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Digital Imaging and Communications in Medicine (DICOM)

8
Supplement 121: CT Protocol Storage

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148

Scope and Field of Application

150 This Supplement defines a pair of storage SOP Classes to distribute defined CT protocols and to record performed CT protocols. The Supplement also defines a Query/Retrieve Service and corresponding C-
152 FIND behaviors. Similar pairs of SOP Classes for other modalities may be added in other supplements.

The two storage SOP Classes are:

154 • **CT Defined Procedure Protocol Storage** SOP Class that describes desired values (and/or value ranges) for various parameters of an acquisition and reconstruction procedure. Defined Protocols
156 are independent of a specific patient. Defined Protocols are typically specific to a certain scanner model and/or version (identified by device attributes in the protocol), but model-non-specific
158 protocols are not prohibited.

• **CT Performed Procedure Protocol Storage** SOP Class that describes the values actually used
160 in a performed acquisition. Performed protocols are patient-specific.

The SOP Classes address details including:

162 • patient preparation & positioning

• equipment characteristics

164 • acquisition technique

• reconstruction technique

166 • preliminary image handling such as filtering, enhancement

• results data storage (auto-sending)

168 The Defined Procedure Protocol Query/Retrieve Service Classes facilitate access to Defined Procedure Protocol composite objects. Important matching keys include the anatomic region, corresponding
170 procedure and protocol codes, and applicable models and versions.

Performed Procedure Protocol instances exist in the traditional Patient-Study-Series hierarchy and can be
172 accessed with the conventional query/retrieve service.

The primary goal is to set up the scanner, not to script the entire behavior of the department, or the scan
174 suite. The protocol object supports simple textual instructions relevant to the protocol such as premedication, patient instructions, etc. Formal coding and management of instructions may be handled
176 with other objects and services such as the Contrast Injection SR or the Modality Worklist (MWL).

It is also not the intent to serialize the internal state of the system.   The Defined Procedure Protocol
178 represents are starting point for setting up a scan for a given patient and the Performed Procedure Protocol represents the actual parameters when the initial scan is completed, but there is no record of the
180 intermediate states between those.   New objects describing delayed reconstructions or delayed storage may be added to a study.

182 The supplement also introduces a Private Data Element dictionary to permit description of scanner model characteristics and the ongoing addition of system-specific features and settings. This dictionary allows
184 protocol management systems to display the value with an appropriate label to the operator.

186 Methods of specification of tube current modulation (and other technical features) vary between vendors and models and is not addressed in standard DICOM data elements.   Vendor protocols are expected to include the relevant private tags and annotate them in the private tag dictionary.

188 It is expected that the vast majority of protocol objects will be specific to a certain model and version of scanner. There is no requirement that a scanner be able to run a protocol from another scanner.

190

192   **Changes to NEMA Standards Publication PS 3.2**

Digital Imaging and Communications in Medicine (DICOM)

194   **Part 2: Conformance**

Add new SOP Classes in Table A.1-2

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

UID Value	UID NAME	Category
…		
1.2.840.10008.5.1.4.1.1.200.1	**CT Defined Procedure Protocol Storage**	**Transfer**
1.2.840.10008.5.1.4.1.1.200.2	**CT Performed Procedure Protocol Storage**	**Transfer**
1.2.840.10008.5.1.4.20.1	**Defined Procedure Protocol Information Model - FIND**	**Query/Retrieve**
1.2.840.10008.5.1.4.20.2	**Defined Procedure Protocol Information Model - MOVE**	**Query/Retrieve**
1.2.840.10008.5.1.4.20.3	**Defined Procedure Protocol Information Model - GET**	**Query/Retrieve**
…		

198

200

202   **Changes to NEMA Standards Publication PS 3.3**

Digital Imaging and Communications in Medicine (DICOM)

204   **Part 3: Information Object Definitions**

Add to PS3.3 Section 2.6 Other References as shown:

206

[AAPM Report 204] American Association of Physicists in Medicine. 2011. *Size-Specific Dose Estimates*
208 *(SSDE) in Pediatric and Adult Body CT Examinations.* https://www.aapm.org/pubs/reports/RPT_204.pdf.

