
Visit Admission	C.3.4	Describes patient's admission
Visit Status	C.3.3	Describes patient's stay
Visit Discharge	C.3.5	Describes patient's discharge
Visit Scheduling	C.3.6	Describes scheduling information for the patient's stay

B.3 Study information object definition

B.3.1 *IOD description*

The Study Information Object Definition is an abstraction of the information which describes a diagnostic imaging study. It includes such information as the reason for performing the study, the radiological procedure performed, and the time and date of the radiological procedure. The Study IOD is tailored by Service Class Definitions which use services which facilitate the exchange of study-related information between DICOM Application Entities.

A Study SOP Instance uses the Study Information Object Definition as a basis to describe a real world diagnostic imaging study for a patient. Each Study SOP Instance references related Visit SOP Instances and Patient SOP Instances as described by the entity relation diagram in section 7.

B.3.2 *IOD modules*

Table B.3-1 identifies and defines the Modules which comprise this IOD. Modules listed are either mandatory or optional as specified in PS 3.4. Mandatory modules contain Attributes which are included in all SOP Instances of this IOD.

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Table B.3-1—Study IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Study Relationship	C.4.1	References to related SOP's
Study Indentification	C.4.2	Indentifies the real world study
Study Classification	C.4.3	Classifies the real world study
Study Scheduling	C.4.4	Times and dates to perform study
Study Acquisition	C.4.5	Information acquired in study
Study Read	C.4.6	Reading related information

B.4 Study component information object definitions

B.4.1 *IOD description*

A Study Component Information Object Definition is the specification of an abstract information model of summary information for a study, which may be exchanged between connecting devices which claim conformance to the DICOM Standard. This study component is intended to be modality independent.

Each Study IOD as defined in B.3 relates to one or more Study Component IOD. This relationship is maintained by the Study Component Relationship Module. A study component represents one modality's contribution to a study which may include additional components contributed by other modalities.

B.4.2 *IOD modules*

Table B.4-1—Study component IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP common information
Study Component Relationship	C.4.8	Reference to related SOPs
Study Component Acquisition	C.4.9	Status and acquisition information
Study Component	C.4.7	Identifies the related series

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B.5 Results information object definition

B.5.1 *IOD description*

The Results Information Object Definition is an abstraction of the information resulting from the analysis of a diagnostic imaging study. This information consists of an initial report, some number of amendments to the initial report, and associated general attributes. The results IOD is tailored by Service Class Definitions which use services which facilitate the exchange of results-related information between DICOM Application Entities.

A Results SOP Instance uses the Results Information Object Definition as a basis to describe real world diagnostic imaging results for a patient. Each Results SOP Instance references related Interpretation SOP Instances which represent diagnoses made during interpretation of the related studies. There may be one report (i.e. original interpretation) and many amendments (i.e. additional interpretations). The full results for a diagnostic study are hence the sum of the original report and all of its associated amendments.

Each Results SOP Instance references related Study SOP Instances and Interpretation Sop Instances as described by the entity relation diagram in section 7.

B.5.2 *IOD modules*

Table B.5-1 identifies and defines the Modules which comprise this IOD. Modules listed are either mandatory or optional as specified in PS 3.4. Mandatory modules contain Attributes which are included in all SOP Instances of this IOD.

Table B.5-1—Results IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP common information
Results Relationship	C.5.1	References to related SOPs
Results Indentification	C.5.2	Indentifies the real world results
Results Impressions	C.5.3	Classifies the real world results

B.6 Interpretation information object definition

B.6.1 *IOD description*

The Interpretation Information Object Definition is an abstraction of the information resulting from a single interpretation of a diagnostic imaging study. This interpretation may be either a report (initial interpretation) or an amendment to a report for a diagnostic imaging study. The Interpretation IOD is tailored by Service Class Definitions which use services which facilitate the exchange of interpretation-related information between DICOM Application Entities.

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An Interpretation SOP Instance uses the Interpretation Information Object Definition as a basis to describe real world interpretation of a diagnostic imaging study. Each Interpretation SOP Instance references Results SOP Instances which represent the total diagnosis made for the related study. There may be one report interpretation and many amendment interpretations. The full results for a diagnostic study are hence the sum of the original report and all of its associated amendments.

B.6.2 *IOD modules*

Table B.6-1 identifies and defines the Modules which comprise this IOD. Modules listed are either mandatory or optional as specified in PS 3.4. Mandatory Modules contain Attributes which are included in all SOP Instances of this IOD.

Table B.6-1—Interpretation IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Interpretation Relationship	C.6.1	References to related SOPs
Interpretation Identification	C.6.2	Indentifies the real world interpretation
Interpretation State	C.6.3	State of real world interpretation
Interpretation Recording	C.6.4	When, by whom the interpretation was recorded
Interpretation Transcription	C.6.5	When, by whom the interpretation was transcribed
Interprettion Approval	C.6.6	When, by whom the interpretation was approved

B.7 Basic film session information object definition

B.7.1 *IOD description*

The Basic Film Session Information Object Definition describes the presentation parameters, which are common for all the films of a film session (e.g. number of films, film destination).

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B.7.2 *IOD modules*

Table B.7-1—Film session IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Basic Film Session Presentation Module	C.13.1	Contains Film Session presentations information
Basic Film Session Relationship	C.13.2	References to related SOPs

B.8 Basic film box information object definition

B.8.1 *IOD description*

The Basic Film Box Information Object Definition is an abstraction of the presentation of one film of the film session. The Basic Film Box IOD describes the presentation parameters which are common for all images on a given sheet of film.

B.8.2 *IOD modules*

Table B.8-1—Film Box IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Basic Film Box Presentation Module	C.13.3	Contains Film Box presentation information
Basic Film box Relationship	C.13.4	References to related SOPs

B.9 Image box information object definition

B.9.1 *IOD description*

The Image Box Information Object Definition is an abstraction of the presentation of an image and image related data in the image area of a film. The Image Box IOD describes the presentation parameters and image pixel data which apply to a single image of a sheet of film.

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B.9.2 *IOD modules*

Table B.9-1—Image box IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Basic Image Box Presentation Module	C.13.5	Contains Image Box presentation information
Basic Image Box Relationship Module	C.13.6	References to related SOPs

B.10 Basic annotation information object definition

B.10.1 *IOD description*

The Basic Annotation Box Information Object Definition is an abstraction of the presentation of an annotation (e.g. text string) on a film. The Basic Annotation Box IOD describes the most used text related presentation parameters.

B.10.2 *IOD modules*

Table B.10-1—Annotation IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Basic Annotation Presentation Module	C.13.7	Contains annotation presentation information

B.11 Basic print job information object definition

B.11.1 *IOD description*

The Print Job Information Object Definition is an abstraction of the print job transaction and is the basic information entity to monitor the execution of the print process. A print job contains one film or multiple films, all belonging to the same film session.

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B.11.2 *IOD modules*

Table B.11-1—Print job IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Print Job Module	C.13.8	Contains print job transaction information

B.12 Printer information object definition

B.12.1 *IOD description*

The Printer Information Object Definition is an abstraction of the hardcopy printer and is the basic information entity to monitor the status of the printer.

B.12.2 *IOD modules*

Table B.12-1—Printer IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Printer Module	C.13.9	Contains status information to monitor the printer

B.13 VOI LUT box information object definition

B.13.1 *IOD description*

The VOI LUT Box Information Object Definition is an abstraction of a Value Of Interest LUT. The VOI LUT transforms the modality pixel values into pixel values which are meaningful for the user or the application.

B.13.2 *IOD modules*

Table B.13-1—VOI LUT box IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
VOI LUT Module	C.11.2	Contains VOILUT information

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B.14 Image overlay box information object definition

B.14.1 *IOD description*

The Image Overlay Box Information Object Definition is an abstraction of the presentation of an image overlay in an image box.

B.14.2 *IOD modules*

Table B.14-1—Image overlay box IOD modules

Module	Reference	Module Description
SOP Common	C.12.1	Contains SOP Common information
Image Overlay Box Presentation Module	C.13.10	Contains Film Box presentation information
Image Overlay Box Relationship Module	C.13.11	References to related SOPs

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Annex C
(Normative)
Information module definitions

C.1 Elements of a module definition

A Module definition is composed of the following sections

a) Module description
b) Module definition
c) Attribute description (optional)

Sections C.1.1 through C.1.3 define the requirements of a) through c) above.

C.1.1 *Module description*

This section briefly describes the Module and references the Module definition.

C.1.2 *Module definition*

This section contains a table which enumerates each attribute contained in the Module. For each attribute in the table the following information is given:

a) Attribute name (see C.1.2.1)

b) Data Element Tag (see C.1.2.2)

c) Type designation (see C.1.2.3)

d) Attribute definition (see C.1.2.4)

C.1.2.1 ATTRIBUTE NAME

This name shall be used whenever referencing the Attribute. This name shall also identify the Attribute in PS 3.6.

C.1.2.2 ATTRIBUTE TAG

Each Attribute has a tag which uniquely identifies the Attribute (also used for encoding into a data set - see PS 3.5). This tag also serves as an index into the Data Dictionary of PS 3.6.

C.1.2.3 TYPE DESIGNATION

Each Attribute contained in a Module referenced by a Composite IOD defines a type designation which indicates if a specific Attribute is required for all DIMSE operations/notifications associated with a SOP class using this Module. PS 3.5 defines a choice of generic type designations available for DICOM Attributes.

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NOTE— The type designation specified is generally determined by the value most appropriate for the C-STORE DIMSE service.

The type designation given in a Module is a default value and as such may be overridden by an IOD referencing the Module. Some Attributes may also be contained in more than one Module for the IOD. In that case, the type designation applicable for the Attribute of the specific IOD is the lowest type value (e.g., if type 2 is specified in one module and type 3 in another, then type 2 shall apply).

The type designation given in a Module (and/or IOD) may also be overridden by Service Class Definitions referencing the IOD containing the Module. PS 3.4 specifies the Service Class Definitions.

C.1.2.4 ATTRIBUTE DEFINITION

A brief definition will be provided for each Attribute in the Module definition table. The description shall provide a context for the use of the Attribute and provide general elucidation. Defined terms and enumerated values applicable to the Attribute may also be listed in the Attribute description.

C.1.3 *Attribute descriptions*

Additional information may be provided if necessary for selected Attributes. Such information shall be placed following the Module definition table. Dependencies between Attributes may be specified in this section.

C.2 Patient modules

The following sections specify Modules used for patient management.

C.2.1 *Patient relationship module*

Table C.2-1 defines the attributes that reference SOP Instances related to this SOP Class.

C.2.2 *Patient identification module*

Table C.2-2 defines the Attributes relevant to identifying a patient.

C.2.3 *Patient demographic module*

Table C.2-3 defines the Attributes relevant to generally describing a patient.

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Table C.2-1—Patient relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Study Sequence	(0008,1110)	Uniquely identifies the Study SOP Instances associated with the Patient SOP Instance.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Visit Sequence	(0008,1125)	Uniquely identifies the Visit SOP Instances associated with this Patient SOP Instance
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Patient Alias Sequence	(0038,0004)	Uniquely identifies any Patient SOP Instances which also describe this patient. These SOP Instances are aliases.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.

Table C.2-2—Patient identification module attributes

Attribute Name	Tag	Attribute Description
Patient's Name	(0010,0010)	Patient's full legal name
Patient ID	(0010,0020)	Primary hospital identification number or code for the patient
Issuer of Patient ID	(0010,0021)	Name of healthcare provider which issued the Patient ID
Other Patient IDs	(0010,1000)	Other identification numbers or codes used to identify the patient
Other Patient Names	(0010,1001)	Other names used to identify the patient
Patient's Birth Name	(0010,1005)	Patient's birth name
Patient's Mother's Birth Name	(0010,1060)	Birth name of patient's mother
Medical Record Locator	(0010,1090)	An identifier used to find the patient's existing medical record (e.g. film jacket)

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Table C.2-3—Patient demographic module attributes

Attribute Name	Tag	Attribute Description
Patient's Birth Date	(0010,0030)	Date of birth of the named patient
Patient's Birth Time	(0010,0032)	Time of birth of the named patient
Patient's Sex	(0010,0040)	Sex of the named patient. Enumerated Values: M = male F = female O = other
Patient's Insurance Plan Code Sequence	(0010,0050)	A sequence that conveys the patient's insurance plan.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the patient's insurance plan name.
>Coding Scheme Designator	(0008,0102)	The code from Table D-1 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104).
>Code Meaning	(0008,0104)	The patient's insurance plan name that is represented by the Code Value (0008,0100)
Patient's Size	(0010,1020)	Patient's height or length in meters
Patient's Weight	(0010,1030)	Weight of the patient in kilograms
Patient's Address	(0010,1040)	Legal address of the named patient
Military Rank	(0010,1080)	Military rank of patient
Branch of Service	(0010,1081)	Branch of the military. The country allegiance may also be included (e.g. U.S. Army)
Country of Residence	(0010,2150)	Country in which patient currently resides
Region of Residence	(0010,2152)	Region within patient's country of residence
Patient's Telephone Numbers	(0010,2154)	Telephone numbers at which the patient can be reached
Ethnic Group	(0010,2160)	Ethnic group or race of patient
Patient's Religious Preference	(0010,21F0)	The religious preference of the patient
Patient Comments	(0010,4000)	User-defined comments about the patient

C.2.4 *Patient medical module*

Table C.2-4 defines the Attributes relevant to a patient's medical state or history.

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Table C.2-4—Patient medical module attributes

Attribute Name	Tag	Attribute Description
Medical Alerts	(0010,2000)	Conditions to which medical staff should be alerted (e.g. contagious condition, drug allergies, etc.)
Contrast Allergies	(0010,2110)	Description of prior reaction to contrast agents.
Smoking Status	(0010,21A0)	Indicates whether patient smokes. Enumerated Values: YES NO UNKNOWN
Additional Patient History	(0010,21B0)	Additional information about the patient's medical history
Pregnancy Status	(0010,21C0)	Describes pregnancy state of patient. Enumerated Values: 0001 = not pregnant 0002 = possibly pregnant 0003 = definitely pregnant 0004 = unknown
Last Menstrual Date	(0010,21D0)	Date of onset of last menstrual period
Special Needs	(0038,0050)	Medical and social needs (e.g. wheelchair, oxygen, non-English-speaking etc.)
Patient State	(0038,0500)	Description of patient state (comatose, disoriented, vision impaired etc.)

C.3 Visit modules

The following sections specify Modules relevant to a real world patient visit.

C.3.1 *Visit relationship module*

Table C.3-1 defines the Attributes which reference SOP Instances related to this SOP Class.

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Table C.3-1—Visit relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Study Sequence	(0008,1110)	Uniquely identifies the Study SOP Instances associated with the Visit SOP Instance.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Patient Sequence	(0008,1120)	Uniquely identifies the Patient SOP Instance that relates to the Visit SOP Instance
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.

C.3.2 *Visit identification module*

Table C.3-2 defines the Attributes relevant to identifying a visit.

Table C.3-2—Visit identification module attributes

Attribute Name	Tag	Attribute Description
Institution Name	(0008,0080)	Institution where the equipment is located
Institution Address	(0008,0081)	Mailing Address of the institution where the equipment is located
Institution Code Sequence	(0008,0082)	A sequence that conveys the healthcare facility identification.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the healthcare facility name.
>Coding Scheme Designator	(0008,0102)	The code from table D-1 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The healthcare facility name that is represented by the Code Value (0008,0100)
Admission ID	(0038,0010)	Identification number of the visit as assigned by the healthcare provider
Issuer of Admission ID	(0038,0011)	Name of healthcare provider which issued the Admission ID

C.3.3 *Visit status module*

Table C.3-3 defines the Attributes relevant to the patient's stay with the healthcare provider.

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Table C.3-3—Visit status module attributes

Attribute Name	Tag	Attribute Description
Visit Status ID	(0038,0008)	Identifies the state of the visit. Defined Terms: CREATED = Created but not yet scheduled SCHEDULED = Scheduled but not yet admitted ADMITTED = Patient admitted to institution DISCHARGED = Patient Discharged
Current Patient Location	(0038,0300)	Describes the current known location of the patient
Patient's Institution Residence	(0038,0400)	Primary location where patient resides (ward, floor, room, etc. or outpatient)
Visit Comments	(0038,4000)	User-defined comments about the visit

C.3.4 *Visit admission module*

Table C.3-4 defines the Attributes relevant to admitting a patient during a visit.

Table C.3-4—Visit admission module attributes

Attribute Name	Tag	Attribute Description
Referring Physician's Name	(0008,0090)	Patient's primary referring physician for this visit
Referring Physician's Address	(0008,0092)	Referring physician's address
Referring Physician's Phone Numbers	(0008,0094)	Referring physician's phone numbers
Admitting Diagnosis Description	(0008,1080)	Description of admitting diagnosis
Admitting Diagnosis Code Sequence	(0008,1084)	A sequence that conveys the admitting diagnosis.
Route of Admissions	(0038,0016)	Mode of admission: emergency, normal
Admitting Date	(0038,0020)	Date patient visit began
Admitting Time	(0038,0021)	Time patient visit began
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the admitting diagnosis.
>Coding Scheme Designator	(0008,0102)	The code from table D-1 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The admitting diagnosis that is represented by the Code Value (0008,0100)

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C.3.5 *Visit discharge module*

Table C.3-5 defines the Attributes relevant to the discharging of a patient from a visit.

Table C.3-5—Visit discharge module attributes

Attribute Name	Tag	Attribute Description
Discharge Date	(0038,0030)	Date patient visit ended or is scheduled to end
Discharge Time	(0038,0032)	Time patient visit ended or is scheduled to end
Discharge Diagnosis Description	(0038,0040)	Institution-generated description of discharge diagnosis
Discharge Diagnosis Code Sequence	(0038,0044)	A sequence that conveys the discharge diagnosis.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the discharge diagnosis.
>Coding Scheme Designator	(0008,0102)	The code from table D-1 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The discharge diagnosis that is represented by the Code Value (0008,0100)

C.3.6 *Visit scheduling module*

Table C.3-6 defines the Attributes relevant to the scheduling of a patient visit.

Table C.3-6—Visit scheduling module attributes

Attribute Name	Tag	Attribute Description
Scheduled Admission Date	(0038,001A)	Date patient visit is scheduled to start
Scheduled Admission Time	(0038,001B)	Time patient visit is scheduled to start
Scheduled Discharge Date	(0038,001C)	Date patient visit is scheduled to end
Scheduled Discharge Time	(0038,001D)	Time patient visit is scheduled to end
Scheduled Patient Institution Residence	(0038,001E)	Scheduled location where patient is to reside (ward, floor, room, etc. or outpatient)

C.4 Study modules

The following sections specify Modules relevant to a real world diagnostic imaging study performed on a patient.

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C.4.1 *Study relationship module*

Table C.4-1 defines the Attributes which reference SOP Instances subordinate or superior to this SOP Class in the naming hierarchy.

Table C.4-1—Study relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Visit Sequence	(0008,1125)	Uniquely identifies the Visit SOP Instances associated with this Study SOP Instance
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Patient Sequence	(0008,1120)	Uniquely identifies the Patient SOP Instance that relates to the Study SOP Instance
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Results Sequence	(0008,1100)	Uniquely identifies the results SOP Instance for which the interpretation SOP Instance applies
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Study Component Sequence	(0008,1100)	Uniquely identifies the Study Component SOP Instances to which the Study SOP Instance is related.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Study Instance UID	(0020,000D)	Unique identifier for the Study
Accession Number	(0008,0050)	A RIS generated number which identifies the order for the Study.

C.4.2 *Study identification module*

Table C.4-2 defines the Attributes relevant to identifying a study.

C.4.3 *Study classification module*

Table C.4-3 defines the Attributes relevant to classifying a study.

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Table C.4-2—Study identification module attributes

Attribute Name	Tag	Attribute Description
Study ID	(0020,0010)	User or equipment generated Study identifier
Study ID Issuer	(0032,0012)	Name of healthcare provider that issued the Study ID
Other Study Numbers	(0020,1070)	Other identifiers assigned to study by institution

Table C.4-3—Study classification module attributes

Attribute Name	Tag	Attribute Description
Study Status ID	(0032,000A)	Identifies the state of the study. Enumerated Values: CREATED = Created but not yet scheduled SCHEDULED = Scheduled but not yet started ARRIVED = Patient Arrived but study not started STARTED = Started but not yet finished COMPLETED = Complete but image quality not verified VERIFIED = Complete and image quality verified READ = Read by the Physicians
Study Priority ID	(0032,000C)	Identifies the priority of the study. Enumerated values: LOW, MED, HIGH
Study Comments	(0032,4000)	User-defined comments about the study

C.4.4 *Study scheduling module*

Table C.4-4 defines the Attributes relevant to scheduling a study.

Table C.4-4—Study scheduling module attributes

Attribute Name	Tag	Attribute Description
Scheduled Study Start Date	(0032,1000)	Date on which the study is scheduled to start
Scheduled Study Start Time	(0032,1001)	Time at which the study is scheduled to start
Scheduled Study Stop Date	(0032,1010)	Date on which the patient examination for the study is scheduled to end
Scheduled Study Stop Time	(0032,1011)	Time at which the patient examination for the study is scheduled to end
Scheduled Study Location	(0032,1020)	User-defined location at which the study will be performed

Table continued on next page

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Table C.4-4 Continued

Scheduled Study Location AE Title	(0032,1021)	A list of Application Entity Title(s) of the location at which the study will be performed
Reason for Study	(0032,1030)	Describes the reason for performing study
Requesting Physician	(0032,1032)	Physician who requested the study
Requesting Service	(0032,1033)	Institutional department where the request initiated.
Requested Procedure Description	(0032,1060)	Institution-generated description or classification of requested procedure
Requested Procedure Code Sequence	(0032,1064)	A sequence that conveys the requested procedure.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the type of procedure requested.
>Coding Scheme Designator	(0008,0102)	The code from table D-2 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The requested procedure that is represented by the Code Value (0008,0100)
Requested Contrast Agent	(0032,1070)	Contrast agent requested for use in the procedure

C.4.5 *Study acquisition module*

Table C.4-5 defines the Attributes relevant to acquiring a study.

C.4.6 *Study read module*

Table C.4-6 defines the Attributes relevant to the reading of a study.

C.4.7 *Study component module*

Table C.4-7 defines the Attributes relevant to the study component.

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Table C.4-5—Study acquisition module attributes

Attribute Name	Tag	Attribute Description
Study Arrival Date	(0032,1040)	Date that patient arrived at study check-in location
Study Arival Time	(0032,1041)	Time at which patient arrived at study check-in location
Study Date	(0008,0020)	Date on which the acquisition of the study information was started
Study Time	(0008,0030)	Time at which the acquisition of the study information was started
Study Completion Date	(0032,1050)	Date on which the acquisition of study information was completed
Study Completion Time	(0032,1051)	Time at which the acquisition of study information was completed
Study Verified Date	(0032,0032)	Date on which the image quality for the patient examination was verified
Study Verified Time	(0032,0033)	Time at which the image quality for the patient examination was verfied
Series in Study	(0020,1000)	Number of series in the study
Acquisitions in Study	(0020,1004)	Number of image data acquisitions used in performing the study

Table C.4-6 — Study read module attributes

Attribute Name	**Tag**	**Attribute Description**
Name of Physician(s) Reading Study	(0008,1060)	Physician(s) reading the study
Study Read Date	(0032,0034)	Date on which the study was read
Study Read Time	(0032,0035)	Time at which the study was read

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Table C.4-7—Study component module attributes

Attribute Name	Tag	Attribute Description
Study ID	(0020,0010)	User or equipment generated Study identifier
Study Instance UID	(0020,000D)	Unique identifier for the Study
Referenced Series Sequence	(0008,1115)	Sequence of Repeating Items where each Item includes the Attributes of zero or more Series.
>Series Date	(0008,0021)	Date the Series started.
>Series Time	(0008,0031)	Time the Series started.
>Series Instance UID	(0020,000E)	Unique identifier of the Series.
>Retrieve AE Title	(0008,0054)	Title of the DICOM Application Entity where the Image(s) may be retrieved on the network.
>Storage Media File-Set ID	(0088,0130)	The user or implementation specific human readable identifier that identifies the Storage Media on which the Image(s) reside.
>Storage Media File-Set UID	(0088,0140)	Uniquely identifies the Storage Media on which the Image(s) reside.
>Referenced Image Sequence	(0008,1140)	Sequence of Repeating Items where each Item provides reference to a set of Image SOP Class/SOP Instance pairs that are contained in the Series identified by the Series Instance UID (0020,000E).
>>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class. This Attribute is used only if Images may be retrieved as Single Image SOP Classes.
>>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance. This Attribute is used only if Images may be retrieved as Single Image SOP Classes.
>>Retrieve AE Title	(0008,0054)	Title of the DICOM Application Entity where the Image(s) may be retrieved on the network.
>>Storage Media File-Set ID	(0088,0130)	The user or implementation specific human readable identifier that identifies the Storage Media on which the Image(s) reside.
>>Storage Media File-Set UID	(0088,0140)	Uniquely identifies the Storage Media on which the Image(s) reside.

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C.4.8 *Study component relationship module*

Table C.4-8—Study component relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Study Sequence	(0008,1110)	Uniquely identifies the Study SOP Instances associated with this SOP Instance.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the SOP Instance.

C.4.9 *Study component acquisition module*

Table C.4-9—Study component acquisition module attributes

Attribute Name	Tag	Attribute Description
Modality	(0008,0060)	Type of equipment that acquired the data used to create the images in this Study Component. See C.7.3.1.1.1 for Defined Terms.
Study Description	(0008,1030)	Institution-generated description or classification of the Study (component) performed.
Procedure Code Sequence	(0008,1032)	A sequence that conveys the (single) type of procedure performed.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the procedure performed.
>Coding Scheme Designator	(0008,0102)	The code from table D-2 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The procedure performed that is represented by the Code Value (0008,0100)
Performing Physician's Name	(0008,1050)	Physician administering the study
Study Component Status ID	(0032,1055)	Identifies the state of the Study Component. Enumerated values: CREATED = Instance created but not yet complete INCOMPLETE = Acquisition not complete COMPLETED = Acquisition complete VERIFIED = Acquisition complete and Quality Control review complete POSTINTERPRET = Instance created or updated after referenced Study Instance status = COMPLETED

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C.5 Results modules

The following sections specify Modules relevant to a real world diagnostic imaging results performed on a patient.

C.5.1 *Results relationship module*

Table C.5-1 defines the Attributes which reference SOP Instances subordinate or superior to this SOP Class in the naming hierarchy.