[NEMA XR-25] National Electrical Manufacturers Association. 2010. *Computed Tomography Dose Check.*

210 ***Add to PS3.3 Section 3.8 the following definitions:***

Protocol Element – a sequential component of a protocol, consisting of all the parameters necessary to
212 perform that component of the protocol.

Acquisition Protocol Element – a sequential component of an acquisition protocol, that contains the
214 SCANNING PARAMETERS necessary to perform a single SCAN.   In the case of CT this would
correspond to tube voltage, tube current, rotation time, spatial location, etc. and an Acquisition Protocol
216 Element also corresponds to an XR-25 PROTOCOL ELEMENT.

Reconstruction Protocol Element – a sequential component of a reconstruction protocol, such as
218 generating CT thin images or multiplanar reformats.

Storage Protocol Element – a sequential component of a storage protocol, such as sending a series of
220 images to a PACS or an archive or a processing workstation.

222 ***Modify section 7.3.1 as shown:***

7.3.1.4   PROCEDURE TYPE
224 A Procedure Type identifies a class of procedures. In the context of imaging services, a Procedure Type is
an item in a catalog of imaging procedures that can be requested and reported upon in an imaging service
226 facility. An instance of a Procedure Type typically has a name and one or more other identifiers. A
Procedure Type is associated with one or more Procedure Plans.

228   Note: The information content of this entity relates to the general identification of a Procedure Type rather than
to its decomposition into the protocol(s) required to perform a specific instance of a Requested Procedure
230   for a particular Patient.

232 **7.3.1.5   REQUESTED PROCEDURE**

A Requested Procedure is an instance of a Procedure of a given Procedure Type. An instance of a
234 Requested Procedure includes all of the items of information that are specified by an instance of a
Procedure Plan that is selected for the Requested Procedure by the imaging service provider. This

236 Procedure Plan is defined by the imaging service provider on the basis of the Procedure Plan templates
associated with the considered Procedure Type. An Imaging Service Request may include requests for
238 several different Requested Procedures. The purpose of this entity is to establish the association between
Imaging Service Requests and Procedure Types, to convey the information that belongs to this association
240 and to establish the relationships between Requested Procedures and the other entities that are needed to
describe them. A single Requested Procedure of one Procedure Type is the smallest unit of service that
242 can be requested, reported, coded and billed. Performance of one instance of a Requested Procedure is
specified by exactly one Procedure Plan. A Requested Procedure leads to one or more Scheduled
244 Procedure Steps involving Protocols as specified by a Procedure Plan. A Requested Procedure may be
associated with one or more Visits. A Requested Procedure may involve one or more pieces of equipment.

246 7.3.1.6   SCHEDULED PROCEDURE STEP

A Modality Scheduled Procedure Step is an arbitrarily defined scheduled unit of service, that is specified by
248 the Procedure Plan for a Requested Procedure. A Modality Scheduled Procedure Step prescribes Protocol
which may be identified by one or more protocol codes. A Modality Scheduled Procedure Step involves
250 equipment (e.g., imaging Modality equipment, anesthesia equipment, surgical equipment, transportation
equipment), human resources, consumable supplies, location, and time (e.g., start time, stop time,
252 duration). While in the context of imaging services the scheduling of a Modality Scheduled Procedure Step
might include only a general designation of imaging Modality that could be satisfied by multiple pieces of
254 the same equipment type, the performance of one instance of a Modality Scheduled Procedure Step
involves one and only one piece of imaging Modality equipment.

256 The performance of a Modality Scheduled Procedure Step may result in the creation of zero or more
Modality Performed Procedure Step instances.

258   Notes: 1. The Procedure Step entity is provided to support management of the logistical aspects of procedures
(e.g., materials management, human resources, scheduling). The full definition of the contents of
260   Procedure Steps and protocols according to which they are performed is implementation dependent and
is beyond the scope of this Standard.

262   2. A Modality Scheduled Procedure Step may contribute to more than one Requested Procedure (e.g., a
Modality Scheduled Procedure Step requiring an intravenous iodine contrast injection might be shared by
264   an intravenous pyelogram and a CT examination). However, for billing purposes an instance of a
Modality Scheduled Procedure Step is typically considered to be a part of only one Requested
266   Procedure.

268 7.3.1.7   PROCEDURE PLAN

A Procedure Plan is a specification that defines the set of Protocols that must be done in order to perform
270 the Scheduled Procedure Steps of a Requested Procedure. Each Scheduled Procedure Step is performed
according to a single Protocol, which may be identified by one or more Protocol Codes **and may be
272 described in a Defined Procedure Protocol**. The Protocols actually performed during a Procedure Step
may **be recorded in a Performed Procedure Protocol and may** differ from those prescribed in the
274 related Procedure Plan. Audit of actually performed Protocols versus the prescribed Procedure Plan is an
important element of quality control~~, but is not specified by this Standard~~.

276   ~~Note: The fact that Protocols Codes are in a given order in a Procedure Plan is not evident in Figure~~
~~7.3. However, the order of Protocols is represented at the syntax level (i.e. as the sequence of~~
278   ~~items present in the Protocol Code Sequence (0040,0008)).~~

280 7.3.1.8   PROTOCOL

A Protocol is a specification of actions prescribed by a Procedure Plan to perform a specific Procedure
282 Step. A Scheduled Procedure Step contains only one Protocol which may be conveyed by one or more

Protocol Codes. ~~Typically, the code or codes identifying a Protocol instance would be selected from~~
284 ~~a catalog of protocols. Multiple Protocols may not exist in one Scheduled Procedure Step.~~

A Protocol may be specified by a Defined Procedure Protocol to be used on any appropriate
286 **patient.**

A Protocol can be documented, once a Procedure Step has been performed, in a Performed
288 **Procedure Protocol.**

7.3.1.8.1 DEFINED PROCEDURE PROTOCOL
290 **A Defined Procedure Protocol describes a set of parameters and associated details for the**
prescribed action. The Defined Procedure Protocol may provide specific values for relevant
292 **parameters, or may provide constraints on those parameters (such as an acceptable range) to**
guide the choice of specific values.

294 **A Defined Procedure Protocol is not associated with any particular Patient or Scheduled**
Procedure Step. A Defined Procedure Protocol may contain parameters specific to a particular
296 **model or version of device, or it may be generic in that it only describes parameters common to**
multiple device models.

298 **A Defined Procedure Protocol may include information such as the clinical purpose, indications,**
and appropriate device models, intended for selection and management.

300 **7.3.1.8.2 PERFORMED PROCEDURE PROTOCOL**

A Performed Procedure Protocol encodes the parameter values used. A Performed Procedure
302 **Protocol is always associated with a specific Patient and Performed Procedure Step. The**
Performed Procedure Protocol may reference the Defined Procedure Protocol on which it was
304 **based, but does not otherwise record the orginal constraints and whether or not they were**
satisfied by the final values as recorded in the Performed Procedure Protocol.

306

Add new section 7.13.4

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308 **7.13.4 EXTENSION OF THE DICOM MODEL OF THE REAL WORLD FOR PROTOCOL STORAGE**

The DICOM Model of the Real World is extended with the addition of Defined Procedure Protocol and
310 Performed Procedure Protocol objects whose whose relationship to existing DICOM Real World objects is
shown in Figure 7.13.4-1.