Table C.5-1—Results relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Study Sequence	(0008,1110)	Uniquely identifies the Study SOP Instances associated with the Results SOP Instance.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.
Referenced Interpretation Sequence	(4008,0050)	Uniquely identifies the report SOP Instances and amendment SOP Instances which comprise the results SOP Instance.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the referenced SOP Instance.

C.5.2 *Results identification module*

Table C.5-2 defines the Attributes relevant to identifying results.

Table C.5-2—Results identification module attributes

Attribute Name	Tag	Attribute Description
Results ID	(4008,0040)	Healthcare provider generated number used to reference the results
Results ID Issuer	(4008,0042)	Name of healthcare provider which issued the results ID

C.5.3 *Results impressions module*

Table C.5-3 defines the Attributes relevant to the result's impressions.

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Table C.5-3—Results impression module attributes

Attribute Name	Tag	Attribute Description
Impressions	(4008,0300)	Short impressions summarizing the full results
Results Comments	(4008,4000)	User-defined comments about the results

C.6 Interpretation modules

The following sections specify Modules relevant to a real world results interpretation.

C.6.1 *Interpretation relationship module*

Table C.6-1 defines the Attributes which reference SOP Instances subordinate or superior to this SOP Class in the naming hierarchy.

Table C.6-1—Interpretation relationship module attributes

Attribute Name	Tag	Attribute Description
Referenced Results Sequence	(0008,1100)	Uniquely identifies the results SOP Instances for which the interpretation SOP Instance applies.
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance ID	(0008,1155)	Uniquely identifies the referenced SOP Instance.

C.6.2 *Interpretation identification module*

Table C.6-2 defines the Attributes relevant to identifying an interpretation.

Table C.6-2—Interpretation identification module attributes

Attribute Name	Tag	Attribute Description
Interpretation ID	(4008,0200)	Healthcare provider generated number used to reference the interpretation
Interpretation ID Issuer	(4008,0202)	Name of healthcare provider which issued the interpretation ID

C.6.3 *Interpretation state module*

Table C.6-3 defines the Attributes relevant to the state of an interpretation.

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Table C.6-3—Interpretation state module attributes

Attribute Name	Tag	Attribute Description
Interpretation Type ID	(4008,0210)	The type of interpretation. Defined Terms: REPORT = Report AMENDMENT = Amendment
Interpretation Status ID	(4008,0212)	An Enumerated Value element used to track production status of the interpretation. Defined Terms: CREATED = Interpretation Created RECORDED = Interpretation captured in a format external to the information system which handles reports. TRANSCRIBED = Interpretation converted into or entered in the internal format of the information system which handles reports. APPROVED = Interpretation Approved

C.6.4 *Interpretation recording module*

Table C.6-4 defines the Attributes relevant to the recording of an interpretation.

Table C.6-4—Interpretation recording module attributes

Attribute Name	Tag	Attribute Description
Interpretation Recorded Date	(4008,0100)	Date interpretation was dictated or entered
Interpretation Recorded Time	(4008,0101)	Time interpretation was dictated or entered
Interpretation Recorder	(4008,0102)	Name of the person who recorded the interpretation
Reference to Recorded Sound	(4008,0103)	A reference used to identify or locate the sound recording of the interpretation

C.6.5 *Interpretation transcription module*

Table C.6-5 defines the Attributes relevant to the transcription of an interpretation recording.

C.6.6 *Interpretation approval module*

Table C.6-6 defines the Attributes relevant to the approval of an interpretation.

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Table C.6-5—Interpretation transcription module attributes

Attribute Name	Tag	Attribute Description
Interpretation Transcription Date	(4008,0108)	Date interpretation was transcribed
Interpretation Transcription Time	(4008,0109)	Time interpretation was transcribed
Interpretation Transcriber	(4008,010A)	Name of person who transcribed the interpretation
Interpretation Text	(4008,010B)	Text of the interpretation
Interpretation Author	(4008,010C)	Name of author of interpretation

Table C.6-6—Interpretation approval module attributes

Attribute Name	Tag	Attribute Description
Interpretation Approver Sequence	(4008,0111)	Identifies the approvers of the interpretation. Encoded as a sequence of items: (4008,0112), (4008,0113), and (4008,0114)
>Interpretation Approval Date	(4008,0112)	Date the report or amendment was approved
>Interpretation Approval Time	(4008,0113)	Time the report or amendment was approved
>Physicians Approving Interpretation	(4008,0114)	Physician approving the report or amendment
Interpretation Diagnosis Description	(4008,0115)	Diagnosis produced by the Physician
Int erpretation Diagnosis Codes Sequence	(4008,0117)	A sequence that conveys the interpretation diagnosis.
>Code Value	(0008,0100)	The code value (defined by the coding scheme) that represents the interpretation diagnosis.
>Coding Scheme Designator	(0008,0102)	The code from table D-1 designating the coding scheme which maps the Code Value (0008,0100) onto the Code Meaning (0008,0104)
>Code Meaning	(0008,0104)	The interpretation diagnosis that is represented by the Code Value (0008,0100)
Results Distribution List Sequence	(4008,0118)	Names and addresses of persons to receive a copy of the report and amendments. Encoded as a sequence of items: (4008,0119) and (4008,011A)
>Distribution Name	(4008,0119)	Name of one of the persons to receive a copy of the report and amendments.
>Distribution Address	(4008,011A)	Address of one of the persons to receive a copy of the report and amendments.

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C.7 Common composite image IOD modules

This section defines the Modules which are Common to all Composite Image IODs.

C.7.1 *Common patient IE modules*

The following patient IE Module is common to all Composite Image IODs which reference the patient IE.

C.7.1.1 PATIENT MODULE

Table C.7-1 specifies the Attributes of the patient that describe and identify the patient who is the subject of a diagnostic study. This Module contains Attributes of the patient that are needed for diagnostic interpretation of the image and are common for all studies performed on the patient. It contains Attributes that are also included in the patient Modules in Section C.2.

Table C.7-1—Patient module attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Patient's full legal name.
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient.
Patient's Birth Date	(0010,0030)	2	Birth date of the patient.
Patient's Sex	(0010,0040)	2	Sex of the named patient. Enumerated Values are: M = male F = female O = other
Referenced Patient Sequence	(0008,1120)	3	A sequence which provides reference to a Patient SOP Class/Instance pair. Only a single reference is allowed. 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 Patient Sequence(0008,1120) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Patient Sequence(0008,1120) is sent.
Patient's Birth Time	(0010,0032)	3	Birth time of the Patient.
Other Patient IDs	(0010,1000)	3	Other identification numbers or codes used to identify the patient.
Other Patient Names	(0010,1001)	3	Other names used to identify the patient.
Ethnic Group	(0010,2160)	3	Ethnic group or race of the patient.
Patient Comments	(0010,4000)	3	User-defined additional information about the patient.

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C.7.2 *Common study IE modules*

The following study IE Modules are common to all Composite Image IODs which reference the study IE. These Modules contain Attributes of the patient and study that are needed for diagnostic interpretation of the image. They contain Attributes that are also in the patient Modules in C.2 and study Modules in C.4.

C.7.2.1 GENERAL STUDY MODULE

Table C.7-2 specifies the Attributes which describe and identify the study performed upon the patient.

Table C.7-2—General study module attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier for the Study.
Study Date	(0008,0020)	2	Date the Study started.
Study Time	(0008,0030)	2	Time the Study started.
Referring Physician's Name	(0008,0090)	2	Patient's referring physician
Study ID	(0020,0010)	2	User or equipment generated Study identifier.
Accession Number	(0008,0050)	2	A RIS generated number which identifies the order for the Study.
Study Description	(0008,1030)	3	Institution-generated description or classification of the Study (component) performed.
Name of Physician(s) Reading Study	(0008,1060)	3	Physician(s) reading the Study.
Referenced Study Sequence	(0008,1110)	3	A sequence which provides reference to a Study SOP Class/Instance pair. Only a single reference is allowed. 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 Study Sequence (0008,1110) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Referenced Study Sequence (0008,1110) is sent.

C.7.2.2 PATIENT STUDY MODULE

Table C.7-3 defines Attributes that provide information about the patient at the time the study was performed.

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Table C.7-3—Patient study module attributes

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Description of the admitting diagnosis (diagnoses)
Patient's Age	(0010,1010)	3	Age of the Patient.
Patient's Size	(0010,1020)	3	Length or size of the Patient, in meters.
Patient's Weight	(0010,1030)	3	Weight of the Patient, in kilograms.
Occupation	(0010,2180)	3	Occupation of the Patient.
Additional Patient's History	(0010,21B0)	3	Additional information about the Patient's medical history.

C.7.3 *Common series IE modules*

The following series IE Modules are common to all Composite Image IODs which reference the series IE.

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
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. See C.7.3.1.1.1 for Defined Terms.
Series Instance UID	(0020,000E)	1	Unique identifier of the Series.
Series Number	(0020,0011)	2	A number that identifies this Series.
Laterality	(0020,0060)	2C	Laterality of (paired) body part examined. Required if the body part examined is a paired structure. Enumerated Values: R = right, L = left
Series Date	(0008,0021)	3	Date the Series started.
Series Time	(0008,0031)	3	Time the Series started.
Performing Physicians' Name	(0008,1050)	3	Name of the physicians administering the Series.
Protocol Name	(0018,1030)	3	User-defined description of the conditions under which the Series was performed.
Series Description	(0008,103E)	3	User provided description of the Series

Table continued on next page

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Table C.7-4 Continued

Operators' Name	(0008,1070)	3	Technologist (s) supporting the Series.
Referenced Study Component Sequence	(0008,1111)	3	Uniquely identifies the Study Component SOP Instances to which the Series is related.
>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.
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
Patient Position	(0018,5100)	2C	Patient position descriptor relative to the equipment. Required for CT and MR images. See C.7.3.1.1.2. for Defined Terms and further explanation.
Smallest Pixel Value in Series	(0028,0108)	3	The minimum value of all images in this Series.
Largest Pixel Value in Series	(0028,0109)	3	The maximum value of all images in this Series.

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
DS = Digital Subtraction Angiography
MR = Magnetic Resonance
NM = Nuclear Medicine
US = Ultrasound
OT = Other
AS = Angioscopy
BI = Biomagnetic imaging
CD = Color flow Doppler
CF = Cinefluorography
CP = Culposcopy
CS = Cystoscopy
DD = Duplex Doppler
DF = Digital fluoroscopy
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
VF = Videofluorography

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C.7.3.1.1.2 Patient position

Patient position (0018,5100) specifies the position of the patient relative to the imaging equipment space. This Attribute is intended for annotation purposes only. It does not provide an exact mathematical relationship of the patient to the imaging equipment.

When facing the front of the imaging equipment, Head First is defined as the patient's head being positioned toward the front of the imaging equipment. Feet First is defined as the patient's feet being positioned toward the front of the imaging equipment. Prone is defined as the patient's face being positioned in a downwards (gravity) direction. Supine is defined as the patient's face being in an upwards direction. Decubitus Right is defined as the patient's right side being in a downwards direction. Decubitus Left is defined as the patient's left side being in a downwards direction.

The Defined Terms are:

HFP = Head First-Prone
HFS = Head First-Supine
HFDR = Head First-Decubitus Right
HFDL = Head First-Decubitus Left
FFDL = Feet First-Decubitus Left
FFDR = Feet First-Decubitus Right
FFP = Feet First-Prone
FFS = Feet First-Supine

C.7.4 *Common frame of reference information entity modules*

The following Frame of Reference IE Module is common to all Composite Image IODs which reference the Frame of Reference IE.

C.7.4.1 FRAME OF REFERENCE MODULE

Table C.7-5 specifies the Attributes necessary to uniquely identify a frame of reference which insures the spatial relationship of Images within a series. It also allows images across multiple series to share the same frame of reference. This frame of reference (or coordinate system) shall be constant for all images related to a specific frame of reference.

When a frame of reference is identified, it is not important how the patient is positioned relative to the imaging equipment or where the origin of the frame of reference is located. It is important that the position of the patient and the origin are constant in relationship to a specific frame of reference.

NOTE— Since the criteria used to group images into a series is application specific, it is possible for imaging applications to define multiple series within a study which share the same imaging space. Previous versions of the DICOM Standard specified that all images within the series must be spatially related. However, insufficient information was available to determine if multiple series within a study were spatially related.

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Table C.7-5—Frame of reference module attributes

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series. See C.7.4.1.1.1 for further explanation.
Position Reference Indicator	(0020,1040)	2	Part of the patient's anatomy used as a reference, such as the iliac crest, orbital-medial, sternal notch, symphysis pubis, xiphoid, lower coastal margin, external auditory meatus. See C.7.4.1.1.2 for further explanation.

C.7.4.1.1 Frame of reference attribute descriptions

C.7.4.1.1.1 Frame of reference UID

The Frame of Reference UID (0020,0052) shall be used to uniquely identify a frame of reference for a series. Each series shall have a single Frame of Reference UID. However, multiple series within a study may share a Frame of Reference UID. All images in a series which share the same Frame of Reference UID shall be spatially related to each other.

NOTE— Previous versions of this Standard defined a Data Element "Location" which has been retired. Frame of Reference UID provides a completely unambiguous identification of the image location reference used to indicate position.

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.

C.7.5 *Common equipment IE modules*

The following equipment IE Module is common to all Composite Image IODs which reference the equipment IE.

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.

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Table C.7-6—General equipment module attributes

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Manufacturer of the equipment that produced the digital images.
Institution Name	(0008,0080)	3	Institution where the equipment is located that produced the digital images.
Institution Address	(0008,0081)	3	Mailing address of the institution where the equipment is located that produced the digital images.
Station Name	(0008,1010)	3	User defined name identifying the machine that produced the digital images.
Institutional Department Name	(0008,1040)	3	Department in the institution where the equipment is located that produced the digital images
Manufacturer's Model Name	(0008,1090)	3	Manufacturer's model number of the equipment that produced the digital images.
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produced the digital images.
Software Versions	(0018,1020)	3	Manufacturer's designation of software version of the equipment that produced the digital images.
Spatial Resolution	(0018,1050)	3	The inherent limiting resolution in mm of the equipment for high contrast objects for the data gathering and reconstruction technique chosen. If variable across the images of the series, the value at the image center.
Date of Last Calibration	(0018,1200)	3	Date when the image acquisition device calibration was last changed in any way. Multiple entries may be used for additional calibrations at other times. See C.7.5.1.1.1 for further explanation.
Time of Last Calibration	(0018,1201)	3	Time when the image device was last changed in any way. Multiple entries may be used. See C.7.5.1.1.1 for further explanation.
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.

C.7.5.1.1 General equipment attribute descriptions

C.7.5.1.1.1 Date of last calibration, time of last calibration

Date of Last Calibration (0018,1200) and Time of Last Calibration (0018,1201) are used to convey the date and time of calibration. The Attribute Date of Last Calibration (0018,1200) may be supported alone, however, Time of Last Calibration (0018,1201) Attribute has no meaning unless Attribute Date of Last Calibration (0018,1200) is also supported. The order for each Attribute shall be from the oldest date/time to the most recent date/time. When the Attributes are both supported they shall be provided as pairs.

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C.7.5.1.1.2 Pixel padding value

Pixel Padding Value (0028,0120) is used to pad non-rectangular images to rectangle 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.

C.7.6 *Common IE modules*

The following Image IE Modules are common to all Composite Image IODs which reference the Image IE.

C.7.6.1 GENERAL IMAGE MODULE

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

C.7.6.1.1 General image attribute descriptions

C.7.6.1.1.1 Patient orientation

The Patient Orientation (0020,0020) relative to the image plane shall be specified by two values that designate the anatomical direction of the positive row axis (left to right) and the positive column axis (top to bottom). The first entry is the direction of the rows, given by the direction of the last pixel in the first row from the first pixel in that row. The second entry is the direction of the columns, given by the direction of the last pixel in the first column from the first pixel in that column.

Anatomical direction shall be designated by the capital letters: A (anterior), P (posterior), R (right), L (left), H (head), F (foot). Each value of the orientation Attribute shall contain at least one of these characters. If refinements in the orientation descriptions are to be specified, then they shall be designated by one or two additional letters in each value. Within each value, the letters will be ordered with the principal orientation designated in the first character.

C.7.6.1.1.2 Image type

The image type (0008,0008) Attribute identifies important image identification characteristics. These characteristics are:

1) Pixel data characteristics

   a) is the image an ORIGINAL image; an image whose pixel values are based on original or source data

   b) is the image a DERIVED Image; an image whose pixel values have been derived in some manner from the pixel values of one or more other images

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Table C.7-7—General image module attributes

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	A number that identifies this image
Patient Orientation	(0020,0020)	2C	Patient direction of the rows and columns of the image. Required if image is part of a series which does not require the Image Plane Module. See C.7.6.1.1.1 for more explanation.
Image Date	(0008,0023)	2C	The date the image pixel data creation started. Required if image is part of a series in which the images are temporally related.
Image Time	(0008,0033)	2C	The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related.
Image Type	(0008,0008)	3	Image identification characteristics. See C.7.6.1.1.2 for Defined Terms and further explanation.
Acquisition Number	(0020,0012)	3	A number identifying the single continuous gathering of data over a period of time which resulted in this image.
Acquisition Date	(0008,0022)	3	The date the acquisition of data that resulted in this image started
Acquisition Time	(0008,0032)	3	The time the acquisition of data that resulted in this image started
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) 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 Reference Image Sequence (0008,1140) is sent.
Derivation Description	(0008,2111)	3	A text description of how this image was derived. See C.7.6.1.1.3 for more explanation.
Source Image Sequence	(0008,2112)	3	A sequence which identifies the set of Image SOP Class/Instance pairs of the Images which were used to derive this Image. Encoded as sequence of items: (0008,1150) and (0008,1155) See C.7.6.1.1.4 for further explanation.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Source Image Sequence (0008,2112) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Source Image Sequence (0008,2112) is sent.
Images in Acquisition	(0020,1002)	3	Number of images that resulted from this acquisition of data
Image Comments	(0020,4000)	3	User-defined comments about the image

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2) Patient examination characteristics

a) is the image a PRIMARY image; an image created as a direct result of the patient examination

b) is the image a SECONDARY image; an image created after the initial patient examination

3) Modality specific characteristics

4) Implementation specific identifiers; other implementation specific identifiers shall be documented in an implementation's conformance statement.

The image type attribute is multi-valued and shall be provided in the following manner:

a) Value 1 shall identify the pixel data characteristics; Enumerated values for the pixel data characteristics are:

ORIGINAL = identifies an original image
DERIVED = identifies a derived image

b) Value 2 shall identify the patient examination characteristics; Enumerated values for the patient examination characteristics are:

PRIMARY = identifies a primary image
SECONDARY = identifies a secondary image

c) Value 3 shall identify any Image IOD specific specialization (optional)

d) Other values which are implementation specific (optional)

If the pixel data of the derived image is different from the pixel data of the source images and this difference is expected to affect professional interpretation of the image, the derived image shall have a UID different than all the source images.

C.7.6.1.1.3 Derivation description

If an image is identified to be a derived image (see C.7.6.1.1.2 image type), Derivation Description (0008,2111) is an optional text description of the way the image was derived. It may be used whether or not the Source Image Sequence (0008,2112) is provided. It may also be used in cases when the Derived Image pixel data is not significantly changed from one of the source images and the SOP Instance UID of the derived image is the same as the one used for the source image.

NOTES— Examples of derived images which would normally be expected to affect professional interpretation and would thus have a new UID include:

a. images resulting from image processing of another image (e.g. unsharp masking),
b. a multiplanar reformatted CT image,
c. a DSA image derived by subtracting pixel values of one image from another,
d. an image that has been decompressed after having been compressed with a lossy compression algorithm. To ensure that the user has the necessary information about the lossy compression, the approximate compression ratio may be included in derivation description (0008,2111).

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An example of a derived image that would normally not be expected to affect professional interpretation and thus would not require a new UID is an image that has been padded with additional rows and columns for display purposes.

C.7.6.1.1.4 Source image sequence

If an image is identified to be a derived image (see C.7.6.1.1.2 image type), Source Image Sequence (0008,2112) is an optional list of Referenced SOP Class UID (0008,1150)/ referenced SOP instance UID (0008,1150) pairs which identify the source images used to create the derived image. It may be used whether or not there is a description of the way the image was derived in Derivation Description (0008,2111).

C.7.6.2 IMAGE PLANE MODULE

Table C.7-8 specifies the Attributes which define the transmitted pixel array of a two dimensional image plane.

NOTE— In previous versions of this Standard, image position and image orientation were specified relative to a specific equipment coordinate system. This equipment coordinate system was not fully defined and a number of ambiguities existed. The equipment based coordinate system has been retired and replaced by the patient based coordinate system defined in this Module.

Table C.7-8—Image plane module attributes

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Image Orientation (Patient)	(0020,0037)	1	The direction cosines of the first row and the first column with respect to the patient. See C.7.6.2.1.1 for further explanation.
Image Position (Patient)	(0020,0032)	1	The x, y, and z coordinates of the upper left hand corner (first pixel transmitted) of the image. See C.7.6.2.1.1 for further explanation.
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.
Slice Location	(0020,1041)	3	Relative position of exposure expressed in mm. C.7.6.2.1.2 for further explanation.

C.7.6.2.1 Image plane attribute descriptions

C.7.6.2.1.1 Image position and image orientation

The Image Position (0020,0032) specifies the x, y, and z coordinates of the upper left hand corner of the image; it is the first pixel transmitted. Image Orientation (0020,0037) specifies the direction cosines of the first row and the first column with respect to the patient. These Attributes shall be provide as a pair. Row value for the x, y, and z axes respectively followed by the Column value for the x, y, and z axes respectively.

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The direction of the axes is defined fully by the patient's orientation. The x-axis is increasing to the left hand side of the patient. The y-axis is increasing to the posterior side of the patient. The z-axis is increasing toward the head of the patient.

The patient based coordinate system is a right handed system, i.e. the vector cross product of a unit vector along the positive x-axis and a unit vector along the positive y-axis is equal to a unit vector along the positive z-axis.

NOTE— If a patient lies parallel to the ground, face-up on the table, with his feet-to-head direction same as the front-to-back direction of the imaging equipment, the direction of the axes of this patient based coordinate system and the equipment based coordinate system in previous versions of this Standard will coincide.

C.7.6.2.1.2 Slice location

The Slice Location (0020,1041) is defined as the relative position of exposure expressed in mm. This information is relative to an unspecified implementation specific reference point.

C.7.6.3 IMAGE PIXEL MODULE

Table C.7-9 specified the Attributes that describe the pixel data of the image.

Table C.7-9—Image pixel module attributes

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. See C.7.6.3.1.1 for further explanation.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.7.6.3.1.2 for further explanation.
Rows	(0028,0010)	1	Number of rows in the image
Columns	(0028,0011)	1	Number of columns in the image
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See PS 3.5 for further explanation.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See PS 3.5 for further explanation.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See PS 3.5 for further explanation.
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. Enumerated Values: 0000H = unsigned integer 0001H = 2's complement

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Table C.7-9 continued

Pixel Data	(7FE0,0010)	1	A data stream of the pixel samples which comprise the Image. See C.7.6.3.1.4 for further explanation.
Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are sent color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1. See C.7.6.3.1.3 for further explanation.
Pixel Aspect Ratio	(0028,0034)	1C	Ratio of the real world spacing of the pixels in the image, specified by a numeric pair: row value (delimiter) column value. Required if the aspect ratio is not 1\1 and the Image Plane Module is not applicable to this Image.
Smallest Image Pixel Value	(0028,0106)	3	The minimum actual pixel value encountered in this image.
Largest Image Pixel Value	(0028,0107)	3	The maximum actual pixel value encountered in this image.
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	Specifies the format of the Red Palette Color Lookup Table Data (0028,1201) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.5 for further explanation.
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	Specifies the format of the Green Palette Color Lookup Table Data (0028,1202) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.5 for further explanation.
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	Specifies the format of the Blue Palette Color Lookup Table Data (0028,1203) Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.5 for further explanation.
Red Palette Color Lookup Table Data	(0028,1201)	1C	Red Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.6 for further explanation.
Green Palette Color Lookup Table Data	(0028,1202)	1C	Green Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.6 for further explanation.
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Blue Palette Color Lookup Table Data. Required if Photometric Interpretation (0028,0004) has a value of PALETTE COLOR or ARGB. See C.7.6.3.1.6 for further explanation.

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C.7.6.3.1 Image pixel attribute descriptions

C.7.6.3.1.1 Samples per pixel

Samples Per Pixel (0028,0002) is the number of separate planes in this image. One, three, and four image planes are defined. Other numbers of image planes are allowed, but their meaning is not defined by this Standard.

For monochrome (gray scale) and palette color images, the number of planes is 1. For RGB and other three vector color models, the value of this attribute is 3. For ARGB and other four vector color models, the value of this attribute is 4.

All image planes shall have the same Number of Rows (0028,0010), Columns (0028,0011), Bits Allocated (0028,0100), Bits Stored (0028,0101), High Bit (0028,0102), Pixel Representation (0028,0103), and Pixel Aspect Ratio (0028,0034).

C.7.6.3.1.2 Photometric interpretation

The value of Photometric Interpretation (0028,0004) specifies the intended interpretation of the image pixel data.

The following values are defined. Other values are permitted but the meaning is not defined by this Standard.

MONOCHROME1 = Pixel data represent a single monochrome image plane. The minimum sample value is intended to be displayed as white after any VOI grayscale transformations have been performed. See PS 3.4. This value may be used only when Samples per Pixel (0028,0002) has a value of 1.

MONOCHROME2 = Pixel data represent a single monochrome image plane. The minimum sample value is intended to be displayed as black after any VOI grayscale transformations have been performed. See PS 3.4. This value may be used only when Samples per Pixel (0028,0002) has a value of 1.

PALETTE COLOR = Pixel data describe a color image with a single sample per pixel (single image plane). The pixel value is used as an index into each of the red, blue, and green palette color lookup tables (0028,1101-1103&1201-1203). This value may be used only when Samples per Pixel (0028,0002) has a value of 1. When the Photometric Interpretation is palette color; red, blue, and green palette color lookup tables shall be present.

RGB = Pixel data represent a color image described by red, green, and blue image planes. The minimum sample value for each color plane represents minimum intensity of the color. This value may be used only when Samples per Pixel (0028,0002) has a value of 3.

HSV = Pixel data represent a color image described by hue, saturation, and value image planes. The minimum sample value for each HSV plane represents a minimum value of each vector. This value may be used only when Samples per Pixel (0028,0002) has a value of 3.

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ARGB = Pixel data represent a color image described by red, green, blue, and alpha image planes. The minimum sample value for each RGB plane represents minimum intensity of the color. The alpha plane is passed through palette color lookup tables. If the alpha pixel value is greater than 0, the red, green, and blue lookup table values override the red, green, and blue, pixel plane colors. This value may be used only when Samples per Pixel (0028,0002) has a value of 4.

CMYK = Pixel data represent a color image described by cyan, magenta, yellow, and black image planes. The minimum sample value for each CMYK plane represents a minimum intensity of the color. This value may be used only when Samples per Pixel (0028,0002) has a value of 4.

C.7.6.3.1.3 Planar configuration

Planar Configuration (0028,0006) indicates whether the color pixel data are sent color-by-plane or color-by-pixel. This attribute shall be present if Samples per Pixel (0028,0002) has a value greater than 1. It shall not be present otherwise.

Enumerated Values:

000 = The sample values for the first pixel are followed by the sample values for the second pixel, etc. For RGB images, this means the order of the pixel values sent shall be R1, G1, B1, R2, G2, B2, ..., etc. For HSV images, this means the order of the pixel values sent shall be H1, S1, V1, H2, S2, V2, ... etc. For ARGB images, this means the order of the pixel values sent shall be A1, R1, G1, B1, A2, R2, G2, B2, ... etc. For CMYK images, this means the order of the pixel values sent shall be C1, M1, Y1, K1, C2, M2, Y2, K2, ... etc.

001 = Each color plane shall be sent contiguously. For RGB images, this means the order of the pixel values sent is R1, R2, R3, ..., G1, G2, G3, ..., B1, B2, B3, etc. For HSV images, this means the order of the pixel values sent is H1, H2, H3, ..., S1, S2, S3, ..., V1, V2, V3, etc. For ARGB images, this means the order of the pixel values sent is A1, A2, A3, ..., R1, R2, R3, ..., G1, G2, G3, ... B1, B2, B3... etc. For CMYK images, this means the order of the pixel values sent is C1, C2, C3, ..., M1, M2, M3, ..., Y1, Y2, Y3, ..., K1, K2, K3... etc.

C.7.6.3.1.4 Pixel data

Pixel Data (7FE0,0010) for this image. The order of pixels sent for each image plane is left to right, top to bottom (upper left pixel, followed by the remainder of row 1, followed by the remainder of the columns).

For multi-plane images see Planar Configuration (0028,0006) in this section.

C.7.6.3.1.5 Palette color lookup table descriptor

The three values of Palette Color Lookup Table Descriptor (0028,1101–1103) describe the format of the lookup table data in the corresponding data element (0028,1201–1203).

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 lookup table data. All image pixel values less than the first entry are also mapped to the first entry in the lookup table data. An image pixel value one greater than the first entry is mapped to the second entry in the lookup table data. Subsequent image pixel values are mapped to the subsequent entries in the lookup table data up to an image pixel value equal to number of entries + first entry - 1 which is mapped to the last

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entry in the lookup table data. Image pixel values greater than number of entries + first entry are also mapped to the last entry in the lookup table data.

The third value specifies the number of bits for each entry in the lookup table data.

C.7.6.3.1.6 Palette color lookup table data

Palette Color Lookup Table Data (0028,1201–1203) contain the lookup table data corresponding to the lookup table descriptors (0028,1101–1103). If padding is required to complete a full word, the padding value shall be 0.

These lookup tables shall be used only when there is a single sample per pixel (single image plane) in the image.

These lookup tables are required when the value of Photometric Interpretation (0028,0004) is palette color. The semantics of these lookup tables is not defined otherwise.

C.7.6.4 CONTRAST/BOLUS MODULE

Table C.7-10 specifies the Attributes that describe the contrast/bolus used in the acquisition of the image.

Table C.7-10—Contrast/bolus module attributes

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Contrast or bolus agent
Contrast/Bolus Route	(0018,1040)	3	Administration route of contrast agent
Contrast/Bolus Volume	(0018,1041)	3	Volume of contrast agent in cubic centimeters
Contrast/Bolus Start Time	(0018,1042)	3	Time of start of injection
Contrast/Bolus Stop Time	(0018,1043)	3	Time of end of contrast injection
Contrast/Bolus Total Dose	(0018,1044)	3	Total amount of the active ingredient in injection

C.7.6.5 CINE MODULE

Table C.7-11 specifies the Attributes of a Multi-frame Cine Image.

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Table C.7-11—Cine module attributes

Attribute Name	Tag	Type	Attribute Description
Frame Time	(0018,1063)	1C	Nominal time (in msec) per individual frame. See C.7.6.5.1.1 for further explanation. Required if Frame Increment Pointer (0028,0009) points to Frame Time.
Frame Time Vector	(0018,1065)	1C	An array which contains the real time increments (in msec) between frames for a Multi-frame image. See C.7.6.5.1.2 for further explanation. Required if Frame Increment Pointer (0028,0009) points to Frame Time Vector.
Start Trim	(0008,2142)	3	The frame number of the first frame of the Multi-frame image to be displayed.
Stop Trim	(0008,2143)	3	The Frame Number of the last frame of a Multi-frame image to be displayed.
Recommended Display Frame Rate	(0008,2144)	3	Recommended rate at which the frames of a Multi-frame image should be displayed in frames/second.
Cine Rate	(0018,0040)	3	Number of frames per second.
Frame Delay	(0018,1066)	3	Time (in msec) from Image Time to the start of the first frame in a Multi-frame image.
Effective Duration	(0018,0072)	3	Total time in seconds that data was actually taken for the entire Multi-frame image.
Actual Frame Duration	(0018,1242)	3	Elapsed time of data acquisition in msec per each frame.

C.7.6.5.1 Cine attribute descriptions

C.7.6.5.1.1 Frame time

Frame Time (0018,1063) is the nominal time (in seconds) between individual frames of a Multi-frame image. If the Frame Increment Pointer points to this Attribute, Frame Time shall be used in the following manner to calculate 'the relative time' for each frame:

Frame 'Relative Time' (n) = Frame Delay + Frame Time • (n-1)

where: n = number of frame within the Multi-frame image and the first frame number is one

C.7.6.5.1.2 Frame time vector

Frame Time Vector (0018,1065) is an array which contains the time increments (in seconds) between frames for a Multi-frame image. If the Frame Increment Pointer points to this Attribute, the Frame Time Vector shall be used in the following manner to calculate 'relative time' for each frame:

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Frame 'Relative Time' (n) = Frame Time Vector(n) + Frame Time Vector(n-1)

+ Frame Time Vector(n-2)+... + Frame Time Vector(1)

where: n = number of frame within the Multi-frame image and the first frame number is one

C.7.6.6 MULTI-FRAME MODULE

Table C.7-12 specify the Attributes of a Multi-frame pixel data Image.

Table C.7-12—Multi-frame module attributes

Attribute Name	Tag	Type	Attribute Description
Number of Frames	(0028,0008)	1	Number of frames in a Multi-frame Image. See C.7.6.6.1.1 for further explanation.
Frame Increment Pointer	(0028,0009)	1	Contains the Data Element Tag of the attribute which is used as the frame increment in Multi-frame pixel data. See C.7.6.6.1.1 for further explanation.

C.7.6.6.1 Multi-frame attribute descriptions

C.7.6.6.1.1 Number of frames and frame increment pointer

A Multi-frame image is defined as an image whose pixel data consists of a sequential set of individual image pixel frames. A Multi-frame image is transmitted as a single contiguous stream of pixels. Frame headers do not exist within the data stream.

Each individual frame shall be defined (and thus can be identified) by the Attributes in the Image Pixel Module (see C.7.6.3). All image IE attributes shall be related to the first frame in the Multi-frame image.

The total number of frames contained within a Multi-frame image is conveyed in the Number of Frames (0028,0008).

The frames within a Multi-frame image shall be conveyed as a logical sequence. The information which determines the sequential order of the frames shall be identified by the data element tag or tags conveyed by the Frame Increment Pointer (0028,0009). Each specific Image IOD which supports the Multi-frame Module specializes the Frame Increment Pointer (0028,0009) to identify the Attributes which may be used as sequences.

C.7.7 *Patient summary module*

Table C.7-13 defines Attributes that provide summary information about the patient.

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Table C.7-13—Patient summary module attributes

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Patient's full legal name.
Patient ID	(0010,0020)	2	Primary hospital identification number or code for the patient.

C.7.8 *Study content module*

Table C.7-14 defines Attributes that provide study content information.

Table C.7-14—Study content module attributes

Attribute Name	Tag	Type	Attribute Description
Study ID	(0020,0010)	2	User or equipment generated Study identifier
Study Instance UID	(0020,000D)	1	Unique identifier for the Study
Referenced Series Sequence	(0008,1115)	1	Sequence of Repeating Items where each Item includes the Attributes of zero or more Series.
>Series Instance UID	(0020,000E)	1	Unique identifier of the Series.
>Retrieve AE Title	(0008,0054)	2C	Title of the DICOM Application Entity where the Image(s) may be retrieved on the network. This Attribute shall be present only if the Images may be retrieved at the SERIES Query/Retrieve Level. See PS 3.4.
>Storage Media File-Set ID	(0088,0130)	2C	The user or implementation specific human readable identifier that identifies the Storage Media on which the Image(s) reside. This Attribute shall be present only if the Image(s) may be retrieved at the SERIES level using a media storage.
>Storage Media File-Set UID	(0088,0140)	2C	Uniquely identifies the Storage Media on which the Image(s) reside. This Attribute shall be present only if the Image(s) may be retrieved at the SERIES level using a media storage.
>Referenced Image Sequence	(0008,1140)	1	Sequence of Repeating Items where each Item provides reference to a set of Image SOP Class/SOP Instance pairs that are contained in the Series identified by the Series Instance UID (0020,000E).

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Table C.7-14 Continued

>>Referenced SOP Class UID	(0008,1150)	2	Uniquely identifies the referenced SOP Class. This Attribute is used only if Images may be retrieved as Single Image SOP Classes.
>>Reference SOP Instance UID	(0008,1155)	2	Uniquely identifies the referenced SOP Instance. This Attribute is used only if Images may be retrieved as Single Image SOP Classes.
>>Retrieve AE Title	(0008,0054)	2C	Title of the DICOM Application Entity where the Image(s) may be retrieved on the network. This Attribute shall be present only if not present in the Referenced Series Sequence (0008,1115) and if the Images may be retrieved at the IMAGE Query/Retrieve Level. See PS 3.4.
>>Storage Media File-Set ID	(0088,0130)	2C	The user or implementation specific human readable identifier that identifies the Storage Media on which the Image(s) reside. This Attribute shall be present only if not present in the Series Sequence (0008,1115) and if the Image(s) may be retrieved at the IMAGE level using a media storage.
>>Storage Media File-Set UID	(0088,0140)	2C	Uniquely identifies the Storage Media on which the Image(s) reside. This Attribute shall be present only if not present in the Referenced Series Sequence (0008,1115) and if the Image(s) may be retrieved at the IMAGE level using a media storage.

C.8 Modality specific modules

C.8.1 *Computed radiography*

This section describes Computed Radiography series and image Modules. These Modules contain Attributes that are specific to Computed Radiography images. There is no Computed Radiography Equipment Module.

C.8.1.1 CR SERIES MODULE

Table C.8-1 contains IOD Attributes that describe a Computed Radiography series performed on the patient.

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Table C.8-1—CR series module attributes

Attribute Name	Tag	Type	Attribute Description
Body Part Examined	(0018,0015)	2	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.
View Position	(0018,5101)	2	Radiographic view associated with Patient Position (0018,5100). Defined Terms: AP = Anterior/Posterior PA = Posterior/Anterior LL = Left Lateral RL = Right Lateral RLD = Right Lateral Decubitus LLD = Right Lateral Decubitus RLO = Right Lateral Oblique LLO = Left Lateral Oblique
Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam
Collimator/grid Name	(0018,1180)	3	Label describing any grid inserted.
Focal Spot	(0018,1190)	3	Size of the focal spot in mm. For devices with variable focal spot or multiple focal spots, small dimension followed by large dimension.
Plate Type	(0018,1260)	3	Label of the type of storage phosphor plates used in this series
Phosphor Type	(0018,1261)	3	Label of type of phosphor on the plates

C.8.1.2 CR IMAGE MODULE

Table C.8-2 contains IOD Attributes that describe Computed Radiography images.

Table C.8-2—CR image module attributes

Attribute Name	Tag	Type	Attribute Description
KVP	(0018,0060)	3	Peak kilo voltage output of the x-ray generator used
Plate ID	(0018,1004)	3	The ID or serial number of the sensing plate upon which the image was acquired
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center

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Table C.8-2 continued

Distance Source to Patient	(0018,1111)	3	Distance in mm from source to isocenter (center of field of view)
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec
X-ray Tube Current	(0018,1151)	3	x-ray tube current in mA.
Exposure	(0018,1152)	3	The product of exposure time and x-ray tube current expressed in mAs.
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.
Acquisition Device Processing Description	(0018,1400)	3	Describes device-specific processing associated with the image (e.g. Organ Description)
Acquisition Device Processing Code	(0018,1401)	3	Code representing the device-specific processing associated with the image (e.g. CR Organ Filtering code)
Cassette Orientation	(0018,1402)	3	Orientation of cassette, used to properly position the image for display. Enumerated Values: LANDSCAPE PORTRAIT
Cassette Size	(0018,1403)	3	Size of cassette. Defined Terms: 18CMX24CM, 8INX10IN, 24CMX30CM, 10INX12IN, 30CMX35CM, 30CMX40CM, 11INX14IN, 35CMX35CM, 14INX141N, 35CMX43CM, 14INXI7IN
Exposures on Plate	(0018,1404)	3	Total number of x-ray exposures that have been made on the plate identified in Plate ID (0018,1004)
Relative X-ray Exposure	(0018,1405)	3	Relative x-ray exposure on the plate. Meaning of values is implementation specific. May be used to adjust the dynamic range of the plate digitizer (scanner).
Sensitivity	(0018,6000)	3	Read out sensitivity.

C.8.2 *CT modules*

This section describes the CT image Module. This Module contains all Attributes that are specific to CT images.

C.8.2.1 CT IMAGE MODULE

The table in this section contains IOD Attributes that describe CT images.

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Table C.8-3—CT image module attributes

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.2.1.1.1 for specialization.
Samples per Pixel	(0028,0002)	1	Number of samples (planes) in this image. See C.8.2.1.1.2 for specialization.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.8.2.1.1.3 for specialization.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See C.8.2.1.1.4 for specialization.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See C.8.2.1.1.5 for specialization.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See C.8.2.1.1.6 for specialization.
Rescale Intercept	(0028,1052)	1	The value b in relationship between stored values (SV) and Hounsfield Units (HU). HU = m*SV +b.
Rescale Slope	(0028,1053)	1	m in the equation specified in Rescale Intercept (0028,1052).
KVP	(0018,0060)	2	Peak kilo voltage output of the x-ray generator used
Acquisition Number	(0020,0012)	2	A number identifying the single continuous gathering of data over a period of time which resulted in this image
Scan Options	(0018,0022)	3	Parameters of scanning sequence.
Data Collection Diameter	(0018,0090)	3	The diameter in mm of the region over which data were collected
Reconstruction Diameter	(0018,1100)	3	Diameter in mm of the region from within 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.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to isocenter (center of field of view)

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Table C.8-3 continued

Gantry/Detector Tilt	(0018,1120)	3	Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations.
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation; below the center is positive.
Rotation Direction	(0018,1140)	3	Direction of rotation of the source when relevant, about nearest principal axis of equipment. Enumerated Values: CW = clockwise CC = counter clockwise
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec
X-ray Tube Current	(0018,1151)	3	X-ray Tube Current in mA.
Exposure	(0018,1152)	3	The product of exposure time and X-ray Tube Current expressed in mas.
Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam.
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.
Focal Spot	(0018,1190)	3	Size of the focal spot in mm. For devices with variable focal spot or multiple focal spots, small dimension followed by large dimension.
Convolution Kernel	(0018,1210)	3	A label describing the convolution kernel or algorithm used to reconstruct the data .

C.8.2.1.1 CT image attribute descriptions

C.8.2.1.1.1 Image type

For CT Images, Image Type (0008,0008) is specified to be Type 1 and uses one of the following Defined Terms for Value 3:

AXIAL = identifies a CT Axial Image
LOCALIZER = identifies a CT Localizer Image

C.8.2.1.1.2 Samples per pixel

For CT images, Samples per Pixel (0028,0002) shall have an enumerated value of 1.

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C.8.2.1.1.3 Photometric interpretation

For CT images, Photometric Interpretation (0028,0004) shall have one of the following enumerated values:
MONOCHROME1
MONOCHROME2

See C.7.6.3.1.2 for definition of these terms.

C.8.2.1.1.4 Bits allocated

For CT images, Bits Allocated (0028,0100) shall have the enumerated value of 16.

C.8.2.1.1.5 Bits stored

For CT images, Bits Stored (0028,0101) shall have the enumerated values of 12 to 16.

C.8.2.1.1.6 High bit

For Ct images, High Bit (0028,0102) shall have only the enumerated value of one less than the value sent in Bits Stored.

C.8.3 *MR*

This section describes the MR Image Module. This Module contains all Attributes that are specific to MR images.

C.8.3.1 MR IMAGE MODULE

Table C.8-4 contains the Attributes that describe MR images.

Table C.8-4—MR image module attributes

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.3.1.1.1 for specialization.
Samples per Pixel	(0028,0002)	1	Number of samples(planes) in this image. See C.8.3.1.1.2 for specialization.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.8.3.1.1.3 for specialization.

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Table C.8-4 continued

Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See C.8.3.1.1.4 for specialization.
Scanning Sequence	(0018,0020)	1	Description of the type of data taken. Enumerated Values: SE = Spin Echo IR = Inversion Recovery GR = Gradient Recalled EP = Echo Planar RM = Research Mode NOTE: Multi-valued, but not all combinations are valid (e.g. SE/GR, etc.).
Sequence Variant	(0018,0021)	1	Variant of the Scanning Sequence. Defined Terms: SK = segmented k-space MTC = magnetization transfer contrast SS = steady state TRSS= time reversed steady state SP = spoiled MP = MAG prepared OSP = oversampling phase NONE = no sequence variant
Scan Options	(0018,0022)	2	Parameters of scanning sequence. Defined Terms: PER = Phase Encode Reordering RG = Respiratory Gating CG = Cardiac Gating PPG = Peripheral Pulse Gating FC = Flow Compensation PFF = Partial Fourier - Frequency PFP = Partial Fourier - Phase SP = Spatial Presaturation FS = Fat Saturation
MR Acquisition Type	(0018,0023)	2	Identification of data encoding scheme. Enumerated Values: 2D = frequency x phase 3D = frequency x phase x phase
Repetition Time	(0018,0080)	2C	The period of time in msec between the beginning of a pulse sequence and the beginning of the succeeding (essentially identical) pulse sequence. Required except when Scanning Sequence(0018,0020) is EP and Sequence Variant(0018,0021) is not SK.

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Table C.8-4 continued

Echo Time	(0018,0081)	2	Time in ms between the middle of the excitation pulse and the peak of the echo produced (kx=0). In the case of segmented k-space, the TE(eff) is the time between the middle of the excitation pulse to the peak of the echo that is used to cover the center of k-space (i.e.-kx=0, ky=0).
Echo Train Length	(0018,0091)	2	Number of lines in k-space acquired per excitation per image.
Inversion Time	(0018,0082)	2C	Time in msec after the middle of inverting RF pulse to middle of excitation pulse to detect the amount of longitudinal magnetization Required if Scanning Sequence (0018,0020) has values of IR.
Trigger Time	(0018,1060)	2C	Time, in msec, between peak of the R wave and the peak of the echo produced. In the case of segmented k-space, the TE(eff) is the time between the peak of the echo that is used to cover the center of k-space. Required for Scan Options (0018,0022) which include heart gating (e.g. CG, PPG, etc.)
Sequence Name	(0018,0024)	3	User defined name for the Scanning Sequence(0018,0020) and Sequence Variant(0018,0021) combination.
Angio Flag	(0018,0025)	3	Angio Image Indicator. Primary image for Angio processing. Enumerated Values: Y = Image is Angio N = Image is not Angio
Number of Averages	(0018,0083)	3	Number of times a given pulse sequence is repeated before any parameter is changed
Imaging Frequency	(0018,0084)	3	Precession frequency in MHz of the nucleus being addressed
Imaged Nucleus	(0018,0085)	3	Nucleus that is resonant at the imaging frequency. Examples: 31P, 1H
Echo Number	(0018,0086)	3	The echo number used in generating this image. In the case of segmented k-space, it is the effective Echo Number.
Magnetic Field Strength	(0018,0087)	3	Nominal field strength of MR magnet, in Tesla
Spacing Between Slices	(0018,0088)	3	Spacing between slices, in mm. The spacing is measured from the center-to-center of each slice.
Number of Phase Encoding Steps	(0018,0089)	3	Total number of lines in k-space in the 'y' direction collected during acquisition.

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Table C.8-4 continued

Percent Sampling	(0018,0093)	3	Fraction of acquisition matrix lines acquired, expressed as a percent.
Percent Phase Field of View	(0018,0094)	3	Ratio of field of view dimension in phase direction to field of view dimension in frequency direction, expressed as a percent.
Pixel Bandwidth	(0018,0095)	3	Reciprocal of the total sampling period, in hertz per pixel.
Nominal Interval	(0018,1062)	3	Average R-R interval used for the scant, in msec
Beat Rejection Flag	(0018,1080)	3	Beat length sorting has been applied. Enumerated Values: Y = yes N = no
Low R-R Value	(0018,1081)	3	R-R interval low limit for beat rejection, in msec
High R-R Value	(0018,1082)	3	R-R interval high limit for beat rejection, in msec
Intervals Acquired	(0018,1083)	3	Number of R-R intervals acquired.
Intervals Rejected	(0018,1084)	3	Number of R-R intervals rejected.
PVC Rejection	(0018,1085)	3	Description of type of PVC rejection criteria used.
Skip Beats	(0018,1086)	3	Number of beats skipped after a detected arrhythmia
Heart Rate	(0018,1088)	3	Beats per minute.
Cardiac Number of Images	(0018,1090)	3	Number of Images per cardiac cycle.
Trigger Window	(0018,1094)	3	Percent of R-R interval, based on Heart Rate (0018,1088), prescribed as a window for a valid/usable trigger.
Reconstruction Diameter	(0018,1100)	3	Diameter in mm of the region from within 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.
Receiving Coil	(0018,1250)	3	Receiving coil used
Transmitting Coil	(0018,1251)	3	Transmitting coil used
Acquisition Matrix	(0018,1310)	3	Dimensions of the acquired frequency/phase data before reconstruction. Multi-valued: frequency rows\frequency columns\phase rows\phase columns.

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Table C.8-4 continued

Phase Encoding Direction	(0018,1312)	3	The axis of phase encoding with respect to the image. Enumerated Values: ROW = phase encoded in rows COL = phase encoded in columns
Flip Angle	(0018,1314)	3	Steady state angle in degrees to which the magnetic vector is flipped from the magnetic vector of the primary field.
SAR	(0018,1316)	3	Calculated whole body Specific Absorption Rate in watts/kilogram.
Variable Flip Angle Flag	(0018,1315)	3	Flip angle variation applied during image acquisition. Enumerated Values: Y = yes N = no
dB/dt	(0018,1318)	3	The rate of change of the gradient coil magnetic flux density with time (T/s).
Temporal Position Identifier	(0020,0100)	3	Temporal order of a dynamic or functional set of Images.
Number of Temporal Positions	(0020,0105)	3	Total number of temporal positions prescribed.
Temporal Resolution	(0020,0110)	3	Time delta between Images in a dynamic of functional set of Images.

C.8.3.1.1 MR image attribute descriptions

C.8.3.1.1.1 Image type

For MR images, Image Type (0008,0008) is specified to be type 1 and use one of the following defined terms for Value 3:

MPR
PROJECTION IMAGE
T1 MAP
T2 MAP
DIFFUSION MAP
DENSITY MAP
PHASE MAP
VELOCITY MAP
IMAGE ADDITION
PHASE SUBTRACT
MODULUS SUBTRACT
OTHER

C.8.3.1.1.2 Samples per pixel

For MR images, Samples per Pixel (0028,0002) shall have an enumerated value of 1.

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C.8.3.1.1.3 Photometric interpretation

For MR images, Photometric Interpretation (0028,0004) shall have one of the following enumerated values:
MONOCHROME1
MONOCHROME2

See C.7.6.3.1.2 for definition of these terms.

C.8.3.1.1.4 Bits allocated

For MR images, Bits Allocated (0028,0100) shall have the enumerated value of 16.

C.8.4 *Nuclear medicine*

This section describes Nuclear Medicine Series, Equipment, and Image Modules. These Modules contain Attributes that are specific to NM image IOD.

C.8.4.1 NM SERIES MODULE

Table C.8-5—NM series module attributes

Attribute Name	Tag	Type	Attribute Description
Radionuclide	(0018,0030)	2	Name of isotope administered. See (0018,1070-1074). If multiple isotopes, all Attributes shall have values in corresponding order.
Nuclear Medicine Series Type	(0008,0042)	2	Further description of the type of Nuclear Medicine study. Defined Terms: STATIC, DYNAMIC, GATED, WHOLE BODY, STEP_SHOOT TOMO, CONTINUOUS TOMO, GATED TOMO
Scan Velocity	(0018,1300)	2C	The speed of the camera motion over the body in mm/sec. Required if Nuclear Medicine Series Type (0008,0042) contains the value WHOLE BODY.
Whole Body Technique	(0018,1301)	2C	The type of scan performed. Required if Nuclear Medicine Series Type (0008,0042) contains the value WHOLE BODY. Enumerated Values: 1PS = one pass 2PS = two pass PCN = patient contour following employed DIV = diverging collimator used MSP = multiple static images collected into a whole body image.