312 Note that the information in the Equipment IE describes the equipment that created the instance. The
information in the Protocol Parameters may describe the equipment on which the protocol is intended to be
314 executed which may or may not be the same as the equipment that created the instance.
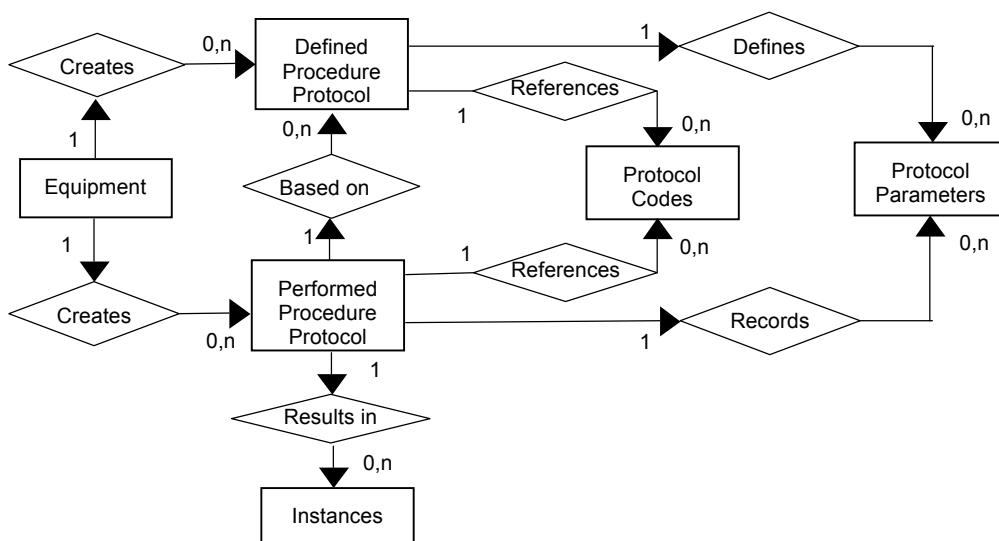
316 **Figure 7.13.4-1. DICOM Model of the Real World – Protocol Storage**

318 | *Add new section 10.27* |

10.27 REFERENCE LOCATION MACRO

320 This Macro allows a reference location in the context of a patient or scan to be identified and described. E.g., the Macro may describe an anatomically defined location along the axis of a CT scan to prescribe the
322 extent of a scan or reconstruction. The location might be internal to the patient (and appear on a localizer image) or might be an external landmark (on which a laser is aligned).

324 **Table 10.27-1**
REFERENCE LOCATION MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Reference Location Label	(0018,9900)	1	Brief user-readable label for the location.
Reference Location Description	(0018,9901)	3	Further elaboration of the Reference Location. The value may include a description of the relative anatomical location, the appearance of the feature or landmark, or how it can be identified.
Reference Basis Code Sequence	(0018,9902)	1	The anatomical feature or point of reference on which the reference location is based. Only a single Item shall be included in this Sequence.
>Include Code Sequence Macro Table 8.8-1			*CID may be defined in the macro invocation.*

Reference Geometry Code Sequence	(0018,9903)	1	Characterizes the geometry of the reference location (e.g. a plane or point). Only a single Item shall be included in this Sequence.
>*Include Code Sequence Macro Table 8.8-1*			*Context ID may be defined in the macro invocation.*
Offset Distance	(0018,9904)	3	Positive offset (in mm) from the Reference Basis to the actual Reference Location. See 10.27.1
Offset Direction	(0018,9905)	1C	Direction of the offset (in terms of patient position) from the Reference Basis to the Reference Location. Enumerated Values: SUPERIOR INFERIOR ANTERIOR POSTERIOR LEFT RIGHT PROXIMAL DISTAL MEDIAL LATERAL Required if Offset Distance (0018,9904) is present.

326

10.27.1   Offset Distance and Direction

328 An example of the use of offsets might be:

Reference Location Label	(0018,9900)	"1cm above Liver"
330 Reference Location Description	(0018,9901)	"1cm above the uppermost extent of the liver."
Reference Basis		
332 Code Sequence	(0018,9902)	(T-62000, SRT, "Liver")
Reference Geometry		
334 Code Sequence	(0018,9903)	(128120, DCM, "Plane through Superior Extent")
Offset Distance	(0018,9904)	10
336 Offset Direction	(0018,9905)	SUPERIOR

338 | **Add new section 10.28** |

10.28   PROTOCOL ELEMENT IDENTIFICATION MACRO

340 This Macro identifies and describes an element in a protocol such as an acquisition protocol, a processing protocol or a storage protocol.

342

Table 10.28-1
PROTOCOL ELEMENT IDENTIFICATION MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Protocol Element Number	(0018,9921)	1	Identifies the protocol element and the order in which the elements are performed in the Protocol. The value shall start at 1 and increase monotonically by 1.
Protocol Element Name	(0018,9922)	2	Name for this protocol element.
Protocol Element Purpose	(0018,9924)	3	Description of the purpose this element serves in the protocol. Notes: 1. This is intended for use by the radiologist, technologist and/or physicist during management of the Protocol to understand the purpose the Protocol Element serves in the Protocol. 2. It is not intended to be copied into the Series Description. Rather there is an attribute in the Performed Storage Module called Requested Series Description (0018,9937) that is intended to be copied into the Series Description of the stored instances.
Protocol Element Characteristics Summary	(0018,9923)	3	Summary description of characteristics of this element. Notes: 1. This is intended for use by the radiologist, technologist and/or physicist during management of the Protocol to understand the characteristics of the Protocol Element. 2. It is not intended to be copied into the Series Description. Rather there is an attribute in the Performed Storage Module called Requested Series Description (0018,9937) that is intended to be copied into the Series Description of the stored instances.

344

346 *Modify Figure A.1-1 "DICOM Composite Instance IOD Information Model" by adding another "Series content" box for "Performed Procedure Protocol" to the bottom row with a multiplicity of*
348 *0,n*

350 **Add Section A.1.2.28 with a new IE for Procedure Protocols**

A.1.2.28 Procedure Protocol IE

352 The Procedure Protocol IE defines the Attributes that describe a Protocol. This IE may encode a Defined Procedure Protocol or a Performed Procedure Protocol.

354 **Add new IODs in Table A.1-1**

IODs Modules	CT Performed Procedure Protocol	CT Defined Procedure Protocol
Patient	**M**	
Clinical Trial Subject	**U**	
General Study	**M**	
Patient Study	**U**	
Clinical Trial Study	**U**	
General Series	**M**	
Clinical Trial Series	**U**	
Enhanced Series	**M**	
CT Protocol Series	**M**	
Frame of Reference	**M**	
General Equipment	**M**	**M**
Enhanced General Equipment	**M**	**M**
SOP Common	**M**	**M**
Protocol Context	**M**	**M**
Clinical Trial Context		**U**
Patient Protocol Context	**U**	
Patient Specification		**M**
Equipment Specification		**M**
Instructions	**M**	**M**
Patient Positioning	**M**	**M**
Defined CT Acquisition		**M**
Performed CT Acquisition	**M**	
Defined CT Reconstruction		**M**

Performed CT Reconstruction	**M**	
Defined Storage		**M**
Performed Storage	**M**	

356

Add section to Annex A

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358 **A.82   PROCEDURE PROTOCOL INFORMATION OBJECT DEFINITIONS**

Procedure Protocol Information Object Definitions (IODs) encode the details of procedure protocols.

360 Separate IODs are defined for different types of Procedure Protocol, such as a CT image acquistion Procedure Protocol. A CT Performed Procedure Protocol IOD encodes the details of a procedure that has 362 been performed, and a CT Defined Procedure Protocol IOD specifies details of a procedure that may be used for one or more Procedure Protocols to be peformed in the future.

364 **A.82.1   CT Performed Procedure Protocol Information Object Definition**

A.82.1.1   CT Performed Procedure Protocol IOD Description

366 The CT Performed Procedure Protocol IOD describes acquisition and reconstruction protocol parameter values used during a specific performed CT procedure.

368 **A.82.1.2   CT Performed Procedure Protocol IOD Entity-Relationship Model**

This IOD uses the E-R Model in Section A.1.2, with only the Procedure Protocol IE below the Series IE.

370 **A.82.1.3   CT Performed Procedure Protocol IOD Module Table**

Table A.82.1.3-1
372 **CT Performed Procedure Protocol IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Enhanced Series	C.7.3.3	M
	CT Protocol Series	C.34.1	M
Frame of Reference	Frame of Reference	C.7.4.1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M

Equipment	1	creates	1,n	Procedure Protocol

Procedure Protocol	SOP Common	C.12.1	M
	Protocol Context	C.34.2	M
	Patient Protocol Context	C.34.3	U
	Instructions	C.34.7	U
	Patient Positioning	C.34.8	U
	Performed CT Acquisition	C.34.10	U
	Performed CT Reconstruction	C.34.12	U
	Performed Storage	C.34.14	U

374 **A.82.2** **CT Defined Procedure Protocol Information Object Definition**

A.82.2.1 **CT Defined Procedure Protocol IOD Description**

376 The CT Defined Procedure Protocol IOD describes acquisition protocol parameters and related details for a defined CT procedure.