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Table C.8-5 continued

Scan Length	(0018,1302)	2C	Length of the scan in mm. Required if Nuclear Medicine Series Type (0008,0042) contains the value WHOLE BODY.
Radiopharmaceutical	(0018,0031)	3	Name of the radiopharmaceutical in use.
Energy Window Centerline	(0018,0032)	3	The centerline of the energy window in KeV.
Energy Window Total Width	(0018,0033)	3	Energy window total width expressed as a percentage about the energy window centerline. Half of this percentage is on either side of the energy window center.
Intervention Drug Name	(0018,0034)	3	Name of intervention drug.
Intervention Drug Start Time	(0018,0035)	3	Time of administration of the intervention drug.
Effective Series Duration	(0018,0072)	3	Total time in seconds that data was actually taken.
Syringe counts	(0018,1045)	3	Syringe count rate in counts/sec.
Trigger Source or Type	(0018,1061)	3	Text indicating trigger source.
Radionuclide Route	(0018,1070)	3	Route of injection.
Radionuclide Volume	(0018,1071)	3	Volume of injection in cubic cm.
Radionuclide Start Time	(0018,1072)	3	Time of start of injection.
Radionuclide Stop Time	(0018,1073)	3	Time of end of injection.
Radionuclide Total Dose	(0018,1074)	3	Total amount of radionuclide injected.
Gantry/Detector Tilt	(0018,1120)	3	Angle of tilt in degrees of the scanning detector as normally given by this device.
Isotope Number	(0020,0014)	3	A subset of an acquisition corresponding to a given energy window.

C.8.4.2 NM EQUIPMENT MODULE

The table in this Section contains IOD Attributes that describe Nuclear Medicine equipment used to produce an image.

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Table C.8-6—NM equipment module attributes

Attribute Name	Tag	Type	Attribute Description
Center of Rotation Offset	(0018,1145)	3	Average center of rotation offset of Nuclear Medicine camera in mm.
Field of View Shape	(0018,1147)	3	Shape of the field of view of the Nuclear Medicine camera. Defined Terms: RECTANGLE ROUND HEXAGONAL
Field of View Dimension (s)	(0018,1149)	3	Dimensions of the Field of View (0018,1147) in mm. If Rectangle, row dimension followed by column; if Round, diameter; if Hexagonal, maximum row dimension.
Collimator/grid name	(0018,1180)	3	Label describing any collimator (LEAP, hires, etc.)
Collimator Type	(0018,1181)	3	Collimator type. Defined Terms: PARA = Parallel PINH = Pinhole FANB = Fan-beam CONE = Cone-beam SLNT = Slant hole ASTG = Astigmatic
Focal Distance	(0018,1182)	3	Focal distance, in mm. A value of 0 means infinite distance for parallel collimation.
X Focus Center	(0018,1183)	3	Center of focus in x dimension
Y Focus Center	(0018,1184)	3	Center of focus in y dimension

C.8.4.3 NM IMAGE MODULE

Table C.8-7 contains the Attributes that describe Nuclear Medicine Images.

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Table C.8-7—NM image module attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1C	Contains the Data Element Tag of the Attribute which is used as the frame increment in Multi-frame pixel data. Required if Number of Frames (0028,0008) is sent. See C.8.4.3.1.1 for further specialization.
Zoom Factor	(0028,0031)	2	The amount of magnification applied to each pixel in the image, specified by a numeric pair: row value (delimiter) column value
Counts Accumulated	(0018,0070)	2	Sum of all gamma events
Referenced Overlay Sequence	(0008,1130)	3	A Sequence which provides reference to a set of SOP Class/Instance pairs which are related independent Overlays. Uniquely identifies Overlays significantly related to this Image. 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 Overlay Sequence (0008,1130) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Reference Overlay Sequence (0008,1130) is sent.
Referenced Curve Sequence	(0008,1145)	3	A Sequence which provides reference to a set of SOP Class/Instance pairs which are related independent Curves. Uniquely identifies Curves significantly related to this Image. 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 Curve Sequence (0008,1145) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the Referenced SOP Instance. Required if Reference Curve Sequence (0008,1145) is sent.

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Table C.8-7 continued

Acquisition Termination Condition	(0018,0071)	3	Description of how the data collection was stopped. Defined Terms: CNTS = counts DENS = density MANU = manual OVFL = data overflow TIME = time TRIG = physiological trigger
Reconstruction Diameter	(0018,1100)	3	Diameter in mm. of the region from within 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.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation; below the center is positive.
Table Traverse	(0018,1131)	3	Location of the patient table (or gantry relative to the table) in mm.
Angular Position	(0018,1141)	3	Position of the detector about the patient in degrees. Zero degrees is referenced to the origin at the patient's back. Viewing from the patient's feet, angle increases in an anti-clockwise direction (detector normal rotating from the patient's back towards the patient's left side).
Radial Position	(0018,1142)	3	Radial distance of the detector from the center of rotation, in mm.
Convolution Kernel	(0018,1210)	3	A label describing the convolution kernel or algorithm used to reconstruct the data .
Actual Frame Duration	(0018,1242)	3	Elapsed time of data acquisition in msec
Count Rate	(0018,1243)	3	Maximum number of counts achieved during the acquisition in counts/sec.
Preprocessing Function	(0018,5020)	3	Code or description of preprocessing function applied to the data in the receiver portion of the equipment. In general, a signal processing function applied before or as the data is written to scan converter memory.

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Table C.8-7 continued

Postprocessing Function	(0018,5021)	3	Code or description of postprocessing function applied to the data in the scan converter portion of the equipment. In general, an image processing function applied to the image after storage in memory and before or as the data is being sent to the display.
Phase Number	(0020,0015)	3	A subset of an acquisition in which each image has the same duration of collection
Interval Number	(0020,0016)	3	A subset of acquisition corresponding to cardiac cycles that fall into a defined window of R to R intervals
Time Slot Number	(0020,0017)	3	A subset of acquisition including all the data corresponding to one time slice of a cardiac cycle
Angle Number	(0020,0018)	3	A subset of acquisition including all the data corresponding to one angular position of the detector
Zoom Center	(0028,0032)	3	The amount of offset from (0,0) applied to each pixel in the image before application of the zoom factor, specified by a numeric pair: row value (delimiter) column value (in mm).
Corrected Image	(0028,0051)	3	A value that indicates which, if any, corrections have been applied to the image. Defined Terms: UNIF = flood corrected COR = center of rotation corrected NCO = non-circular orbit corrected DECY = decay corrected ATTN = attenuation corrected SCAT = scatter corrected DTIM = dead time corrected

C.8.4.3.1 NM image attribute descriptions

C.8.4.3.1.1 Frame increment pointer

If NM images are Multi-frame images, the Frame Increment Pointer (0028,0009) of the Multi-frame module (see section C.7.6.6) is specified by the following Defined Terms:

00180050 = sequencing by Slice Thickness (0018,0050)
00181063 = sequencing by Frame Time (0018,1063)
00181144 = sequencing by Angular Step (0018,1144)

C.8.4.4 NM SPECT ACQUISITION IMAGE MODULE

This Module applies to a SPECT Multi-frame Image.

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Table C.8-8—NM SPECT acquisition image module attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	Contains the Data Element Tag of the Attribute which is used as the frame increment in Multi-frame pixel data (see C.7.6.6). Enumerated Value: 00181144 = Angular Step (0018,1144)
Angular Step	(0018,1144)	1	The angular scan arc step between views of the SPECT acquisition, in degrees.
Zoom Factor	(0028,0031)	2	The amount of magnification applied to each pixel in the image, specified by a numeric pair: row value (delimiter) column value
Scan Arc	(0018,1143)	2C	The angular range of the scan data in degrees. Required if the image is tomographic.
Reconstruction Diameter	(0018,1100)	3	Diameter in mm. of the region from within 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.
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center
Table Height	(0018,1130)	3	The distance in mm of the top of the patient table to the center of rotation; below the center is positive.
Table Traverse	(0018,1131)	3	Location of the patient table (or gantry relative to the table) in mm.
Rotation Direction	(0018,1140)	3	Direction of rotation of the source when relevant, about nearest principal axis of equipment. Enumerated Values: CW = clockwise CC = counter clockwise
Angular Position	(0018,1141)	3	Position of the detector about the patient in degrees. For Multi-frame images, this Attribute only applies to the first frame. Zero degrees is referenced to the origin at the patient's back. Viewing from the patient's feet, angle increases in an anti-clockwise direction (detector normal rotating from the patient's back towards the patient's left side).
Radial Position	(0018,1142)	3	Radial distance of the detector from the center of rotation, in mm.

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Table C.8-8 continued

Rotation Offset	(0018,1146)	3	Actual offset from center of rotation of image in mm. The offset can be positive or negative. This Attribute is specific to tomographic acquisitions.
Angle Number	(0020,0018)	3	A subset of acquisition including all the data corresponding to one angular position of the detector. For Multi-frame images with Frame Increment Pointer = Angular Step, This attribute applies only to the first frame.
Zoom Center	(0028,0032)	3	The amount of offset from (0,0) applied to each pixel in the image before application of the zoom factor, specified by a numeric pair: row value (delimiter) column value (in mm).

C.8.4.4.1 NM SPECT acquisition attribute descriptions

C.8.4.4.1.1 Angular Step

Angular Step (0018,1144) is the nominal frame-to-frame incremental angle for SPECT acquisition images, defined in degrees. The Angular Step may be signed, but is not required to be signed. To avoid redundancy, the Angular Step is assumed to be the scan arc divided by the number of views. Summation of Angular Step values is not defined to give accurate angular position or scan arc values. If the NM series type is CONTINUOUS TOMO, the Angular Step is the effective angular spacing between resultant frames of the Multi-framed planar image data.

C.8.4.5 NM MULTI-GATED ACQUISITION IMAGE MODULE

Table C.8-9 contains Attributes that describe a multi-gated acquisition image performed on the patient.

Table C.8-9—NM multi-gated acquisition image module attributes

Attribute Name	Tag	Type	Attribute Description
Frame Increment Pointer	(0028,0009)	1	Contains the Data Element Tag of the Attribute which is used as the frame increment in Multi-frame pixel data (see C.7.6.6). Enumerated Value: 00181063 = Frame Time (0018,1063)
Trigger Source or Type	(0018,1061)	2	Text indicating trigger source.
Frame Time	(0018,1063)	2	Nominal time per individual frame in seconds.
Trigger Time	(0018,1060)	3	Time interval measured in msec from the start of the R-wave to the beginning of data taking

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Table C.8-9 continued

Nominal Interval	(0018,1062)	3	Average R-R interval used for these data, in msec
Framing Type	(0018,1064)	3	Description of type of framing performed such as forward, backward, forward/backward by thirds, phase.
Beat Rejection Flag	(0018,1080)	3	Beat length sorting has been applied. Enumerated Values: Y = yes N = no
Low R-R Value	(0018,1081)	3	R-R interval low limit for beat rejection, in msec
High R-R Value	(0018,1082)	3	R-R interval high limit for beat rejection, in msec
Intervals Acquired	(0018,1083)	3	Number of R-R intervals acquired.
Intervals Rejected	(0018,1084)	3	Number of R-R intervals rejected.
PVC Rejection	(0018,1085)	3	Description of type of PVC rejection criteria used.
Skip Beats	(0018,1086)	3	Number of beats skipped after a detected arrhythmia
Heart Rate	(0018,1088)	3	Beats per minute.
Cardiac Number of Images	(0018,1090)	3	Number of Images per cardiac cycle.

C.8.5 *Ultrasound*

This section describes ultrasound frame of reference and image modules. These Modules contain Attributes that are specific to ultrasound images.

C.8.5.1 US FRAME OF REFERENCE MODULE

Table C.8-10 contains IOD Attributes that describe an ultrasound frame of reference.

C.8.5.1.1 US frame of reference attribute definitions

C.8.5.1.1.1 Region location min x_0, region location min y_0, region location max x_1, region location max y_1

The bounds of a rectangle specifying the location of the Region, Region Location Min x_0 (0018,6018), Region Location Min y_0 (0018,601A), Region Location Max x_1 (0018,601c), Region Location Max y_1 (0018,601E). The upper left corner of the entire image is x=0,y=0 and the lower right corner is x=image width - 1, and y=image length - 1. Thus, a region will be specified as within these bounds. Where x_0,y_0 is the coordinate of the upper left corner of the region and x_1,y_1 is the coordinate of the lower right corner of the region.

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Table C.8-10—US frame of reference module attributes

Attribute Name	Tag	Type	Attribute Description
Region Location Min x_0	(0018,6018)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
Region Location Min y_0	(0018,601A)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
Region Location Max x_1	(0018,601C)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
Region Location Max y_1	(0018,601E)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
Physical Units X Direction	(0018,6024)	1	The physical units of the dimensions of the region. See C.8.5.1.1.2 for Enumerated Values.
Physical Units Y Direction	(0018,6026)	1	The physical units of the dimensions of the region. See C.8.5.1.1.2 for Enumerated Values.
Physical Delta X	(0018,602C)	1	The physical value increments per positive X pixel increment. The units are as specified in the Physical units data element.
Physical Delta Y	(0018,602E)	1	The physical value increments per positive Y pixel increment. The units are as specified in the Physical units data element.
Reference Pixel x_0	(0018,6020)	3	This coordinate pair, x_0,y_0 defines the location of a virtual "reference" pixel. See C.8.5.1.1.3 for further explanation.
Reference Pixel y_0	(0018,6022)	3	This coordinate pair, x_0,y_0 defines the location of a virtual "reference" pixel. See C.8.5.1.1.3 for further explanation.
Ref. Pixel Physical Value X	(0018,6028)	3	The Physical Value at the reference pixel x location. The units are specified in the Physical Units field.
Ref. Pixel Physical Value Y	(0018,602A)	3	The Physical Value at the reference pixel y location. The units are specified in the Physical Units field.

C.8.5.1.1.2 Physical units X direction and physical units Y direction

Physical Units X Direction (0018,6024) and Physical Units Y Direction (0018,6026) provide Enumerated Values indicating the physical units of the dimensions of the region.

Value	Meaning
0000H	None or not applicable
0001H	Percent
0002H	dB
0003H	cm
0004H	seconds
0005H	hertz($seconds^{-1}$)

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Value	Meaning
0006H	dB/seconds
0007H	cm/sec
0008H	cm^2
0009H	cm^2/sec
000AH	cm^3
000BH	cm^3/sec
000CH	degrees

C.8.5.1.1.3 Reference pixel x_0 and reference pixel y_0

This coordinate pair, Reference Pixel x_0 (0018,6020), Reference Pixel y_0 (0018,6022) defines the location of a virtual "reference" pixel. The Reference Pixel is used to tie the image's pixel coordinate system to the physical coordinate system. For example, the Reference Pixel could be defined where a depth of zero centimeters occurs in the 2D image, or it could define where the baseline (i.e.: zero frequency) resides in a spectral display. The Reference Pixel location is the relative offset from the region location, not necessarily the image origin. The location is not required to be within the region or even within the image boundary. For this reason, the Reference Pixel location can be positive or negative.

Recommended locations are:
- Sector - Skin line
- Linear - Skin line left corner
- Doppler Spectral - Baseline left
- M-Mode - Skin line left
- Physio - Baseline left (where baseline = 0)

C.8.5.2 US REGION CALIBRATION MODULE

The US Region Calibration Module has been introduced into the ultrasound IOD to provide access to the full range of data which may be present in a single US image. US images often contain multiple regions which have independent data regions, e.g. quad screen loops which may have different calibration information. The data presented in the various regions of a US image can represent a multiplicity of physical parameters, e.g., spatial distance, blood velocity, time, volume, etc., and these are often contained in the value of the pixel itself. It is therefore imperative that physical information be available for the various regions of a single region independent of each other.

C.8.5.2.1 US region calibration attribute definitions

Table C.8-11 contains IOD Attributes that describe an ultrasound region calibration.

C.8.5.2.1.1 Region spatial format

Enumerated values for Region Spatial Format (0018,6012) indicate the spatial organization of the data within the region.

Value	Meaning
0000H	None or not applicable
0001H	2D(tissue or flow)
0002H	M-Mode(tissue or flow)

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Value	Meaning
0003H	Spectral (CW or PW Doppler)
0004H	Wave form (physiological traces, doppler traces,....)
0005H	Graphics

Table C.8-11—US region calibration module attributes

Attribute Name	Tag	Type	Attribute Description
Sequence of Ultrasound Regions	(0018,6011)	1	Defines a sequence of Ultrasound Regions.
>Region Location Min x_0	0018,6018)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
>Region Location Min y_0	(0018,601A)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
>Region Location Max x_1	(0018,601C)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
>Region Location Max y_1	(0018,601E)	1	The bounds of a rectangle specifying the location of the region, x_0,y_0,x_1,y_1. See C.8.5.1.1.1 for further explanation.
>Physical Units X Direction	(0018,6024)	1	The physical units of the dimensions of the region. See C.8.5.1.1.2 for Enumerated Values.
>Physical Units Y Direction	(0018,6026)	1	The physical units of the dimensions of the region. See C.8.5.1.1.2 for Enumerated Values.
>Physical Delta X	(0018,602C)	1	The physical value increments per positive X pixel increment. The units are as specified in the physical units data element.
>Physical Delta Y	(0018,602E)	1	The physical value increments per positive Y pixel increment. The units are as specified in the physical units data element.
>Reference Pixel x_0	(0018,6020)	3	This coordinate pair, x_0,y_0 defines the location of a virtual "reference" pixel. See C.8.5.1.1.3 for further explanation.
>Reference Pixel y_0	(0018,6022)	3	This coordinate pair, x_0,y_0 defines the location of a virtual "reference" pixel. See C.8.5.1.1.3 for further explanation.
>Ref. Pixel Physical Value X	(0018,6028)	3	The Physical Value at the reference pixel x location. The units are specified in the Physical Units field.
>Ref. Pixel Physical Value Y	(0018,602A)	3	The Physical Value at the reference pixel y location. The units are specified in the Physical Units field.

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Table C.8-11 Continued

>Region Spatial Format	(0018,6012)	1	The spatial organization of the data within the region. See C.8.5.2.1.1 for Enumerated Values.
>Region Data Type	(0018,6014)	1	The type of data within the region. See C.8.5.2.1.2 for Enumerated Values.
>Region Flags	(0018,6016)	1	Flags used for special handling of the region. See C.8.5.2.1.3 for Enumerated Values and further explanation.
>Pixel Component Organization	(0018,6044)	1C	Describing how the components of a pixel can be described, either by bit aligned positions or ranges of values. The absence of this Data Element means that pixel component calibration does not exist for this region. See C.8.5.2.1.4 for Enumerated Values and further explanation.
>Pixel Component Mask	(0018,6046)	1C	This value is ANDed with the composite pixel code for each pixel within the region, then shifted right by the number of contiguous least significant zeros in the mask to obtain what will be referred to as the "Shifted Masked Composite Pixel Code" (SMCPC). Required if Pixel Component Organization = Bit aligned. See C.8.5.2.1.5 for further explanation.
>Pixel Component Range Start	(0018,6048)	1C	Defines the start of the numeric range of values within the composite pixel where calibration is to be defined by the "pixel physical calibration table". To be used only when ranges are used to describe the portion of the composite pixel. Required if Pixel Component Organization = Ranges.
>Pixel Component Range Stop	(0018,604A)	1C	Defines the stop of the numeric range of values within the composite pixel where calibration is to be defined by the "pixel physical calibration table". To be used only when ranges are used to describe the portion of the composite pixel. Required if Pixel Component Organization = Ranges.
>Pixel Component Physical Units	(0018,604C)	1C	The physical units to be applied to the pixel component. Required if Pixel Component Organization exists. See C.8.5.2.1.6 for further explanation.
>Pixel Component Data Type	(0018,604E)	1C	The type of data for the pixel component. Required if Pixel Component Organization exists. See C.8.5.2.1.7 for further explanation.

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Table C.8-11 Continued

>Number of Table Break Points	(0018,6050)	1C	The number of break point coordinate pairs used to describe a piece wise linear curve. Required if Pixel Component Organization exists. See C.8.5.2.1.8 for further explanation.
>Table of X Break Points	(0018,6052)	1C	An array of X values used to create the piece wise linear curve. Required if Pixel Component Organization exists. See C.8.5.2.1.9 for further explanation.
>Table of Y Break Points	(0018,6054)	1C	An array of Y values used to create the piece wise linear curve. Required if Pixel Component Organization exists. See C.8.5.2.1.9 for further explanation.
>Transducer Frequency	(0018,6030)	3	The manufacturer defined description of center frequency of the interrogating ultrasound energy. The units are Kilohertz.
>Pulse Repetition Frequency	(0018,6032)	3	The ultrasound pulse repetition frequency, as defined by the manufacturer, used to collect data in the region. The units are in hertz.
>Doppler Correction Angle	(0018,6034)	3	The Doppler correction angle. The units are degrees.
>Steering Angle	(0018,6036)	3	The steering angle, as defined by the manufacturer, used for a steered 2D image. The units are degrees.
>Doppler Sample Volume X Position	(0018,6038)	3	The x displacement, in pixels, from the Reference pixel to the center of the Doppler sample volume.
>Doppler Sample Volume Y Position	(0018,603A)	3	The y displacement, in pixels, from the Reference pixel to the center of the Doppler sample volume.
>TM-Line Position x_0	(0018,603C)	3	The starting and ending coordinates pairs of the m-line. Where the X_0,Y_0 are the starting point and X_1,Y_1 are the end point of the tm-line. See C.8.5.2.1.10 for further explanation.
>TM-Line Position y_0	(0018,603E)	3	The starting and ending coordinates pairs of the m-line. Where the X_0,Y_0 are the starting point and X_1,Y_1 are the end point of the tm-line. See C.8.5.2.1.10 for further explanation.
>TM-Line Position x_1	(0018,6040)	3	The starting and ending coordinates pairs of the m-line. Where the X_0,Y_0 are the starting point and X_1,Y_1 are the end point of the tm-line. See C.8.5.2.1.10 for further explanation.
>TM-Line Position y_1	(0018,6042)	3	The starting and ending coordinates pairs of the m-line. Where the X_0,Y_0 are the starting point and X_1,Y_1 are the end point of the tm-line. See C.8.5.2.1.10 for further explanation.

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C.8.5.2.1.2 Region data type

Enumerated Values for Region Data Type (0018,6014) indicate the type of data within the region.

Value	Meaning
0000H	None or not applicable
0001H	Tissue
0002H	Color Flow
0003H	PW Spectral Doppler
0004H	CW Spectral Doppler
0005H	Doppler Mean Trace
0006H	Doppler Mode Trace
0007H	Doppler Max Trace
0008H	Volume Trace
0009H	d(volume)/dt Trace
000AH	ECG Trace
000BH	Pulse Trace
000CH	Phonocardiogram Trace
000DH	Gray bar
000EH	Color bar
000FH	Integrated Backscatter
0010H	Area Trace
0011H	d(area)/dt
0012H	Other Physiological (Amplitude vs. Time) input

C.8.5.2.1.3 Region flag

Region Flags (0018,6016) are used for special handling of the region.

Enumerated Values for Bit 0 (lsb) Transparency:
1 = Transparent
0 = Opaque

If the region is transparent, then measurements may be done on regions underneath this region. This is most useful for ECG overlay regions overlapping with a 2D region.

Enumerated Values for Bit 1 Scaling Protection:
1 = Protected
0 = Not Protected

Ultrasound systems should set this to 1 if the image is scaled automatically by the ultrasound system. If the image is frame grabbed and scaling is not available then it should be set to 0. If the region is protected, the region can not be manually rescaled. That is the data defined by the region calibration Module can not be overridden by a reader of that image.

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Enumerated Values for Bit 2 Doppler Scale Type:
1 = Frequency
0 = Velocity
Valid for PW and CW regions only. Indicates which type of doppler scale is used.

Bits 3-31 Reserved for future use, shall be set to zero.

C.8.5.2.1.4 Pixel component organization

Pixel Component Organization (0018,6044) provides an Enumerated Value describing how the components of a pixel can be described, either by bit aligned positions or ranges of values. The absence of this Data Element means that pixel component calibration does not exist for this region. Where:

0 = Bit aligned positions
1 = Ranges

Other values reserved for future use, shall be set to zero.

C.8.5.2.1.5 Pixel component mask

Pixel Component Mask (0018,6046) is ANDed with the composite pixel code for each pixel within the region, then shifted right by the number of contiguous least significant zeros in the mask to obtain what will be referred to as the "Shifted Masked Composite Pixel Code" (SMCPC). A composite pixel code is formed by concatenating all samples of the pixel, with samples occurring first in the file representing the less significant portions of the pixel code, regardless of byte swapping or planar configuration formats. Said another way, as each sample is encountered in the file it should be added as a prefix to the accruing composite pixel code. For example, if SamplesPerPixel = 2, then, regardless of byte swapping or Planar Configuration, the first byte encountered in the file for a given pixel represents the least significant byte. The composite pixel code would be the MSbyteLSbyte- a 16 byte value.

The mask will most likely (but not necessarily) contain a block of contiguous ones, surrounded by leading and trailing zeros. The purpose of this mask is to keep only those bits within the composite pixel code which pertain to the region. It is to be used only when Pixel Organization is bit aligned positions.

C.8.5.2.1.6 Pixel component physical units

For Pixel Component Physical Units (0018,604C), the Enumerated Values describing the physical units to be applied to the pixel component are:

Value	**Meaning**
0000H	None or not applicable
0001H	Percent
0002H	dB
0003H	cm
0004H	seconds
0005H	hertz($seconds^{-1}$)
0006H	dB/seconds
0007H	cm/sec
0008H	cm^2
0009H	cm^2/sec

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Value	Meaning
000AH	cm^3
000BH	cm^3/sec
000CH	degrees

C.8.5.2.1.7 Pixel component data type

For Pixel Component Data Type (0018,604E), the Enumerated Values indicating the type of data for the pixel component are:

Value	Meaning
0000H	None or not applicable
0001H	Tissue
0002H	Spectral doppler
0003H	Color Flow Velocity
0004H	Color Flow Variance
0005H	Color Flow Intensity
0006H	Gray bar
0007H	Color bar
0008H	Integrated Backscatter
0009H	Computed Border

C.8.5.2.1.8 Number of table break points

The Number of Table Break Points (0018,6050) coordinate are pairs used to describe a piece wise linear curve. This curve maps the value of the pixel component to it's actual physical value (units defined in Pixel Component Physical Units Data Element).

C.8.5.2.1.9 Table of X break points and table of Y break points

Table of X Break Points (0018,6052) and Table of Y Break Points (0018,6054) are individual arrays of coordinates which interpreted together are used to create the piece wise linear curve. Note that the units for each direction are different. The x direction for the curve has no units and the y direction units are as described in the pixel component physical units data element.