378 See PS3.17 Annex AAAA for explanatory information and examples.

A.82.2.2 **CT Defined Procedure Protocol IOD Entity-Relationship Model**

380 The Procedure Protocol in a CT Defined Procedure Protocol IOD is not associated with a specific patient, however it is associated with the equipment that created the instance.

382 The E-R model for the CT Defined Procedure Protocol IOD is shown in Figure A.82.2.2-1.
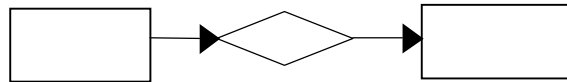
384 **Figure A.82.2.2-1 CT DEFINED PROCEDURE PROTOCOL IOD E-R MODEL**

A.82.2.3 **CT Defined Procedure Protocol IOD Module Table**

386 **Table A.82.2.3-1**
CT Defined Procedure Protocol IOD MODULES

IE	Module	Reference	Usage
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Procedure Protocol	SOP Common	C.12.1	M
	Protocol Context	C.34.2	M
	Clinical Trial Context	C.34.4	U
	Patient Specification	C.34.5	U
	Equipment Specification	C.34.6	M

Instructions	C.34.7	U
Patient Positioning	C.34.8	U
Defined CT Acquisition	C.34.9	U
Defined CT Reconstruction	C.34.11	U
Defined Storage	C.34.13	U

388

A.82.2.3.1   CT Defined Procedure Protocol IOD Content Constraints

390 **A.82.2.3.1.1   Equipment Modality Attribute**

The value of Equipment Modality (0008,0221) shall be CT.

392   Note: An application can query for Protocols by matching on the modality-specific Defined Protocol SOP Class.

394

Modify C.2.4 Patient Medical Module as shown:

---

396 ## C.2.4 Patient Medical Module

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

398   **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.)
Allergies	(0010,2110)	Description of prior reaction to contrast agents, or other patient allergies or adverse reactions.
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

Attribute Name	Tag	Attribute Description
Patient's Sex Neutered	(0010,2203)	Whether or not a procedure has been performed in an effort to render the patient sterile. Enumerated Values: **ALTERED** Altered/Neutered **UNALTERED** Unaltered/intact
Patient's Body Mass Index	**(0010,1022)**	**Body Mass Index of the patient in kg/m2.**
Measured AP Dimension	**(0010,1023)**	**The thickness in mm of the body part being scanned, in the antero-posterior dimension (per AAPM Report 204).** **Note: These values are normally derived from a scanned image, but might also be obtained using physical calipers, e.g. for children.**
Measured Lateral Dimension	**(0010,1024)**	**The side-to-side (left to right) dimension in mm of the body part being scanned (per AAPM Report 204).** **Note: These values are normally derived from a scanned image, but might also be obtained using physical calipers, e.g. for children.**
Special Needs	(0038,0050)	Medical and social needs (e.g., wheelchair, oxygen, translator, etc.)
Patient State	(0038,0500)	Description of patient state (comatose, disoriented, vision impaired, etc.)
…		

400   Note

         The Patient Clinical Trial Participation Sequence (0038,0502) identifies potentially multiple trials in which the
402   patient is enrolled. Application behavior in the presence of multiple items is outside the scope of the standard.

404   ***Modify C.7.2.2 Patient Study Module as shown:***

C.7.2.2 Patient Study Module

406   Table C.7-4a defines Attributes that provide information about the Patient at the time the Study started.

Table C.7-4a. Patient Study Module Attributes

408

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Description of the admitting diagnosis (diagnoses)
Admitting Diagnoses Code Sequence	(0008,1084)	3	A sequence that conveys the admitting diagnosis (diagnoses). One or more Items are permitted in this Sequence.