C.8.5.2.1.10 TM-Line position X_0, TM-Line position Y_0, TM-Line position X_1, TM-Line position Y_1

The TM-Line Position X_0 (0018,603C) and TM-Line Position Y_0 (0018,603E) are the coordinates of the starting point and TM-Line Position X_1 (0018,6040), TM-Line Position Y_1 (0018,6042) are the coordinates of the end point of the TM-Line. The coordinate is defined as the displacement, in pixels, from the reference pixel. Typically used for M-Mode line and CW Doppler.

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C.8.5.3 US IMAGE MODULE

Table C.8-12 specifies the Attributes that describe ultrasound images.

Table C.8-12—US image module attributes

Attribute Name	Tag	Type	Attribute Description
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See C.8.5.3.1.2 for specialization.
Pixel Representation	(0028,0103)	1	Data representation of pixel samples. See C.8.5.3.1.3 for specialization.
Frame Increment Pointer	(0028,0009)	1C	Contains the Data Element Tag of the Attribute which is used as the frame increment in Multi-frame pixel data (see C.7.6.6). Required if Number of Frames is sent. See C.8.5.3.1.4 for specialization.
Image Type	(0008,0008)	2	Image identification characteristics. See C.8.5.3.1.1 for specialization.
Number of Stages	(0008,2124)	2C	Number of Stages in this protocol. Required if image was acquired in a Stage protocol.
Number of Views in Stage	(0008,212A)	2C	Number of Views in this Stage. Required if image was acquired in a Stage protocol.
Referenced Overlay Sequence	(0008,1130)	3	A Sequence which provides reference to a set of SOP Class/Instance pairs which are related independent Overlays. Uniquely identifies Overlays significantly related to this Image. 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 Overlay Sequence (0008,1130) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the Referenced SOP Instance. Required if Reference Overlay Sequence (0008,1130) is sent.
Referenced Curve Sequence	(0008,1145)	3	A Sequence which provides reference to a set of SOP Class/Instance pairs which are related independent Curves. Uniquely identifies Curves significantly related to this Image. 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 Curve Sequence (0008,1145) is sent.

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Table C.8-12 continued

>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the Referenced SOP Instance. Required if Reference Curve Sequence (0008,1145) is sent.
Stage Name	(0008,2120)	3	A Stage is a particular time slice of a protocol in which a set of images are collected. The names can be free form text. Recommended text for Stress Echo stage names are: PRE-EXERCISE, POST-EXERCISE, PEAK-EXERCISE, RECOVERY, BASELINE, LOW DOSE, PEAK DOSE
Stage Number	(0008,2122)	3	A number that identifies the Stage. Stage Number starts at one.
View Number	(0008,2128)	3	A number that identifies the View. View Number starts at one.
Number of Event Timers	(0008,2129)	3	The Number of Event Timers used at the time of acquisition of a Multi-frame image.
Event Elapsed Time(s)	(0008,2130)	3	An array of values associated with each Event Timer. Units in milliseconds.
Event Timer Name(s)	(0008,2132)	3	Name that identifies the Event Timer.
Transducer Position	(0008,2200)	3	Position of the Transducer. See C.8.5.3.1.5 for Defined Terms
Transducer Orientation	(0008,2204)	3	Provides the transducer orientation for TTE and TEE. See C.8.5.3.1.6 for Defined Terms.
Anatomic Structure	(0008,2208)	3	Description of the Anatomic Structure under current interrogation, either by imaging or Doppler. See C.8.5.3.1.7 for Defined Terms.
Trigger Time	(0018,1060)	3	Time interval measured in msec from the start of the R-wave to the beginning of data taking
Nominal Interval	(0018,1062)	3	Average R-R interval used for these data, in msec
Beat Rejection Flag	(0018,1080)	3	Beat length sorting has been applied. Enumerated Values: Y = yes N = no
Low R-R Value	(0018,1081)	3	R-R interval low limit for beat rejection, in msec
High R-R Value	(0018,1082)	3	R-R interval high limit for beat rejection, in msec

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Table C.8-12 continued

Heart Rate	(0018,1088)	3	Beats per minute.
Output Power	(0018,5000)	3	Manufacturer defined character string description of ultrasound output level(s) used in generating a given image. Data may be expressed in dB, %, W/cm^2, etc.
Transducer Data	(0018,5010)	3	Manufacturer defined code or description of ultrasound transducer used.
Transducer Type	(0018,6031)	3	Defined Terms: SECTOR_PHASED SECTOR_MECH SECTOR_ANNULAR LINEAR CURVED LINEAR SINGLE CRYSTAL SPLIT XTAL CWD IV_PHASED IV_ROT XTAL IV_ROT MIRROR ENDOCAV_PA ENDOCAV_MECH ENDOCAV_CLA ENDOCAV_AA ENDOCAV_LINEAR VECTOR_PHASED
Focus Depth	(0018,5012)	3	The Depth, from the transducer face, of the manufacturer defined beam focus used for the image, in cm.
Preprocessing Function	(0018,5020)	3	Manufacturer defined description of processing of echo information. Data may include code or description of gain (initial, overall, TGC, dynamic range, etc.), preprocessing, postprocessing, Doppler processing parameters, e.g. cutoff filters, etc., as used in generating a given image.
Mechanical Index	(0018,5022)	3	See C 8.5.3.1.8 for Description.
Bone Thermal Index	(0018,5024)	3	See C 8.5.3.1.8 for Description.
Cranial Thermal Index	(0018,5026)	3	See C 8.5.3.1.8 for Description.
Soft Tissue Thermal Index	(0018,5027)	3	See C 8.5.3.1.8 for Description.
Soft Tissue-focus Thermal Index	(0018,5028)	3	See C 8.5.3.1.8 for Description.
Soft Tissue-surface Thermal Index	(0018,5029)	3	See C 8.5.3.1.8 for Description.

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Table C.8-12 continued

Depth of Scan Field	(0018,5050)	3	The depth, in mm, from the transducer face to the deepest point included in the displayed image–the field of view.
Image Transformation Matrix	(0018,5210)	3	Transformation Matrix, as described in C.8.5.3.1.9. Used for spatially related images where the relationship includes rotations.
Image Translation Vector	(0018,5212)	3	Translation Vector as described in C.8.5.3.1.9. Used for spatially related images where the relationship includes translations.

C.8.5.3.1 US image attribute descriptions

C.8.5.3.1.1 Image type

For US images, Image Type (0008,0008) is specified to be Type 2. The Defined Terms for value 3 are:

ABDOMINAL
BREAST
CHEST
ENDOCAVITARY
ENDORECTAL
ENDOVAGINAL
EPICARDIAL
FETAL HEART
GYNECOLOGY
INTRACARDIAC
INTRAOPERATIVE
INTRAVASCULAR
MUSCULOSKELETAL
NEONATAL HEAD
OBSTETRICAL
OPHTHALMIC
PEDIATRIC
PELVIC
RETROPERITONEAL
SCROTAL
SMALL PARTS
TEE
THYROID
TRANSCRANIAL
TTE
US BIOPSY
VASCULAR

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Value 4 is constructed as a modality bit map to allow for a description of multi-modality displays. In using this bit map, the sum of the values of the various modalities will unambiguously determine the constituent modalities.

0001 = 2D Imaging
0002 = M-Mode
0004 = CW Doppler
0008 = PW Doppler
0010 = Color Doppler
0020 = Color M-Mode
0040 = 3D Rendering

NOTE— All Values are hexadecimal encoded as a CS. See PS 3.5. For example, Color Flow with CW spectral Doppler would have a value 4 = 0015. Note that no assumption should be made in Color Doppler or Color M-Mode regarding underlying B or M-Mode, respectively.

C.8.5.3.1.2 Photometric interpretation

For US images, Photometric Interpretation (0028,0004) is specified to use the following Defined Terms:

MONOCHROME2
PALETTE COLOR
RGB
ARGB

C.8.5.3.1.3 Pixel representation

For US images, Pixel Representation (0028,0103) is specified to use the following Enumerated Value:

0000H = unsigned integer

C.8.5.3.1.4 Frame increment pointer

For US Multi-frame images, the Attribute Frame Increment Pointer (0028,0009) of the Multi-frame Module (see section c.7.6.6) is specified by the following Defined Terms:

00180063 = sequencing by Frame Time (0018,1063)
00181065 = sequencing by Frame Time Vector (0018,1065)

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C.8.5.3.1.5 Transducer position

For US images, Transducer Position (0008,2200) shall use the following Defined Terms:

ANTERIOR	L SUBCLAVIAN	R SUBCLAVIAN
AORTA	LSUPRACLAVICULAR	RSUPRACLAVICULAR
APICAL	L UIQ	R UIQ
ARTERY	L UOQ	R UOQ
BASAL ESOPHAGUS	L VENTRICLE LATER	R VENTRICLE
BYPASS GRAFT	LEFT	RIGHT
CAUDAL	LEFT PARA	RIGHT PARA
CRANIAL	LOWER ESOPHAGUS	SUBCLAVIAN
DISTAL	MEDIAL	SUBCOSTAL
ENDOVAGINAL	MID ESOPHAGUS	SUP STERN NOTCH
ENDORECTAL	MIDLINE	SUPERIOR
EPICARDIAL	OCCIPITAL	SUPRACLAVICULAR
ESOPHAGUS	POSTERIOR	SURFACE
GASTRIC	PROXIMAL	TRANSGASTRIC
INFERIOR	PULMONARY ART	TRANSORBITAL
L ATRIUM	R ATRIUM	TRANSTEMPORAL
L CORONARY ART	R CORONARY ART	UPPER ESOPHAGUS
L LIQ	R LIQ	VEIN
L LOQ	R LOQ	
L PARASTERN	R PARASTERN	

C.8.5.3.1.6 Transducer orientation

For US images, Transducer Orientation (0008,2204) shall use the following Defined Terms:

2 CHAMBER	CORONAL	OBLIQUE
4 CHAMBER	L PARASAG	R PARASAG
5 CHAMBER	LONG AXIS	SAGITTAL
AXIAL	LONGITUDINAL	SHORT AXIS
		TRANSVERSE

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C.8.5.3.1.7 Anatomic structure

For US images, Anatomic Structure (0008,2208) shall use the following Defined Terms:

4 CH HEART
3RD VENTRICLE
4TH VENTRICLE
AC
ADRENAL
AMNIOTIC FLUID
AORTA
APPENDIX
ASCENDING COLON
BASILAR ART
BILE DUCT
BLADDER
BPD
C SPINE
CELIAC ART
CENTRAL ZONE
CEREBELLUM
CEREB HEMISPHERE
CERVIX
COLON
CUL DE SAC
DESCENDING COLON
DUODENUM
ENDOMETRIUM
FETAL ARMS
FETAL DIGITS
FETAL HEART
FETAL LEGS
FETAL POLE
FEMUR LENGTH
FUNDUS
GALLBLADDER
GEST SAC
HC
HEPATIC ART
ILEUM
ISTHMUS
INF MES ART
INF VENA CAVA
L ACA
L AXILLARY A
L AXILLARY V
L BRACHIAL A
L BRACHIAL V
L BREAST
L BULB
L CCA
L CFA
L CFV
L CHOROID PLEXUS
L COM ILIAC ART
L COM ILIAC V
L ECA
L EPIDIDYMIS
L EXT ILIAC A
L EXT ILIAC V
L EXT JUG V
L EYE
L FEMUR
L GSV
L HEPATIC V
L HUMERUS
L ICA
L ILIAC A
L ILIAC V
L INT JUG V
L KIDNEY
L MCA
L OVARY
L PCA
L POP A
L POP V
L PROF FEM A
L PROF FEM V
L RADIAL A
L RADIUS
L RENAL ART
L RENAL V
L SEM VESICLE
L SAPH V
L SFA
L SFV
L SPINE
L SUBCLAVIAN A
L SUBCLAVIAN V
L TESTIS
L THALAMUS
L TIB FIB
L ULNA
L ULNAR ART
L VENTRICLE
L VERT
LAT VENTRICLES
LIVER
L PORTAL V
MID HEPATIC V
MORRISONS POUCH
OFD
PANCREAS
PENILE VESSELS
PERIPHERAL ZONE
PLACENTA
PORTAL V
PROSTATE
R ACA
R AXILLARY A
R AXILLARY V
R BRACHIAL A
R BRACHIAL V
R BREAST
R BULB
R CCA
R CFA
R CFV
R CHOROID PLEXUS
R COM ILIAC ART
R COM ILIAC V

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R ECA
R EYE
R EPIDIDYMIS
R EXT ILIAC A
R EXT ILIAC V
R EXT JUV V
R FEMUR
R GSV
R HEPATIC V
R HUMERUS
R ICA
R ILIAC A
R ILIAC V
R INT JUG V
R KIDNEY
R MCA
R OVARY
R PCAR POP A
R POP V
R PROF FEM A
R PROF FEM V
R RADIAL A
R RADIUS
R RENAL ART
R RENAL V
R SAPH V
R SEM VESICLE
R SFA
R SFV
R SUBCLAVIAN A
R SUBCLAVIAN V
R TESTIS
R THALAMUS
R TIB FIB
R ULNA
R ULNAR ART
R VENTRICLE
R VERT
R PORTAL V
RECTUM
RETROPERITONEUM
SACRUM
SCROTUM
SIGMOID
SMA
SMALL INTESTINE
SMV
SPLEEN
SPLENIC ART
SPLENIC V
THYROID
TRANSITION ZONE
TRANSVERSE COLON
SIGMOID
UMB CORD
UTERINE FUNDUS
UTERUS
VAGINA
YOLK SAC
ABD AO
AO ANNULUS
AO ARCH
AO LFLT TIPS
AO VALVE
ASCENDING AO
ASD
AZYGOS VEIN
CORONARY SINUS
DIAGONAL
DISTAL LAD
DISTAL LCX
DISTAL RCA
IAS
INNOMINATE A
INT ATRIAL SEPT
INT VENT SEPT
IVS
L ATRIAL APPEN
L ATRIUM
L FOOT
L GERMINAL MATRX
L HIP
L SHOULDER
L MAIN COR ART
L SAPH V
L SVC
LAD
LAD D1
LAD D2
LAD D3
LAD S1
LAD S2
LCX
LCX DM1
LCX DM2
LIMA
LLPV
LOWER DESC AO
LPA
LPV
LV CAVITY
LV MID
LVOT
MAIN PA
MID LAD
MID LCX
MID RCA
MITRAL ANNULUS
MITRAL LFLT TIPS
MITRAL VALVE
OBTUSE MARGINAL
PERINEUM
PLV COR ART
POST DESC ART
POST LV BRANCH
PROX CIRC
PROX LAD
PROX LCX
PROX RCA
PULM ANNULUS
PULM VALVE
PULM VEIN
PV TIPS
R ATRIUM
R FOOT
R GERMINAL MATRX
R HIP
R PV
R SAPH V
R SHOULDER
RAA
RCA
RIMA
RLPV
RPA
RUPV
RV CAVITY
RVOT
SAPH V GRAFT LAD
SUP VENA CAVA
SVG D
SVG LAD
SVG LCX
SVG OM
SVG PDA
SVG PLV
SVG RCA
TRICUSPID ANN
TRICUSPID TIPS
TRICUSPID VALVE

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C.8.5.3.1.8 Mechanical index, bone thermal index, cranial thermal index, soft tissue thermal index

The Thermal and/or Mechanical Indices, when made available by a manufacturer, are defined according to the *Standard for Real-Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment*, a voluntary performance standard jointly published by AIUM and NEMA.

C.8.5.3.1.9 Image transformation matrix and image translation vector

In spatially related US images it is necessary to be able to convert data from the (x', y', z') coordinate system of the echo plane into the (x, y, z) coordinate system of the frame of reference. It is assumed that the echo-plane is a right handed, orthogonal Cartesian coordinate system, with its origin at the reference pixel as defined in the US frame of reference module, such that +x' is directed to the right, +y' is directed toward the top of the screen, and +z' is directed out of the screen toward the viewer. From this definition $z' \equiv 0$ everywhere on the echo plane. (x, y, z) is a similar right-handed system. The origin of (x', y', z') lies at the point (x_0, y_0, z_0) in the (x, y, z) system (x_0 in vector notation). Once the appropriate translation has been applied, the two coordinate systems are related by a 3x3 rotation matrix A, such that a point r' in (x', y', z') may be converted to r in (x, y, z) by a matrix multiplication and translation:

$$r = Ar' + x_0$$

These two operations may be combined in a single matrix multiplication by appending the transtation vector to the rotation matrix:

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & x_0 \\ a_{21} & a_{22} & a_{23} & y_0 \\ a_{31} & a_{32} & a_{33} & z_0 \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \qquad \text{(Equation C.8-1)}$$

Where each a_{ij} represents the cosine of the angle between the ith unit vector of the (x', y', z') system and the jth unit vector of the (x, y, z) system, or $i \cdot j \neq i \cdot j$. These nine rotation components are not independent, but rather are constrained by the orthonormality condition to:

$$\sum_{i=1}^{3} a_{ij} a_{ik} = \delta jk$$

where δ j k is the Kronecker delta function, 0 for $j \neq k$ $i \cdot j$, and 1 for j=k.

Taking advantage of the fact that $z' \equiv 0$, Equation C.8-1 can be reduced to:

$$\begin{bmatrix} a_{11} & a_{12} & 0 & x_0 \\ a_{21} & a_{22} & 0 & y_0 \\ a_{31} & a_{32} & 0 & z_0 \end{bmatrix} \begin{bmatrix} x' \\ y' \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \qquad \text{(Equation C.8-2)}$$

The Image Transformation Matrix (0018,5210) shall consist of the direction cosines in the following order: $a_{11}, a_{21}, a_{31}, a_{12}, a_{22}, a_{32}$.

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The Image Translation Vector (0018,5212) shall consist of the translation elements from Equation. C.8-2 in the following order: x_0, y_0, z_0.

The Frame of Reference (x, y, z) shall be defined by the first image in a spatially related series. Subsequent rotations of θ about x (fan), y (propeller) or z (panorama) shall have the following Image Transformation Matrices.

$$\text{FAN: } \begin{bmatrix} 1 & 0 \\ 0 & \cos\theta \\ 0 & \sin\theta \end{bmatrix} \qquad \text{PROP: } \begin{bmatrix} \cos\theta & 0 \\ 0 & 1 \\ -\sin\theta & 0 \end{bmatrix} \qquad \text{PAN: } \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \\ 0 & 0 \end{bmatrix}$$

The convention used for rotation shall be positive when it appears counterclockwise when looking from the +x axis of rotation to the origin.

C.8.6 *Secondary capture*

C.8.6.1 SC EQUIPMENT MODULE

This Module describes equipment used to convert images into a DICOM format.

Table C.8-13—SC Image equipment module attributes

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Describes the kind of image conversion. Defined Terms are: DV = Digitized Video DI = Digital Interface DF = Digitized Film WSD = Workstation
Modality	(0008,0060)	3	Source equipment for the image. See C.7.3.1 for Enumerated Values.
Secondary Capture Device ID	(0018,1010)	3	User defined identification of the device that converted the image
Secondary Capture Device Manufacturer	(0018,1016)	3	Manufacturer of the Secondary Capture Device
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Manufacturer's model number of the Secondary Capture Device
Secondary Capture Device Software Version	(0018,1019)	3	Manufacturer's designation of Software Version of the Secondary Capture Device
Video Image Format Acquired	(0018,1022)	3	Original format of the captured video image (e.g. NTSC, PAL, Videomed-H)
Digital Image Format Acquired	(0018,1023)	3	Additional information about digital interface used to acquire the image

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C.8.6.2 SC IMAGE MODULE

The table in this section contains IOD Attributes that describe Secondary Capture Images.

Table C.8-14—SC image module attributes

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	The date the Secondary Capture Image was captured.
Time of Secondary Capture	(0018,1014)	3	The time the Secondary Capture Image was captured.

C.9 Overlays

C.9.1 *Overlay identification module*

Table C.9-1 contains Attributes that identify an independent Overlay; i.e.- an Overlay which is handled as an independent Information Entity.

Table C.9-1—Overlay identification module attributes

Attribute Name	Tag	Type	Attribute Description
Overlay Number	(0020,0022)	2	A number that identifies this Overlay.
Overlay Date	(0008,0024)	3	The date the Overlay was created.
Overlay Time	(0008,0034)	3	The time the Overlay was created.
Referenced Image Sequence	(0008,1140)	3	A sequence which provides reference to a set of Image SOP Class/Instance pairs. Uniquely identifies the images significantly related to this Overlay. 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 Reference Image Sequence(0008,1140) is sent.

C.9.2 *Overlay plane module*

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

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Table C.9-2—Overlay plane module attributes

Attribute Name	Tag	Type	Attribute Description
Rows	(60xx,0010)	1	Number of Rows in Overlay.
Columns	(60xx,0011)	1	Number of Columns in Overlay.
Overlay Type	(60xx,0040)	1	Indicates whether this Overlay represents a region of interest or other graphics. Enumerated Values: G = Graphics R = ROI.
Origin	(60xx,0050)	1	Location of first Overlay point with respect to pixels in the Image, given as row and column.
Bits Allocated	(60xx,0100)	1	Number of Bits Allocated in the Overlay
Bit Position	(60xx,0102)	1	Bit in which Overlay is stored
Overlay Data	(60xx,3000)	1C	Overlay Data shall be contained in this Attribute or imbedded with the Image pixel data in Group 7FE0. Required if Overlay Data are in this Group. See C.9.2.1.1 for further explanation
ROI Area	(60xx,1301)	3	Number of pixels in ROI Area. See C.9.2.1.2 for further explanation.
ROI Mean	(60xx,1302)	3	ROI Mean. See C.9.2.1.2 for further explanation.
ROI Standard Deviation	(60xx,1303)	3	ROI Standard Deviation. See C.9.2.1.2 for further explanation.
Overlay Descriptor - Gray	(60xx,1100)	3	The number of bits in each entry of (60xx,1200)
Overlay Descriptor - Red	(60xx,1101)	3	The number of bits in each entry of (60xx,1201)
Overlay Descriptor - Green	(60xx,1102)	3	The number of bits in each entry of (60xx,1202)
Overlay Descriptor - Blue	(60xx,1103)	3	The number of bits in each entry of (60xx,1203)
Overlays- Gray	(60xx,1200)	3	Overlay bits. A value of 1 indicted that the pixel is part of the Overlay Plane.
Overlays - Red	(60xx,1201)	3	Overlay bits. A value of 1 indicted that the pixel is part of the Overlay Plane.
Overlays - Green	(60xx,1202)	3	Overlay bits. A value of 1 indicted that the pixel is part of the Overlay Plane.
Overlays- Blue	(60xx,1203)	3	Overlay bits. A value of 1 indicted that the pixel is part of the Overlay Plane.

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C.9.2.1 OVERLAY ATTRIBUTE DESCRIPTIONS

C.9.2.1.1 Overlay type

There are two specific types of Overlays. The Type is specified in this Attribute.

A Region of Interest (ROI) is a specific use of an Overlay. The Overlay bits corresponding to all the pixels included in the ROI shall be set to 1. All other bits are set to 0. This is used to specify an area of the image of particular interest.

A Graphics Overlay may express reference marks, graphic annotation, or bit mapped text, etc. A Graphics Overlay may be used to mark the boundary of a ROI. If this is the case and the ROI statistical parameters are used, they will only refer to the pixels under the boundaries, not those in the included regions.

C.9.2.1.2 ROI area, ROI mean, and ROI standard deviation

These Attributes contain the statistical parameters of the ROI. The values of these parameters are for the Overlay pixel values set to 1.

C.9.3 *Multi-frame overlay module*

Table C.9-3 specifies the attributes of a multi-frame overlay.

Table C.9-3—Multi-frame overlay module attributes

Attribute Name	Tag	Type	Attribute Description
Number of Frames in Overlay	(60xx,0015)	1	Number of Frames in Overlay. Required if Overlay data contains multiple frames.

C.9.3.1 MULTI-FRAME OVERLAY ATTRIBUTE DESCRIPTIONS

C.9.3.1.1 Number of frames in overlay

A Multi-frame Pverlay is defined as an Overlay whose Overlay Data consists of a sequential set of individual Overlay Frames. A Multi-frame Overlay is transmitted as a single contiguous stream of Overlay data. Frame delimiters are not contained within the data stream.

Each individual frame shall be defined (and thus can be identified) by the Attributes in the Overlay Plane module (see C.9.2).

The total number of frames contained within a Multi-frame Overlay is conveyed in the Number of Frames in Overlay (60xx,0015).

The frames within a Multi-frame Overlay shall be conveyed as a logical sequence. If Multi-frame Overlays are related to a Multi-frame Image, the order of the Overlay Frames are one to one with the order of the Image Frames. Otherwise, no attribute As used to indicate the sequencing of the Overlay Frames.

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C.10 Curve

C.10.1 *Curve identification module*

The table in this section contains Attributes that identify an independent Curve; i.e.- a Curve which is handled as a separate Information Entity.

Table C.10-1—Curve identification module attributes

Attribute Name	Tag	Type	Attribute Description
Curve Number	(0020,0024)	2	A number that identifies this Curve.
Curve Date	(0008,0025)	3	The date the Curve was created.
Curve Time	(0008,0035)	3	The time the Curve was created.
Referenced Image Sequence	(0008,1140)	3	A Sequence which provides reference to a set of Image SOP Class/Instance pairs. Uniquely identifies the Images significantly related to this Curve. 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 Reference Image Sequence(0008,1140) is sent.
Referenced Overlay Sequence	(0008,1130)	3	A Sequence which provides reference to a set of SOP Class/Instance pairs which are related independent Overlays. Uniquely identifies Overlays significantly related to this Curve. 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 Overlay Sequence (0008,1130) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the Referenced SOP Instance. Required if Reference Overlay Sequence (0008,1130) is sent.
Referenced Curve Sequence	(0008,1145)	3	A Sequence which provides reference to a set of Curve SOP Class/Instance pairs. Uniquely identifies the curves significantly related to this Curve. 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 Reference Image Sequence (0008,1140) is sent.

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C.10.2 *Curve module*

This Module defines Attributes of Curves. A Curve may or may not be related to an Image and/or a Curve.