Attribute Name	Tag	Type	Attribute Description
>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*No Baseline CID is defined.*
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.
Patient's Body Mass Index	**(0010,1022)**	**3**	**Body Mass Index of the patient in kg/m2.**
Measured AP Dimension	**(0010,1023)**	**3**	**The thickness in mm of the body part being scanned, in the antero-posterior dimension (per AAPM Report 204).**
Measured Lateral Dimension	**(0010,1024)**	**3**	**The side-to-side (left to right) dimension in mm of the body part being scanned (per AAPM Report 204).**
Patient's Size Code Sequence	(0010,1021)	3	Patient's size category code One or more Items are permitted in this Sequence.
>*Include Table 8.8-1 "Code Sequence Macro Attributes"*			*Baseline CID is CID 7040 "Broselow-Luten Pediatric Size Categories" for pediatric patients* *Baseline CID is CID 7042 "Calcium Scoring Patient Size Categories" for CT calcium scoring*
Medical Alerts	**(0010,2000)**	**3**	**Conditions to which medical staff should be alerted (e.g., contagious condition, drug allergies, etc.)**
Allergies	**(0010,2110)**	**3**	**Description of prior reaction to contrast agents, or other patient allergies or adverse reactions.**
Smoking Status	**(0010,21A0)**	**3**	**Indicates whether patient smokes.** **Enumerated Values:** **YES** **NO** **UNKNOWN**
Pregnancy Status	**(0010,21D0)**	**3**	**Describes pregnancy state of patient.** **Enumerated Values:** **0001 = not pregnant** **0002 = possibly pregnant** **0003 = definitely pregnant** **0004 = unknown**
Last Menstrual Date	**(0010,2203)**	**3**	**Date of onset of last menstrual period**
Patient State	**(0038,0500)**	**3**	**Description of patient state (comatose, disoriented, vision impaired,etc.)**

Attribute Name	Tag	Type	Attribute Description
Occupation	(0010,2180)	3	Occupation of the Patient.
…			

410

Modify C.7.3.1 General Series Module as shown:

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412 **C.7.3.1   General Series Module**

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

Table C.7-5a
416 **GENERAL SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
…			
Protocol Name	(0018,1030)	3	User-defined description of the conditions under which the Series was performed. Note: This Attribute conveys series-specific protocol identification and may or may not be identical to the one presented in the Performed Protocol Code Sequence (0040,0260).
Referenced Defined Protocol Sequence	**(0018,990C)**	**1C**	**Defined Procedure Protocol SOP Instance(s) that were used to create Instances in this Series.** **Required if this instance is a Performed Procedure Protocol that resulted from a Defined Procedure Protocol.** **May be present otherwise.** **One or more Items shall be included in this Sequence.** **Note: Multiple items in this sequence may represent a group case where several Defined Procedure Protocols were performed together as a single Performed Procedure Protocol.**
>Include 'SOP Instance Reference Macro' Table 10-11			
Referenced Performed Protocol Sequence	**(0018,990D)**	**1C**	**Uniquely identifies the Performed Procedure Protocol SOP Instance(s) that describe the conditions by which this Series was generated.**

			Required if a related Performed Procedure Protocol SOP Instance was created. **One or more Items shall be included in this Sequence.** Note: If the acquisition and reconstruction were recorded in separate Performed Procedure Protocol SOP Instances, it is recommended to reference both. However, it is not intended that this sequence reference Defined or prior Performed Protocol SOP Instances on which the current Performed Procedure Protocol SOP Instance was based. Such references may be found inside the current Performed Procedure Protocol SOP Instance itself.
>Include 'SOP Instance Reference Macro' Table 10-11			
Series Description	(0008,103E)	3	Description of the Series
Series Description Code Sequence	(0008,103F)	3	A coded description of the Series. Only a single Item is permitted in this Sequence.
>Include Code Sequence Macro Table 8.8-1		*No Baseline CID is defined.*	
…			

418 ***Modify C.7.3.1.1.1 to add CTPROTOCOL to the list of Modality Terms***

C.7.3.1.1.1 Modality

420 …

Defined Terms:

422 **CTPROTOCOL   CT Protocol (Performed)**

424 ***Modify C.12.1 SOP Common Module as shown:***

Table C.12-1
426 **SOP COMMON MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
…			
Original Attributes Sequence	(0400,0561)	3	Sequence of Items containing all Attributes that were removed or replaced by other values in the main data set.