Table C.10-2—Curve module attributes

Attribute Name	Tag	Type	Attribute Description
Curve Dimensions	(50xx,0005)	1	Number of dimensions for these data. The dimensions may be any number from 1 to n.
Number of Points	(50xx,0010)	1	Number of data points in this Curve
Type of Data	(50xx,0020)	1	Type of data in this curve. See C.10.2.1.1 for Defined Terms.
Data Value Representation	(50xx,0103)	1	Data representation of the Curve data points. See C.10.2.2 for Enumerated Values and further explanation.
Curve Data	(50xx,3000)	1	Curve data. See C.10.2.1.4 for further explanation.
Curve Description	(50xx,0022)	3	User-defined comments about the Curve
Axis Units	(50xx,0030)	3	Units of measure for the axes. See C.10.2.1.3 for Defined Terms.
Axis Labels	(50xx,0040)	3	Text labels for each axis. One label for each axis.
Minimum Coordinate Value	(50xx,0104)	3	The minimum value in the set of data. One value for each dimension.
Maximum Coordinate Value	(50xx,0105)	3	The maximum value in the set of data. One value for each dimension.
Curve Range	(50xx,0106)	3	A minimum-maximum pair for each dimension for defining the range of the Curve representation, in the same units as Axis Units.
Curve Data Descriptor	(50xx,0110)	1C	Specifies the format of the Curve Data. Required if any dimensions of the data are described by interval spacing. See C.10.2.1.5 for further explanation.
Coordinate Start Value	(50xx,0112)	1C	The starting point of a one dimensional data list. Required if Curve Data Descriptor is used. One value for each dimension. The Value Representation is given in Data Value Representation (50xx,0103).
Coordinate Step Value	(50xx,0114)	1C	The interval spacing between two successive points. Required if Curve Data Descriptor is used. One value for each dimension. The Value Representation is given in Data Value Representation (50xx,0103).

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C.10.2.1 CURVE ATTRIBUTE DESCRIPTIONS

C.10.2.1.1 Type of data

A description of the Type of Data (50xx,0020) in this Curve.

Defined Terms:
TAC = time activity curve
PROF= image profile
HIST = histogram
ROI = polygraphic region of interest
TABL = table of values
FILT = filter kernel
POLY = poly line
ECG = ecg data
PRESSURE = pressure data
FLOW = flow data
PHYSIO = physio data
RESP = Respiration trace

C.10.2.1.2 Data value representation

The Data Value Representation (50xx,0103) of the data in the Curve. All dimensions shall have the same value representation.

Enumerated Values:
0000H = unsigned short (US)
0001H = signed short (SS)
0002H = floating point single (FL)
0003H = floating point double (FD)
0004H = signed long (SL)

C.10.2.1.3 Axis units

Axis Units (50xx,0030) are the units of measure for the axes. One value for each dimension. The order for the units is the same order as the dimensions for the curve data in Curve Data (50xx,3000).

Defined Terms:
SEC = Seconds
CNTS = Counts
MM = millimeters
PIXL = Pixels
NONE = Unitless
BPM = beats/min
CM = centimeters
CMS = centimeters/second
CM2 = cm**2
CMS2 = cm**2/second
CM3 = cm**3

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CM3S = cm**3/second
CMS2 = cm/second**2
DB = dB
DBS = dB/second
DEG = degrees
GM = gram
GMM2 = gram/meter**2
HZ = Hertz
IN = inch
KG = kg
LMIN = liters/minute
LMINM2 = liters/minute/meter**2
M2 = meters **2
MS2 = meters/sec**2
MLM2 = milliliters/meter**2
MILS = milliseconds
MILV = millivolts
MMHG = mmHg
PCNT = percent
LB = pound

C.10.2.1.4 Curve data

Curve Data (50xx,3000) points in the curve, each dimension for the first point, followed by dimensions for second point, etc. For a two dimensional curve: X1,Y1,X2,Y2, etc. The Value Representation of all components of the N-tuple must be the same. The Value Representation is given in Data Value Representation (50xx,0103).

A Region of Interest (ROI) is defined as an N-tuple list of end points which form a closed polygraph. A two-dimensional ROI is represented as a list of value pairs; a three dimensional ROI as a list of value triplets, etc. A Region of Interest would normally be represented in pixel units, with the curve range values matching the pixel matrix of the images with which the ROI is associated. Alternatively, it is possible to define a unitized region of interest which can be applied to any size image.

A Poly Line is defined as an n-tuple list of end points which form a general trace not forming a closed polygraph. It is used to represent any graphic which does not fall within the normal understanding of a Curve Plot or Region of Interest. The Poly Line can be used to define any graphic trace.

C.10.2.1.5 Curve data descriptor, coordinate start value, coordinate step value

The Curve Data for Dimension(s) containing evenly distributed data can be eliminated by using a method that defines the Coordinate Start Value and Coordinate Step Value (interval). The one dimensional data list is then calculated rather than being enumerated.

For the Curve Data Descriptor (50xx,0110) an Enumerated Value describing how each component of the N-tuple curve is described, either by points or interval spacing. One value for each dimension. Where:

0000H = Dimension component described using interval spacing
0001H = Dimension component described using values

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Using interval spacing:

Dimension component(s) described by interval spacing use Attributes of Coordinate Start Value (50xx,0112), Coordinate Step Value (50xx,0114) and Number of Points (50xx,0010). The 1-dimensional data list is calculated by using a start point of Coordinate Start Value and adding the interval (Coordinate Step Value) to obtain each data point until the Number of Points is satisfied. The data points of this dimension will be absent from Curve Data (50xx,3000).

Using values:

Dimension component(s) of the N-tuple curve are listed as data points in Curve Data (50xx,3000). Data is absent from the tuple where the dimension data is defined by using the interval spacing method.

The absence of this data element means that the curve is described using points for the complete N-tuple. The interval spacing method is not used.

C.10.3 *Audio module*

This Module defines Attributes that describe characteristics of Audio Curves.

Table C.10-3—Audio module attributes

Attribute Name	Tag	Type	Attribute Description
Audio Type	(50xx,2000)	1	Indicates the type of Audio Sample Data. Enumerated Values: 0000H = none 0001H = Doppler Audio 0002H = Voice Audio 0003H = Phono Audio
Audio Sample Format	(50xx,2002)	1	Format of the Audio Sample Data. Enumerated Values: 0000H = 16 bit 2's complement Stored LSB first, interleaved per channel: channel 0 sample 0, channel 1 sample 0, channel 0 sample 1, channel 1 sample 1 0001H = 8 bit 2's complement, interleaved per channel: channel 0 sample 0, channel 1 sample 0, channel 0 sample 1, channel 1 sample 1
Number of Channels	(50xx,2004)	1	Number of Audio Channels. Enumerated Values: 0000H = mono 0001H = stereo
Number of Samples	(50xx,2006)	1	The number of audio samples for one channel. Each channel will have this many samples.
Sample Rate	(50xx,2008)	1	Number of samples per second at which audio data was acquired. The temporal axis is linear. NOTE: Log compression is not supported.

Table continued on next page

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Table C.10-3 continued

Total Time	(50xx,200A)	1	Length of real time that the audio data covers (in microseconds).
Audio Sample Data	(50xx,200C)	1	Audio Sample Data values. The amplitude representation of the audio sample data is linear. NOTE: Log compression is not supported.
Referenced Image Sequence	(0008,1140)	3	A Sequence which provides reference to a set of Image SOP Class/Instance pairs to which this audio applies. 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.
Audio Comments	(50xx,200E)		User defined comments about the audio.

C.10.3.1 AUDIO SYNCHRONIZATION

The approach being taken is to provide for audio in an elementary, basic way. Audio is typically used for voice commentary of what is found during an examination, and perhaps in a diagnosis, similar to written notes. Audio is also used to record physiological information such as Doppler audio.

The only link between Audio and image time bases is alignment between Audio time zero and image time zero, on a frame boundary. The time bases for each are distinct and separate.

Synchronization of Audio to single frame images is not necessary, since an image is "stationary." The Audio Module need only reference the image to which it applies, using the element Referenced Image Sequence (0008,1140).

Synchronization of Audio to Multi-frame loops is accomplished by referencing the loop to which the Audio applies, similar to single frame images. Audio starts at time zero of the loop and continues for Attribute Total Time (50xx,200a) number of microseconds, using the time base specified in the Audio Module.

Other than synchronizing the Audio at time zero of the image loop, there is no other synchronization between image and Audio time bases. The Audio may partially span, fully span, or overspan the duration of the image loop. This is beyond the scope of this Standard.

If Audio does not start at frame zero, then the appropriate offset may be added by padding the Audio Sample Data with null values to achieve the necessary offset.

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C.11 Lookup tables

C.11.1 *Modality LUT module*

Table C.11-1 specifies the Attributes that describe the Modality LUT.

Table C.11-1—Modality LUT module attributes

Attribute Name	Tag	Type	Attribute Description
Modality LUT Sequence	(0028,3000)	3	Defines a Sequence of Modality 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 Modality LUT Sequence(0028,3000) is sent.
>LUT Explanation	(0028,3003)	3	Free form text explanation of the meaning of the LUT.
>Modality LUT Type	(0028,3004)	1C	Specifies the output values of this Modality LUT. See C.11.1.1 for further explanation. Required if the Modality LUT Sequence(0028,3000) is sent.
>LUT Data	(0028,3006)	1C	LUT Data in this Sequence. If padding is required to complete a full word, the padding value shall be 0. Required if the Modality LUT Sequence(0028,3000) is sent.
Rescale Intercept	(0028,1052)	1C	The value b in relationship between stored values (SV) and the output units specified in Rescale Type (0028,1054). Output units = m*SV + b. Required if Modality LUT Sequence (0028,3000) is not present.
Rescale Slope	(0028,1053)	1C	m in the equation specified by Rescale Intercept (0028,1052). Required if Rescale Intercept is present.
Rescale Type	(0028,1054)	1C	Specifies the output values of Rescale Slope (0028 (0028

C.11.1.1 LUT ATTRIBUTE DESCRIPTIONS

C.11.1.1.1 LUT descriptor

The three values of the LUT descriptor (0028,3002) describe the format of the LUT data in the corresponding data element (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 entry are also mapped to the first entry in the LUT Data. An image pixel value one greater than the first entry 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 entry - 1 which is mapped to the last entry in the LUT Data. Image pixel values greater than number of entries + first entry are also mapped to the last entry in the LUT Data.

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The third value specifies the number of bits for each entry in the LUT data. It shall take the value 8 or 16. The LUT data shall be stored in a format equivalent to 8 or 16 bits allocated and high bit equal 1-bits allocated.

C.11.1.1.2 Modality LUT type

Specifies the units of the output of the Modality LUT.
Defined Terms:

OD = The number in the LUT represents thousandths of optical density. That is, a value of 2140 represents an optical density of 2.140.

US = Unspecified

Other values are permitted, but are not defined by this Standard.

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. If padding is required to complete a full word, the padding value shall be 0. 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.11.2.1.3 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) specifies 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.

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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 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 should be presented.

C.11.3 *LUT identification module*

Table C.11-3 contains Attributes that identify a LUT IOD.

Table C.11-3—LUT identification module attributes

Attribute Name	Tag	Type	Attribute Description
LUT Number	(0020,0026)	2	A number that identifies this LUT.
Referenced Image Sequence	(0008,1140)	3	A Sequence which provides reference to a set of Image SOP Class/Instance pairs to which this Look Up Table applies. Encoded as Sequence of Items: (0008,1150) and (0008,1155).
>Referenced SOP Class UID	(0008,1150)	1C	Required if Referenced Image Sequence (0008,1140) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Required if Reference Image Sequence (0008,1140) is sent.
LUT Number	(0020,0026)	2	A number that identifies this LUT.

C.12 General modules

The SOP common Module shall be mandatory for all DICOM IODs.

C.12.1 *SOP common module*

Table C.12-1 defines the Attributes which are required for proper functioning and identification of the associated SOP instances. They do not specify any semantics about the real-world object represented by the IOD.

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Table C.12-1—SOP common module attributes

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	see C.12.1.1.1	Uniquely identifies the SOP Class. See PS 3.4.
SOP Instance UID	(0008,0018)	see C.12.1.1.1	Uniquely identifies the SOP Instance. See PS 3.4.
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set . Required if an expanded or replacement character set is used. See C.12.1.1.2 for Defined Terms.
Instance Creation Date	(0008,0012)	3	Date the SOP Instance was created.
Instance Creation Time	(0008,0013)	3	Time the SOP Instance was created.
Instance Creator UID	(0008,0014)	3	Uniquely identifies device which created the SOP Instance.

C.12.1.1 SOP COMMON ATTRIBUTE DESCRIPTIONS

C.12.1.1.1 SOP Class UID, SOP Instance UID

The SOP class UID and SOP instance UID attributes are defined for all DICOM IODs. However, they are only encoded in composite IODs with the type equal to 1. When encoded they shall be equal to their respective attributes in the DIMSE services and the file meta information header (media storage see part 10).

C.12.1.1.2 Specific character set

Specific Character Set (0008,0005) identifies the character set that expands or replaces the basic graphic set (G0 set) of ISO 646 for values of data elements that have value representation of SH, LO, ST, PN or LT. See PS 3.5.

Defined Terms are:

ISO-IR 100 = Latin alphabet No. 1, supplementary set
ISO-IR 101 = Latin alphabet No. 2, supplementary set
ISO-IR 109 = Latin alphabet No. 3, supplementary set
ISO-IR 110 = Latin alphabet No. 4, supplementary set
ISO-IR 144 = Cyrillic supplementary set
ISO-IR 127 = Arabic supplementary set
ISO-IR 126 = Greek supplementary set
ISO-IR 138 = Hebrew supplementary set
ISO-IR 148 = Latin alphabet No. 5, supplementary set

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C.13 Print management specific modules

The following sections specify Modules used for Print Management.

C.13.1 *Basic film session presentation module*

Table C.13-1—Basic film session presentation module

Attribute name	Tag	Description
Number of Copies	(2000,0010)	Number of Copies to be printed for each film of the film session.
Print Priority	(2000,0020)	Specifies the priority of the print job; Enumerated Values: HIGH MED LOW
Medium Type	(2000,0030)	Type of medium on which the print job will be printed; Defined Terms: PAPER CLEAR FILM BLUE FILM
Film Destination	(2000,0040)	Film Destination; Enumerated Values: MAGAZINE = the exposed film is stored in film magazine PROCESSOR = the exposed film is developed in film processor
Film Session Label	(2000,0050)	Human readable label that identifies the film session
Memory Allocation	(2000,0060)	Amount of memory allocated for the film session; value is expressed in KB

C.13.2 *Basic film session relationship module*

Table C.13-2—Basic film session relationship module

Attribute Name	Tag	Description
Referenced Film Box Sequence	(2000,0500)	A Sequence which provides references to a set of Film Box SOP Class/Instance pairs. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.

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C.13.3 *Basic film box presentation module*

Table C.13-3—Basic film box presentation module

Attribute Name	Tag	Description
Image Display Format	(2010,0010)	Type of Image Display Format; Enumerated Values: STANDARD\C,R : film contains equal size rectangular image boxes with R rows of image boxes and C columns of image boxes; C and R are integers ROW\R1,R2,R3, etc. : film contains rows with equal size rectangular image boxes with R1 image boxes in the first row, R2 image boxes in second row, R3 image boxes in third row, etc.; R1, R2, R3, etc. are integers COL\C1,C2,C3, etc.: film contains columns with equal size rectangular image boxes with C1 image boxes in the first column, C2 image boxes in second column, C3 image boxes in third column, etc.; C1, C2, C3, etc. are integers SLIDE : film contains 35mm slides; the number of slides for a particular film size is configuration dependent. SUPERSLIDE : film contains 40mm slides; the number of slides for a particular film size is configuration dependent. CUSTOM\I : film contains a customized ordering of rectangular image boxes; I identifies the image display format; the definition of the image display formats is defined in the Conformance Statement; I is an integer
Annotation Display Format ID	(2010,0030)	Identification of Annotation Display Format. The definition of the Annotation Display Formats and the annotation box position sequence are defined in the Conformance Statement
Film Orientation	(2010,0040)	Film Orientation; Enumerated Values: PORTRAIT = vertical film position LANDSCAPE = horizontal film position
Film Size ID	(2010,0050)	Film Size Identification; Defined Terms: 8INX10IN 10INX12IN 10INX14IN 11INX14IN 14INX14IN 14INX17IN 24CMX24CM 24CMX30CM NOTE: 10INX14IN corresponds with 25.7CMX36.4 CM
Magnification Type	(2010,0060)	Interpolation type by which the printer magnifies the image in order to fit the image in the image box on film; Defined Terms: REPLICATE BILINEAR CUBIC NONE

Table continued on next page

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Table C.13-3 Continued

Smoothing Type	(2010,0080)	Further specifies the type of the interpolation function; values are defined in Conformance Statement; only valid for Magnification Type (2010,0060) = CUBIC
Border Density	(2010,0100)	Density of the film areas surrounding and between images on the film; Defined Terms: BLACK WHITE i where i represents the desired density in hundredths of OD (e.g. 150 corresponds with 1.5 OD)
Empty Image Density	(2010,0110)	Density of the image box area on the film that contains no image; Defined Terms: BLACK WHITE i where i represents the desired density in hundredths of OD (e.g. 150 corresponds with 1.5 OD)
Min Density	(2010,0120)	Minimum density of the images on the film, expressed in hundredths of OD; if Min Density is lower than minimum printer density than Min Density is set to minimum printer density.
Max Density	(2010,0130)	Maximum density of the images on the film, expressed in hundredths of OD; if Max Density is higher than maximum printer density than Max Density is set to maximum printer density.
Trim	(2010,0140)	Specifies whether a Trim box shall be printed surrounding each image on the film; Enumerated Values: YES NO
Configuration Information	(2010,0150)	Character string that contains either the ID of the printer configuration table that contains a set of values for implementation specific print parameters (e.g. perception LUT related parameters) or one or more configuration data values, encoded as characters. If there are multiple configuration data values encoded in the string, they shall be separated by backslashes. The definition of values shall be contained in the SCP's Conformance Statement.

C.13.3.1 IMAGE DISPLAY FORMAT

C.13.3.1.1 Standard image display format

The Standard Format subdivides a film into image boxes of equal size. Therefore, the film layout is fully symmetrical, i.e. the arrangement of image boxes on film is left-right and top-bottom symmetric.

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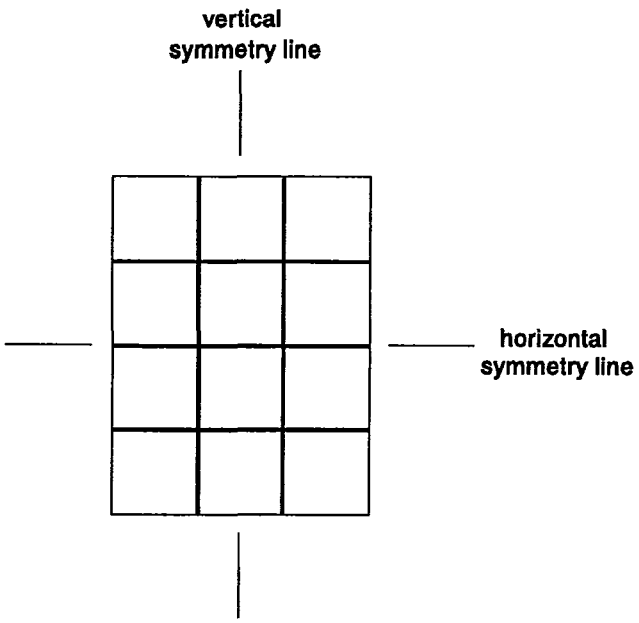
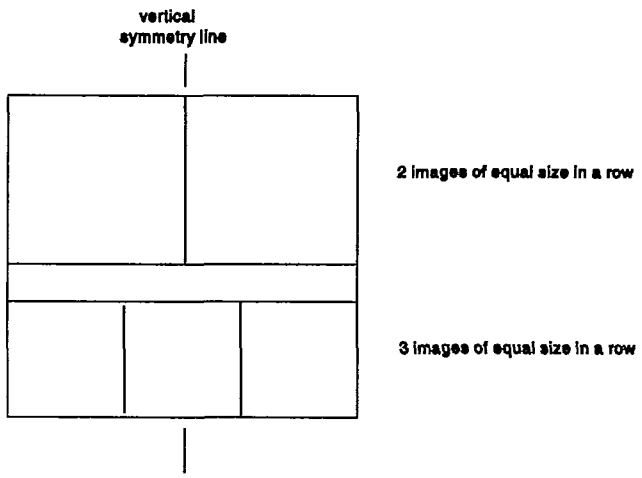
Example: STANDARD\3,4



C.13.3.1.2 Row symmetric image display format

The Row Symmetric Image Display Format subdivides a film into rows of image boxes of equal size. As a result, the layout is left-right symmetric, the associated symmetry line is vertical (V). There is no top-bottom symmetry!

Example: ROW\2,3



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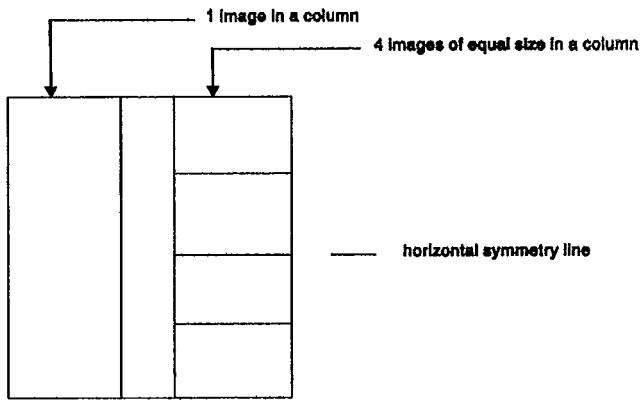
C.13.3.1.3 Column symmetric image display format

The Column Symmetric Image Display Format subdivides a film into columns of image boxes of equal size. As a result, the layout is top-button symmetric, the associated symmetry line is horizontal (H). There is no left-right symmetry !

Example: COL\1,4



C.13.4 *Basic film box relationship module*

Table C.13-4 Basic film box relationship module

Attribute Name	Tag	Description
Referenced Film Session Sequence	(2010,0500)	A Sequence which provides references to a Film Session SOP Class/Instance pairs. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.
Referenced Image Box Sequence	(2010,0510)	A Sequence which provides references to a set of Image Box SOP Class/Instance pairs. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.
Referenced Basic Annotation Box Sequence	(2010,0520)	A Sequence which provides references to a set of Basic Annotation Box SOP Class/Instance pairs. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.

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C.13.5 *Image box pixel presentation module*

Table C.13-5 Image box pixel presentation module

Attribute Name	Tag	Description
Image Position	(2020,0010)	The position of the image on the film, based on Image Display Format (2010,0010). See C.13.5.1 for specification.
Polarity	(2020,0020)	Specifies whether minimum pixel values (after VOI LUT transformation) are to printed black or white; Enumerated Values: NORMAL = pixels shall be printed as specified by the Photometric Interpretation (0028,0004) REVERSE = pixels shall be printed with the opposite polarity as specified by the Photometric Interpretation (0028,0004) If Polarity (2020,0020) is not specified by the SCU, the SCP shall print with NORMAL polarity.
Magnification Type	(2010,0060)	Description is the same as in Table C.13.3-1. Overrides the Magnification Type specified for the Film Box
Smoothing Type	(2010,0080)	Description is the same as in Table C.13.3-1. Overrides the Smoothing Type specified for the Film Box
Requested Image Size	(2020,0030)	Length in mm that Image rows of the Image are to be printed. This value overrides the size that corresponds with optimal filling of the Image Box.
Preformatted Grayscale Image Sequence	(2020,0110)	A sequence which provides the content of the Preformatted Grayscale Image Pixel Attributes. The Preformatted Grayscale Image Pixel Attributes are a specialization of the Image Pixel Module defined in C.7.6.3 of this part. It is encoded as a sequence of Attributes of the Image Pixel Module. See C.13.5.2 for further description.
>Samples Per Pixel	(0028,0002)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 1
>Photometric Interpretation	(0028,0004)	See C.7.6.3 for description of Image Pixel Module; Enumerated Values: MONOCHROME1 MONOCHROME2
>Rows	(0028,0010)	See C.7.6.3 for description of Image Pixel Module
>Columns	(0028,0011)	See C.7.6.3 for description of Image Pixel Module
>Pixel Aspect Ratio	(0028,0034)	See C.7.6.3 for description of Image Pixel Module
>Bits Allocated	(0028,0100)	See C.7.6.3 for description of Image Pixel Module; Enumerated Values: 8 (if Bits Stored = 8) 16 (if Bits Stored = 12)

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Table C.13-5 continued

>Bits Stored	(0028,0101)	See C.7.6.3 for description of Image Pixel Module; Enumerated Values: 8, 12
>High Bit	(0028,0102)	See C.7.6.3 for description of Image Pixel Module Enumerated Values: 7 (if BITS STORED = 8) 11 (if BITS STORED = 12)
>Pixel Representation	(0028,0103)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 0000 (unsigned integer)
>Pixel Data	(7FE0,0010)	See C.7.6.3 for description of Image Pixel Module
Preformatted Color Image Sequence	(2020,0111)	A sequence which provides the content of the Preformatted Color (RGB) Image Pixel Attributes. The Preformatted Color Image (RGB) Pixel Attributes are a specialization of the Image Pixel Module defined in C.7.6.3 of this part. It is encoded as a sequence of Attributes of the Image Pixel Module. See C.13.5.3 for further description.
>Samples Per Pixel	(0028,0002)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 3
>Photometric Interpretation	(0028,0004)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: RGB
>Planar Configuration	(0028,0006)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 0001 (frame interleave)
>Rows	(0028,0010)	See C.7.6.3 for description of Image Pixel Module
>Columns	(0028,0011)	See C.7.6.3 for description of Image Pixel Module
>Pixel Aspect Ratio	(0028,0034)	See C.7.6.3 for description of Image Pixel Module
>Bits Allocated	(0028,0100)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 8
>Bits Stored	(0028,0101)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 8
>High Bit	(0028,0102)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 7
>Pixel Representation	(0028,0103)	See C.7.6.3 for description of Image Pixel Module; Enumerated Value: 0000 (unsigned integer)
>Pixel Data	(7FE0,0010)	See C.7.6.3 for description of Image Pixel Module

C.13.5.1 IMAGE POSITION

The position of the image on the film; the encoding of the Image Position Sequence is based on the selected Image Display Format (2010,0010). The Image Position Sequence shall be increasing order beginning with the value 1. Image Position (2020,0010) is defined as follows:

- STANDARD display format: image box sequence shall be major row order (from left-to-right and from top-to-bottom); top left image position shall be equal to 1.

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- ROW display format: image box sequence shall be major row order (from left-to-right and from top-to-bottom); top left image position shall be set to 1.
- COL display format: image box sequence shall be major column order (from top-to-bottom and from left-to-right); top left image position shall be equal to 1.
- SLIDE display format: image box sequence shall be major row order (from left-to-right and from top-to-bottom); top left image position shall be set to 1.
- SUPERSLIDE display format: image box sequence shall be major row order (from left-to-right and from top-to-bottom); top left image position shall be set to 1.
- CUSTOM STANDARD display format: image box sequence shall be defined in the Conformance Statement; top left image position shall be set to 1.

C.13.5.2 PREFORMATTED GRAYSCALE IMAGE

The Preformatted Grayscale Image is an abstraction of a 8/12 bit grayscale image where annotation, graphics, overlays are burned in and where the LUT operations are already performed (see Part 4 of the DICOM Standard). The Preformatted Grayscale Image is a displayable image where the polarity of the intended display is specified by Photometric Interpretation (0028,0004).

C.13.5.3 PREFORMATTED COLOR IMAGE

The Preformatted Color Image is an abstraction of a color image where annotation, graphics, overlays are burned. The color image is encoded by frame interleaving of the RGB components (see PS 3.4).

C.13.6 *Image box relationship module*

Table C.13-6—Image box relationship module

Attribute Name	Tag	Description
Referenced Image Sequence	(0008,1140)	A Sequence which provides References to an Image SOP Class/Instance pair and a specific Frame Number in Multi-frame instances. Encoded as a Sequence of Items: (0008,1150), (0008,1155), and (0008,1160)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.
>Referenced Frame Number	(0008,1160)	Identifies the frame in the Multi-frame image referenced by this Image Sequence. Frame Number shall be increasing sequential order beginning with the value 1.
Referenced Image Overlay Box Sequence	(2020,0130)	A Sequence which provides references to an Image Overlay Box SOP Class/Instance pair and a specific Frame Number in Multi-frame instances. Encoded as a Sequence of Items : (0008,1150), (0008,1155), and (0008,1160)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.

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Table C.13-6 continued

>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.
>Referenced Frame Number	(0008,1160)	Identifies the frame in the Multi-frame Overlay(s) referenced by the Overlay Plane Sequence that is referenced by this Image Overlay Box Sequence. Frame Number shall be increasing sequential order beginning with the value 1.
Referenced VOI LUT Sequence	(2020,0140)	A Sequence which provides references to a VOI LUT SOP Class/Instance pair. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.

C.13.7 *Basic annotation presentation module*

Table C.13-7—Basic annotation presentation module

Attribute Name	Tag	Description
Annotation Position	(2030,0010)	The position of the annotation box in the parent film box; Annotation Position Sequence depends on the selected Annotation Display Format ID (2010,0030)
Text String	(2030,0020)	Text String

C.13.8 *Print job module*

Table C.13-8—Print job module

Attribute Name	Tag	Description
Execution Status	(2100,0020)	Execution status of print job; Enumerated Values: PENDING PRINTING DONE FAILURE

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Table C.13-8 continued

Execution Status Info	(2100,0030)	Additional information when Execution Status (2100,0020) is PENDING or FAILURE. Defined Terms when the Execution Status is equal to PENDING: QUEUED = Print Job in queue NO SUPPLY MGZ = Supply magazine not available NO RECEIVE MGZ = Receiver magazine not available SUPPLY EMPTY = Printer is out of film RECEIVER FULL = Film receiver magazine full FILM JAM = Film jam No Defined Terms are currently specified for when the Execution Status is equal to FAILURE.
Creation Date	(2100,0040)	Date of print job creation
Creation Time	(2100,0050)	Time of print job creation
Print Priority	(2000,0020)	Priority of print job; (see C.13.1 for further explanation)
Printer Name	(2110,0030)	User defined name identifying the printer
Originator	(2100,0070)	DICOM Application Entity Title that issued the print operation

C.13.9 *Printer module*

Table C.13-9—Printer module

Attribute Name	Tag	Description
Printer Status	(2110,0010)	Printer device status; Enumerated Values: NORMAL WARNING FAILURE
Printer Status Info	(2110,0020)	Additional information when Printer Status (2110,0010) is WARNING or FAILURE. Defined Terms when the Printer Status is equal to WARNING: SUPPLY EMPTY = Printer is out of film SUPPLY LOW = Film supply low RECEIVER FULL = Film receiver magazine full FILM JAM = Film Jam No Defined Terms are currently specified for when the Execution Status is equal to FAILURE.
Printer Name	(2110,0030)	User defined name identifying the printer
Manufacturer	(0008,0070)	Manufacturer of the printer
Manufacturer Model Name	(0008,1090)	Manufacturer's model number of the printer
Device Serial Number	(0018,1000)	Manufacturer's serial number of the printer
Software Versions	(0018,1020)	Manufacturer's designation of software version of the printer
Date Of Last Calibration	(0018,1200)	Date when the printer was last calibrated
Time Of Last Calibration	(0018,1201)	Time when the printer was last calibrated

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C.13.10 *Image overlay box presentation module*

Table C.13-10—Image overlay box presentation module

Attribute Name	Tag	Description
Referenced Overlay Plane Sequence	(2040,0010)	A sequence which provides references to a set of image overlay planes. Encoded as a sequence of items: (0008,1150), (0008,1155), and (2040,0011).
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class that describes the overlay plane.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance that contains the overlay plane.
>Referenced Overlay Plane Groups	(2040,0011)	Uniquely identifies the Overlay Plane Groups (60xx) within the referenced SOP Instance that contains the Overlay Plane description. See C.13.10.1 for further description.
Overlay Magnification Type	(2040,0060)	Overlay magnification type; Defined Terms: REPLICATE BILINEAR CUBIC NONE
Overlay Smoothing Type	(2040,0070)	Further specifies the type of interpolation function; only valid for overlay Magnification Type (2010,0060) = CUBIC
Overlay Foreground Density	(2040,0080)	Overlay foreground density; Defined Terms: BLACK WHITE i where i represents the desired density in hundredths of OD (e.g. 150 corresponds with 1.5 OD)
Overlay Mode	(2040,0090)	Defines the resulting density for pixels which correspond with overlay bit = 1; the density of the other pixels remain unchanged; Defined Terms: REPLACE = overlay replaces image; resulting pixel density is the Overlay Foreground Density (2040,0080) THRESHOLDREPLACE = overlay replaces image depending on original pixel density; resulting pixel density is Overlay Foreground Density if original pixel density <= Threshold Density (2040,0100) resulting pixel density is WHITE if original pixel density > Threshold Density COMPLEMENT = overlay complements the image; resulting pixel density is set to the complement of the original pixel density (maximal contrast between overlay pixel and surrounding pixels)
Threshold Density	(2040,0100)	Threshold density; Defined Terms: BLACK WHITE i where i represents the desired density in hundredths of OD (e.g. 150 corresponds with 1.5 OD)

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C.13.10.1 REFERENCED OVERLAY PLANE SEQUENCE

The Referenced Overlay Plane Sequence (2040,0010) identifies the Overlay Planes that shall be printed with the image. The Overlay Planes shall be linked to the image in one of the following ways:

a. Overlay Planes are encoded as part of the image IOD and are described by the Overlay Plane Module (see C.9.2). In this case the Attribute Referenced SOP Class UID (0008,1150) refers to the image SOP class and the Attribute Referenced SOP Instance UID (0008,1155) refers to the Image SOP instance. The Attribute Referenced Overlay Plane Groups (2040,0011) defines one or more Overlay Plane Groups (60xx,eeee) within the Image SOP Instance.

b. Overlay Planes are encoded as part of the Overlay IOD (see A.12) and are described by the Overlay Plane Module (see c.9.2). In this case the Attribute Referenced SOP Class UID (0008,1150) refers to the Overlay SOP Class and the Attribute Referenced SOP Instance UID (0008,1155) refers to the Overlay SOP Instance. The Attribute Referenced Overlay Plane Groups (2040,0011) defines one or more Overlay Plane Groups (60xx,eeee) within the Overlay SOP Instance.

C.13.11 *Image overlay box relationship module*

Table C.13-11—Image overlay box relationship module

Attribute Name	Tag	Description
Referenced Image Box Sequence	(2040,0500)	A Sequence which provides references to an Image Box SOP Class/Instance pair. Encoded as a Sequence of Items : (0008,1150) and (0008,1155)
>Referenced SOP Class UID	(0008,1150)	Uniquely identifies the Referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	Uniquely identifies the Referenced SOP Instance.

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Annex D
(Normative)
Coding scheme designators

The ANSI HISPP MSDS supports the development of an international health care coding scheme registration authority. The types of coding schemes registered are diagnostic, procedure observation, drug ID, and health outcomes coding schemes. Locally defined coding schemes are also supported. Tables D-1 and D-2 identify the allowable coding schemes which shall be used when encoding a coded entry.

NOTE— The ANSI HISPP MSDS tables are chosen as an interim source of Coding Scheme Designators. It is expected that these tables will evolve when Coding Scheme Designator UID's are available from a registration authority.

D-1—Diagnostic coding schemes

Names	Code	Source
American College of Radiology Index for Radiological Diagnosis	ACR	Index for Radiological Diagnosis Revised, 3rd Edition 1986, American Radiology finding codes. College of Radiology, Reston, VA.
CEN ECG diagnostic codes	CE	CEN PT007. A quite comprehensive set of codes (abbreviations) and descriptions codes published as a pre-standard by CEN TC251. Available from CEN TC251 secretariat, c/o Georges DeMoor, State University Hospital Gent, De Pintelaan 185-5K3, 9000 Gent, Belgium or Jos Willems, University of Gathuisberg, 49 Herestraat, 3000 Leuven, Belgium.
EUCLIDES	E	Available from Euclides Foundation International nv, Excelsiorlaan 4A, B-1930 Zaventem, Belgium; Phone: 32 2 720 90 60.
ICD9	I9	World Health Publications, Albany, NY.
ICD9-CM	I9C	Commission on Professional and Hospital Activities, 1968 Green Rd., Ann Arbor, MI 48105.
ICD-10	I10	World Health Publications, Albany, NY.
Local general code	99zzz	Locally defined codes for purpose of sender or receiver. Local codes can be identified by L (for backward compatibility) or 99zzz (where z is an alphanumeric character).
Local billing code	LB	Local billing codes/names (with extensions if needed).
Read Classification	RC	The Read Clinical Classification of Medicine, Park View Surgery, 26 Leicester Rd., Loughborough LE11 2AG (includes drug procedure and other codes, as well as diagnostic codes).
Systematized Nomenclature of Medicine (SNOMED)	SNM	Systematized Nomenclature of Medicine, 2nd Edition 1984 Vols 1, 2, American College of Pathology, Skokie, IL.
SNOMED III	S3	See above (about to be released).
Unified Medical Language	UML	National Library of Medicine, 8600 Rockville Pike, Bethesda, MD 20894.

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D-2—Procedure observation/drug ID/health outcomes coding schemes

Coding System	Code	Source/Description
ASTM	AS4	American Society for Testing & Materials and CPT4 (see Appendix A of ASTM E1238 and its codes revisions).
Universal		
CPT-4	C4	American Medical Association, P O Box 10946, Chicago, IL 60610.
CPT-5	C5	(under development - same contact as above)
EUCLIDES	E	AFP codes. Available from Euclides Foundation International nv, Excelsiorlaan 4A, B-1930 Zaventem, Belgium; Phone: 32 2 720 90 60.
FDA K10	FDK	Dept. of Health & Human Services, Food & Drug Administration, Rockville, MD 20857. (device & analyte process codes).
HIBCC	HB	Health Industry Business Communications Council, 5110 N. 40th St., Ste 120, Phoenix, AZ 85018.
ICCS	ICS	Commission on Professional and Hospital Activities, 1968 Green Road, Ann Arbor, MI 48105.
ICD-9CM	I9C	Commission on Professional and Hospital Activities, 1968 Green Road, Ann Arbor, MI 48105 (includes all procedures and diagnostic tests).
ISBT	IBT	International Society of Blood Transfusion. Blood Group Terminology "1990". VOX Sanquines 1990 58(2):152-169.
IUPAC/IFCC	IUC	Recommendations of Quantities and Units in Clinical Chemistry DRAFT (to be published in 1992). Henrik Olesen, M.D., D.M.Sc., Chairperson, Department of Clinical Chemistry, KK76.4.2, Rigshospitalet, University Hospital of Copenhagen, DK-2200, Copenhagen.
Local	99zzz	Locally defined codes for purpose of sender or receiver. If multiple local codes exist, the format should be 99zzz, or Lwhere z is an alphanumeric character.
Medicare	MCR	Medicare billing codes/names.
Medicaid	MCD	Medicaid billing codes/names.
UCDS	UC	Uniform Clinical Data Systems. Ms. Michael McMullan, Office of Peer Review Health Care Finance Administration, The Meadows East Bldg., 6325 Security Blvd., Baltimore, MD 21207; (301) 966 6851.

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Table D-2 continued

Japanese Chemistry	JC8	Clinical examination classification code. Japan Association of Clinical Pathology. Version 8, 1990. A multiaxial code. including a subject code (e.g., Rubella = 5f395, identification code (e.g., virus ab IGG), a specimen code (e.g., serum = 023) and a method code (e.g., ELISA = 022)
Health Outcomes	HI	Health Outcomes Institute codes for outcome variables available (with responses) from Health Outcomes Institute, 2001 Killebrew Drive, Suite 122, Bloomington, MN 55425; (612) 858 9188. See examples in Appendix A.
Euclides Lab method codes	E6	Available from Euclides Foundation International nv, Excelsiorlaan 4A, B-1930 Zaventem, Belgium; Phone: 32 2 720 90 60.
Euclides Lab equipment codes	E7	Available from Euclides Foundation International nv (see above)
Euclides kind of quantity codes	E5	Available from Euclides Foundation International nv (see above)
Drug codes:		
Chemical abstract codes	CAS	These include unique codes for each unique chemical, including all generic drugs. The codes do not distinguish among different dosing forms. When multiple equivalent CAS numbers exist, use the first one listed in USAN. USAN 1990 and the USP dictionary of drug names, William M. Heller, Ph.D., Executive Editor, United States Pharmacopeial Convention, Inc., 12601 Twinbrook Parkway, Rockville, MD 20852.
National drug codes	NDC	These provide unique codes for each distinct drug, dosing form, manufacturer, and packaging. (Available from the National Drug Code Directory, FDA, Rockville, MD, and other sources.)
WHO rec# drug codes	W1 W2	World Health organization record number code. A unique sequential number is assigned to each unique single component drug and to each multi-component drug. Eight digits are allotted to each such code, six to identify the active agent, and 2 to identify the salt, of single content drugs. Six digits are assigned to each unique combination of drugs in a dispensing unit. The six digit code is identified by W1, the 8 digit code by W2.
WHO rec#	W4	With ASTM extensions (see appendix A of ASTM 1238-91), the WHO codes can be used to report serum (and other) levels, patient compliance with ASTM ext. with drug usage instructions, average daily doses and more (see Appendix A of ASTM 1238-91)
WHO ATC	WC	WHO's ATC codes provide a hierarchical classification of drugs by therapeutic class. They are linked to the record number codes listed above.

Table continued on next page

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Table D-2 continued

NOTE: The Read and NLM codes in Table 3 also include drugs. A number of sources of unique drug names exist: British Approved Names (BAN), French-approved non proprietary names (DCF), and International Nonproprietary name (INN). These sources are now being reviewed. Those that also provide unique codes will be added to the "registry" of coding systems, using the abbreviations given in parentheses.		
Device Code		
MDNS	UMD	Universal Medical Device Nomenclature System. ECRI, 5200 Butler Pike, Plymouth Meeting, PA 19462 USA. Phone: 215-825-6000, Fax: 215-834-1275.

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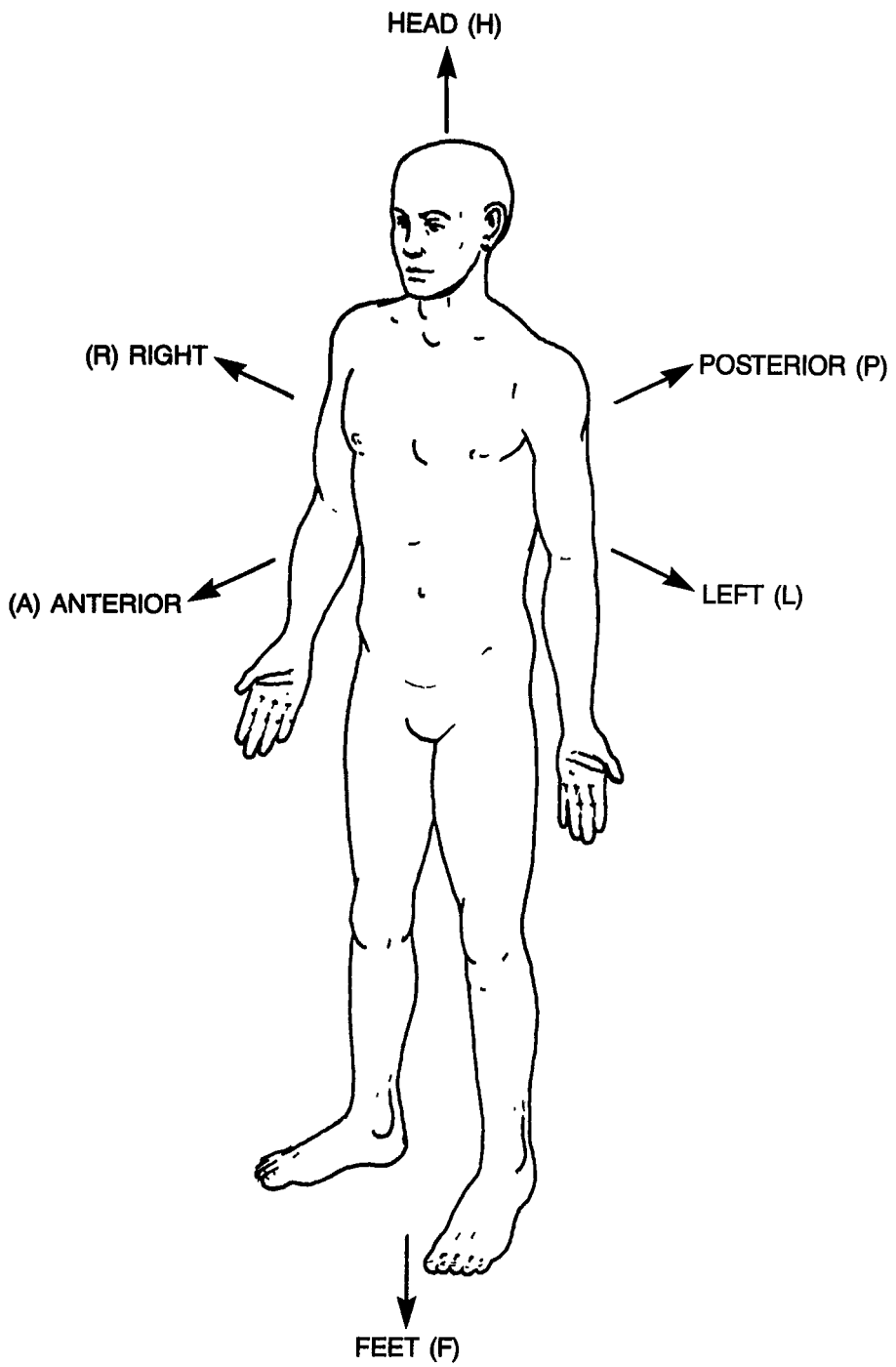
Annex E
(Normative)
Explanation of patient orientation

This Annex provides an explanation of how to use the patient orientation data elements.



The standard anatomic position is standing erect with the palms facing anterior. This position is used to define a label for the direction of the fingers and toes (toward the FEET (F)) while the direction of the wrist and ankle is towards the HEAD (H). This labeling is retained despite changes in the position of the extremities. For bilaterally symmetric body parts, a laterality indicator (R or L) should be used.

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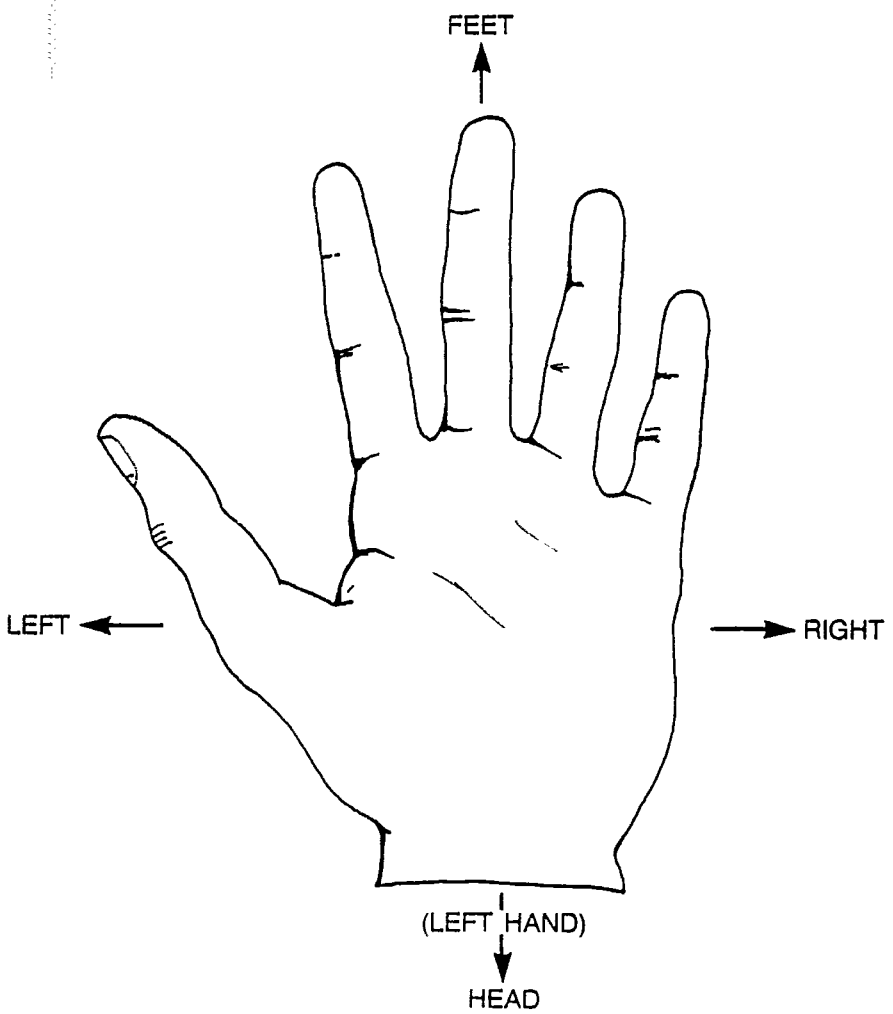

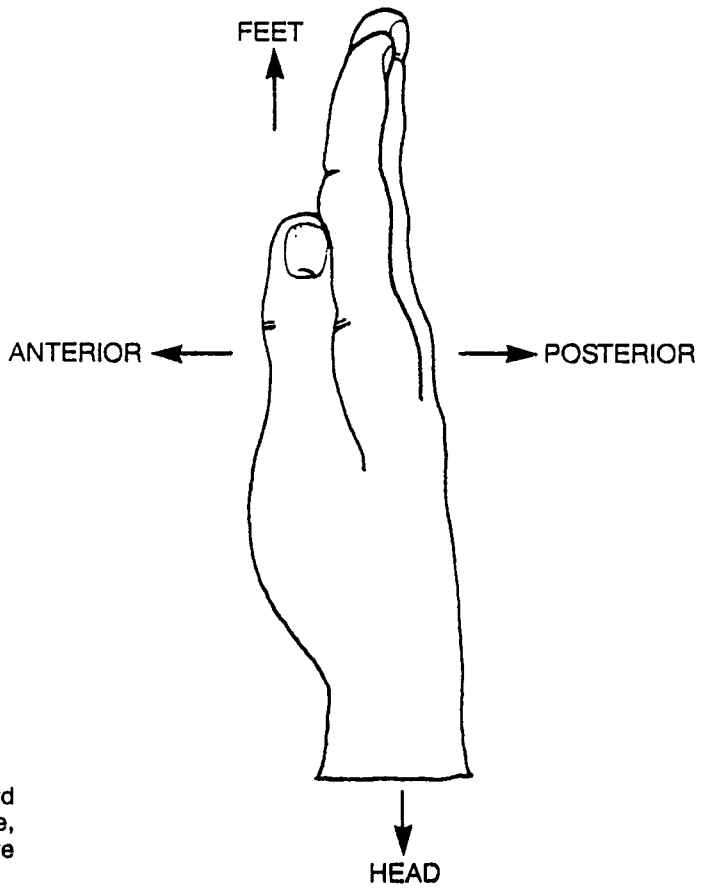

For the hands, the direction labels are based on the standard anatomic position. For the left hand illustrated, for example, LEFT will always be in the direction of the thumb, irrespective of position changes.

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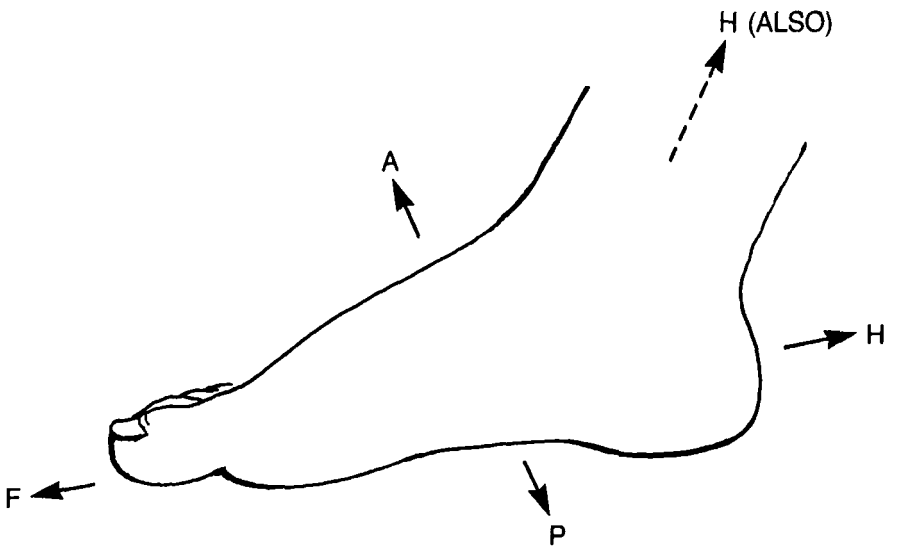
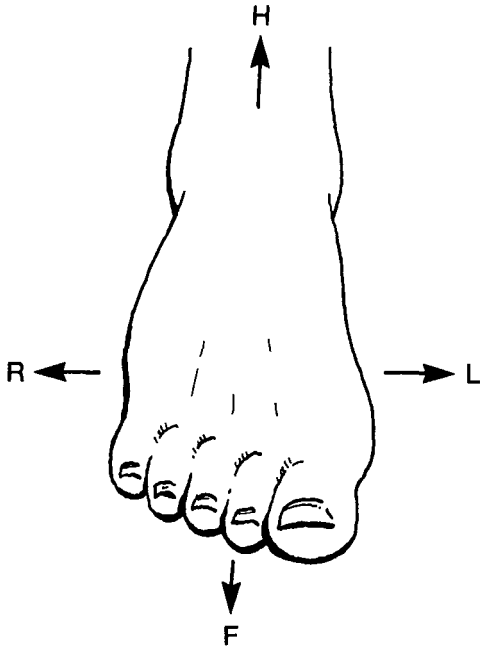


RIGHT FOOT



RIGHT FOOT—ANTERIOR VIEW

As for the hand, the direction labels are based on the foot in the standard anatomic position. For the right foot, for example, RIGHT will be in the direction of the 5th toe. This assignment will remain constant through movement or positioning of the extremity. This is also true of the HEAD and FOOT directions.

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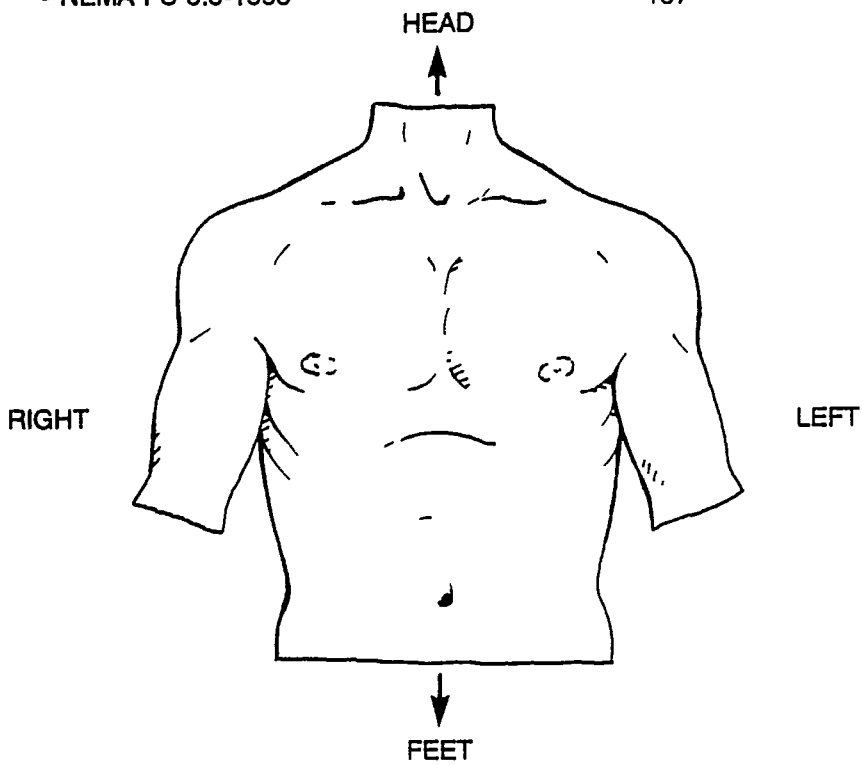
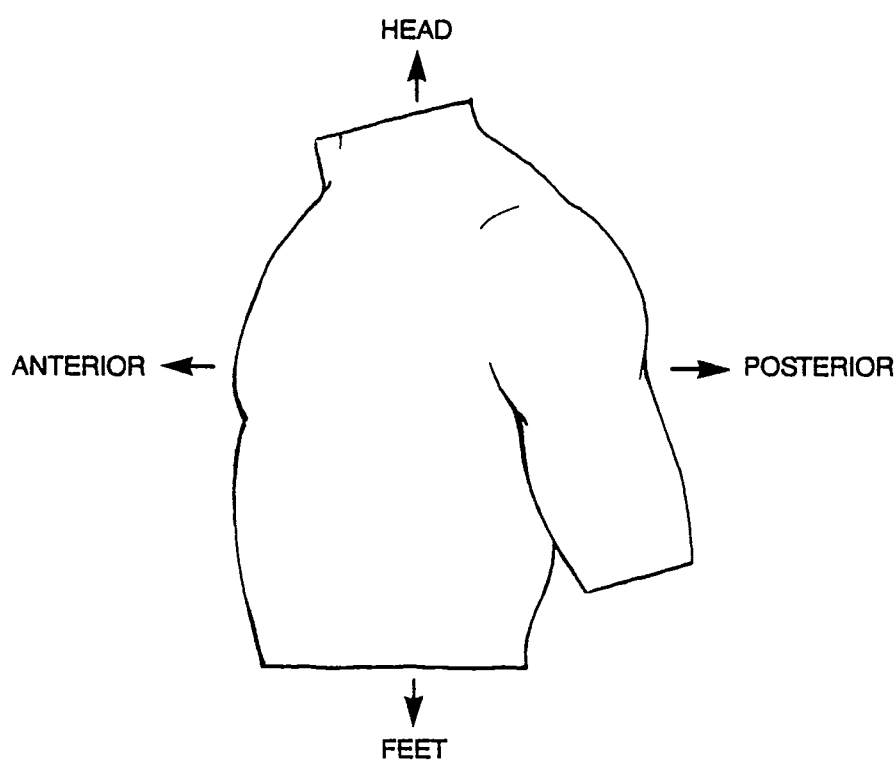


VIEWING THE FRONT OF THE PATIENT



Anterior and left lateral views of the patient. In the view of the left side (bottom illustration) the left arm has been drawn posteriorly.

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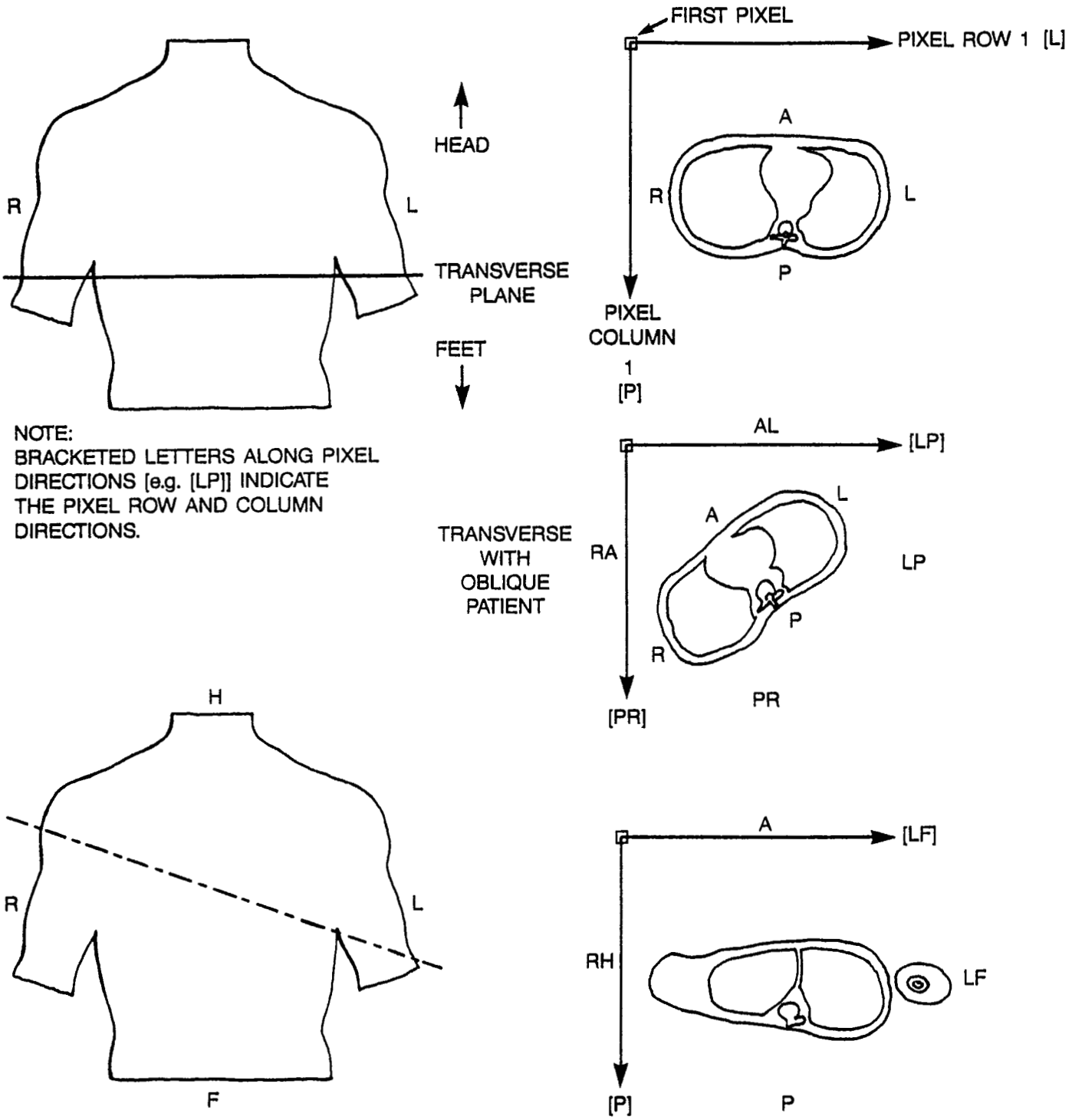

OBLIQUE TRANSVERSE PLANE

Since the major direction of the transverse plane is right-to-left (or anterior-to-posterior), the first letter of the combined direction will indicate this. For example, RH—moving right also moves towards the head.

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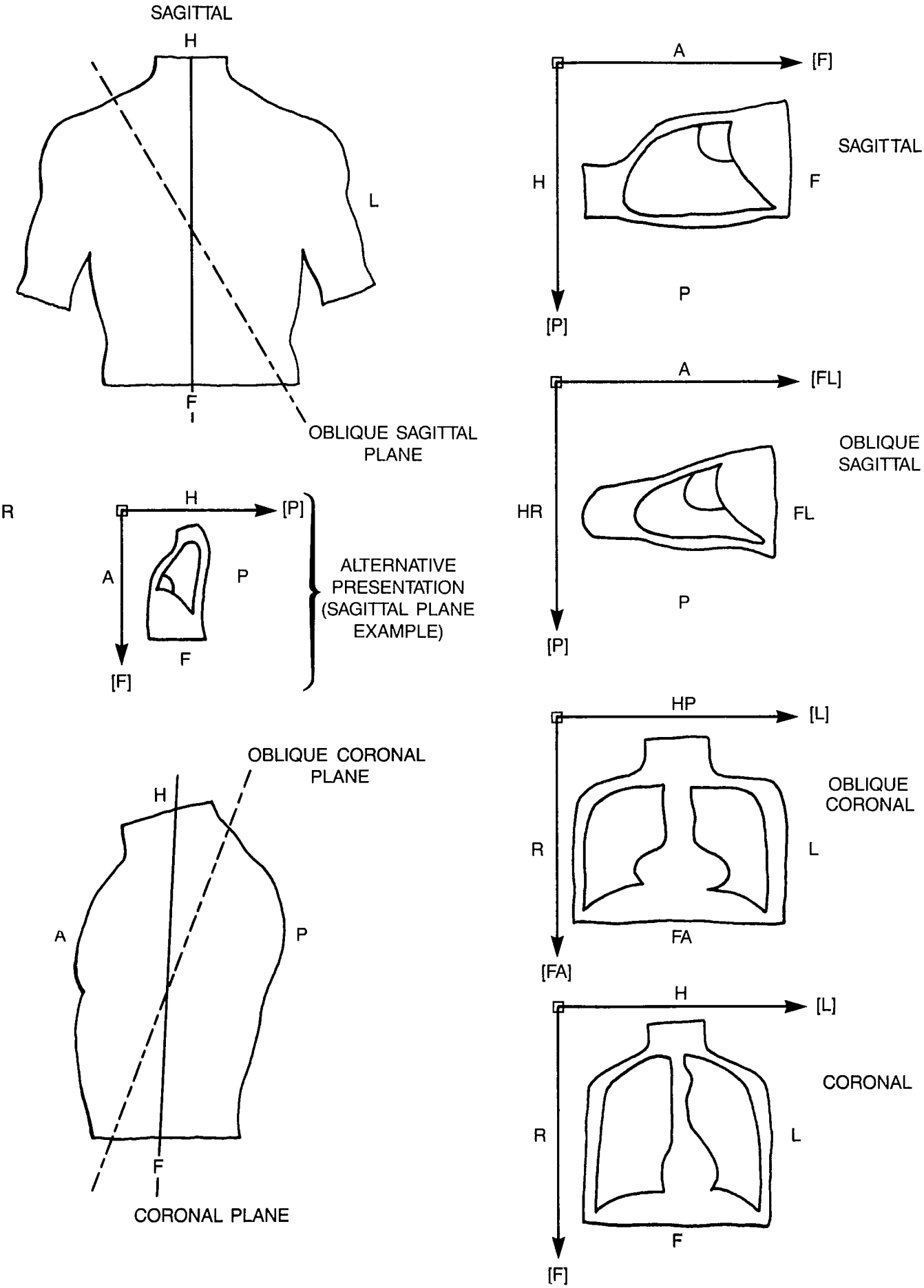

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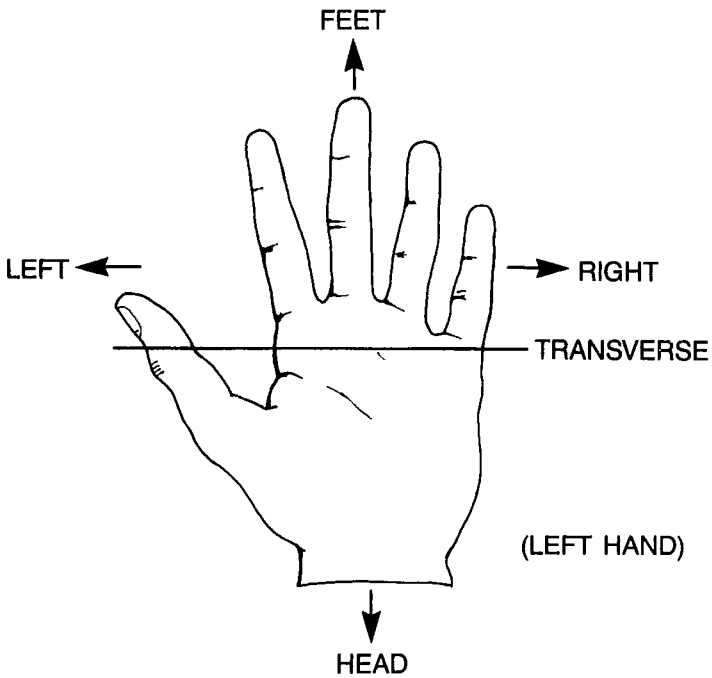

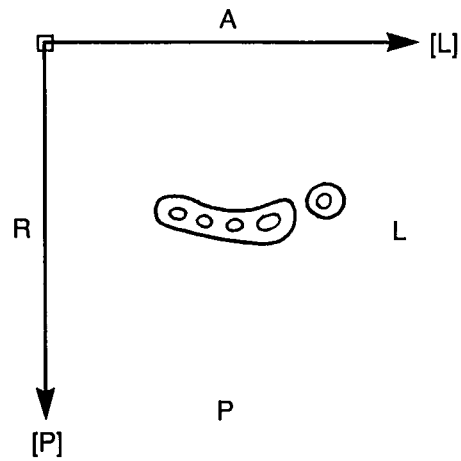

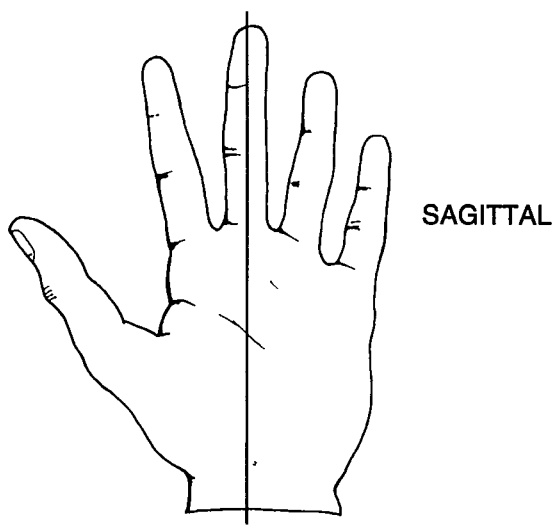

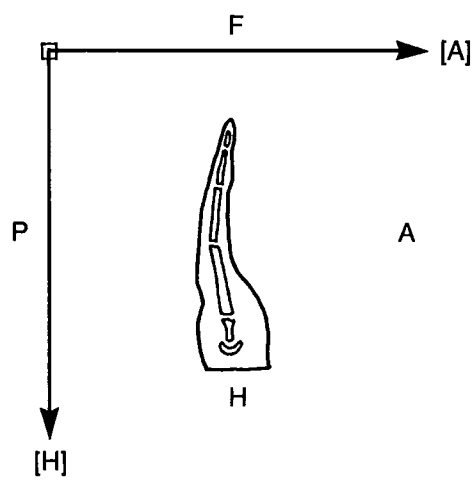

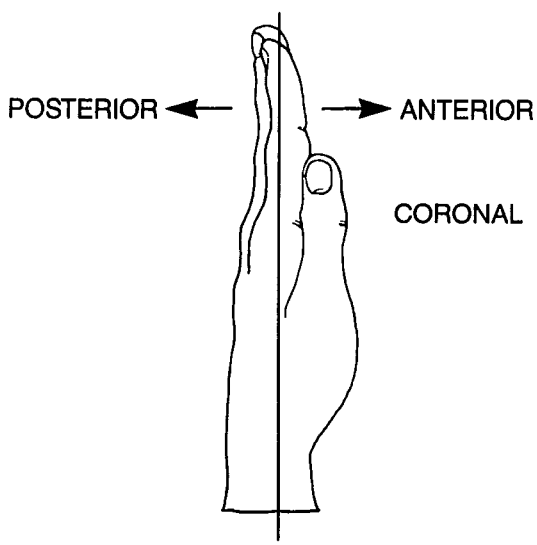

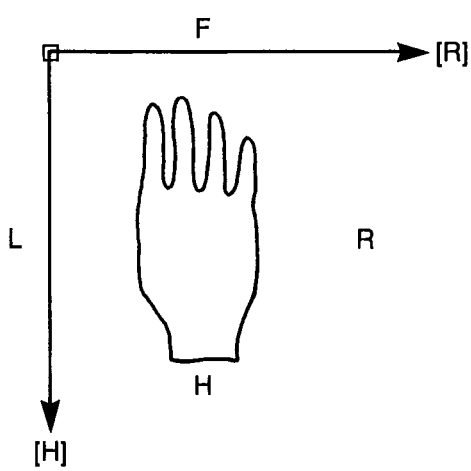

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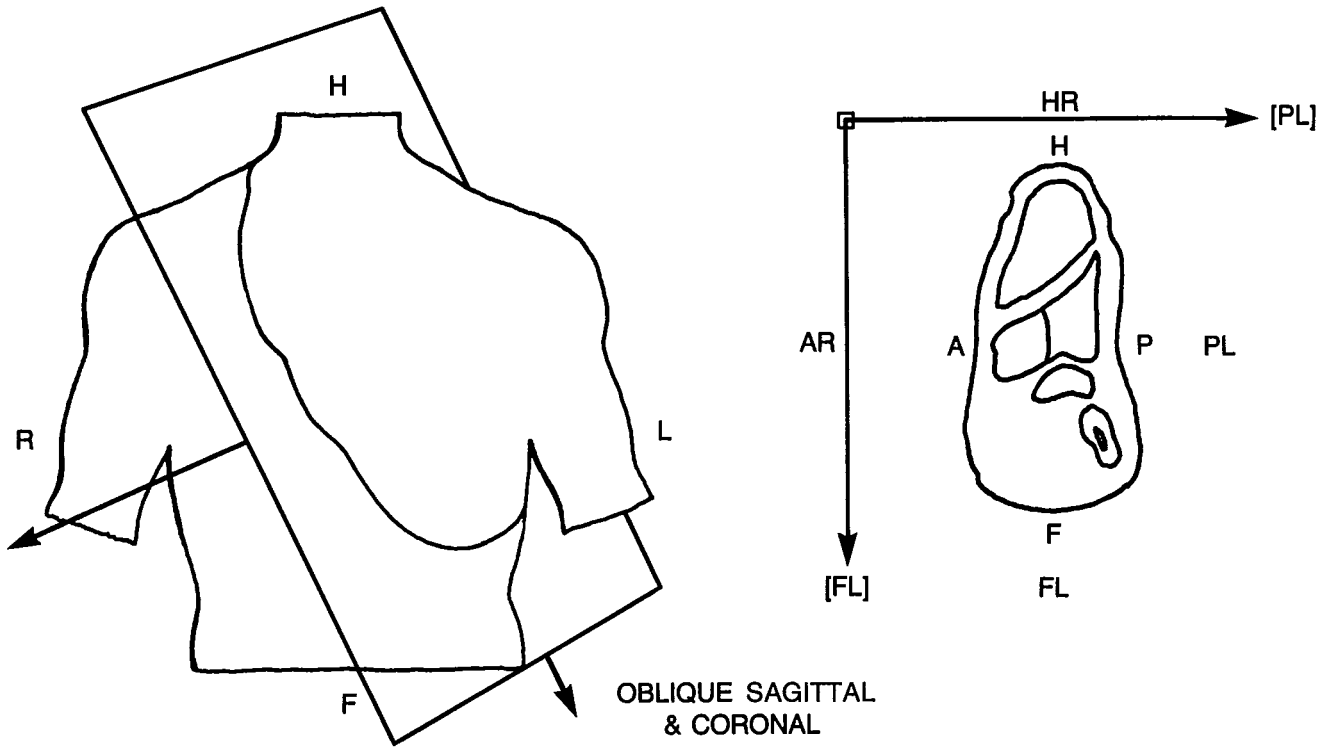
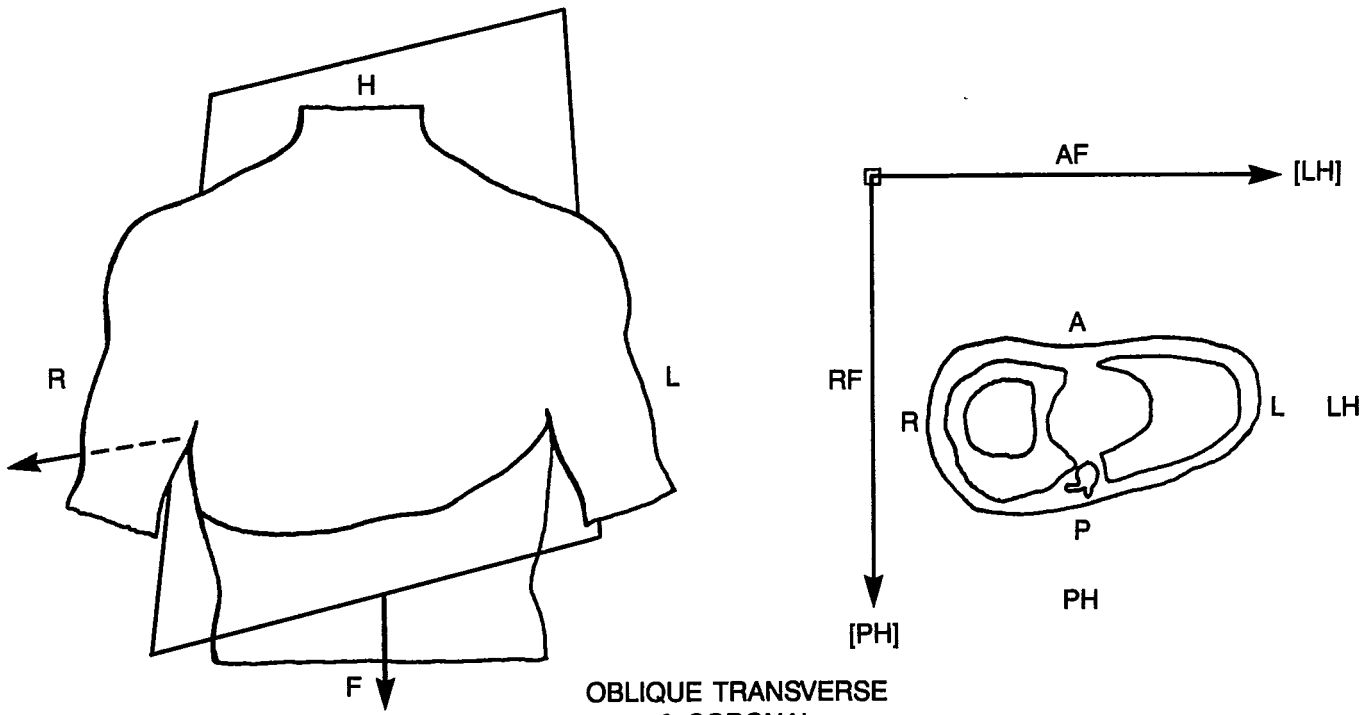


OBLIQUE SAGITTAL
& CORONAL

Combined tilt planes and possible labels are based on major plane directions.



OBLIQUE TRANSVERSE
& CORONAL

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(Informative)
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NEMA STANDARDIZATION BACKGROUND

The purpose of NEMA standards, their classification, and status are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for their particular needs. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 1)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the Standards Publication may be capable of otherwise equivalent performance.

(Standardization Policies and Procedures, p. 6)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes, which have received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative:

1. NEMA Standard, which relates to a product, process, or procedure commercially standardized and subject to repetitive manufacture.
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp. 5)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design, which standard has received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative.

(Standardization Policies and Procedures, pp. 5)

Identification of Status

Standards in NEMA Standards Publications are identified as "NEMA Standard," "Suggested Standard for Future Design," or "Adoptive Standard." These indicate the status of the standard. A statement incorporating the auxiliary verb "shall" indicates that compliance with a requirement is mandatory for compliance with the standard. These classes of standards are identified in the foreword or throughout the text.

The material identified as "Authorized Engineering Information" is designated similarly. Statements incorporating other auxiliary verbs such as "should," "may," etc. refer to the authorized engineering information and not to procedures required for compliance with the standard.

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