			One or more Items are permitted in this Sequence.
>Source of Previous Values	(0400,0564)	2	The source that provided the SOP Instance prior to the removal or replacement of the values. For example, this might be the Institution from which imported SOP Instances were received.
>Attribute Modification DateTime	(0400,0562)	1	Date and time the Attributes were removed and/or replaced.
>Modifying System	(0400,0563)	1	Identification of the system that removed and/or replaced the Attributes.
>Reason for the Attribute Modification	(0400,0565)	1	Reason for the Attribute modification. Defined Terms: **COERCE** Replace values of Attributes such as Patient Name, ID, Accession Number, for example, during import of media from an external institution, or reconciliation against a master patient index. **CORRECT** Replace incorrect values, such as Patient Name or ID, for example, when incorrect worklist item was chosen or operator input error.
>Modified Attributes Sequence	(0400,0550)	1	Sequence that contains all the Attributes, with their previous values, that were modified or removed from the main data set. Only a single Item shall be included in this Sequence.
>>*Any Attribute from the main data set that was modified or removed.*		1	May include Sequence Attributes and their Items.
		...	
Content Qualification	(0018,9004)	3	Content Qualification Indicator Enumerated Values: PRODUCT RESEARCH SERVICE See Section C.8.13.2.1.1 for further explanation.
Private Data Element Characteristics Sequence	(0008,0300)	3	Characteristics of Private Data Elements within **or referenced in** the current SOP Instance. **See C.12.1.1.7.** **One or more Items are permitted in this Sequence.**
>Private Group Reference	(0008,0301)	1	Odd group number within which the Private Data Element block is reserved.
>Private Creator Reference	(0008,0302)	1	The value of the Private Creator Data Element value used to reserve the block of Private Data Elements whose characteristics are described in

			this Item. Note Private blocks are identified by their Private Creator Data Element value, rather than their numeric block number, since instances may be modified and numeric block numbers reassigned but the Private Creator Data Element value, which is required to be unique within a Group of Private Data Elements, will be preserved.
>Private Data Element Definition Sequence	**(0008,0310)**	**3**	**Description of individual private Data Elements.** **One or more Items are permitted in this Sequence.**
>>Private Data Element	**(0008,0308)**	**1**	**Element Number used to identify the Data Element within the reserved block.** **The value of this attribute represents the last two digits of the Data Element tag; i.e. the value of xx in (gggg,00xx) where gggg is the Private Group Reference (0008,0301).**
>>Private Data Element Value Multiplicity	**(0008,0309)**	**1**	**Value Multiplicity (VM) of the Data Element.** **See C.12.1.1.7.1.**
>>Private Data Element Value Representation	**(0008,030A)**	**1**	**Value Representation (VR) of the Data Element.**
>>Private Data Element Number of Items	**(0008,030B)**	**1C**	**Number of items allowed in a sequence Data Element.** **Required if the value of Private Data Element Value Representation (0008,030A) is SQ.** **See C.12.1.1.7.2.**
>>Private Data Element Keyword	**(0008,030D)**	**1**	**Keyword for the Data Element (in the sense of the keywords provided in PS 3.6).**
>>Private Data Element Name	**(0008,030C)**	**1**	**Name for referring to the Data Element.**
>>Private Data Element Description	**(0008,030E)**	**3**	**Description of the purpose and/or proper usage of the Data Element.**
>>Private Data Element Encoding	**(0008,030F)**	**3**	**Description of how the Data Element value contents are encoded.**
>>Retrieve URI	**(0040,E010)**	**3**	**Retrieval access path to associated documentation.** **Includes fully specified scheme, authority, path, and query in accordance with [RFC 3986].**
>Block Identifying Information Status	(0008,0303)	1	Specifies whether some or all of the Private Data Elements in the block are safe from identity leakage as defined by PS3.15 Section E.3.10 Retain Safe Private Option. Enumerated Values: SAFE no data elements within the block

			contain identifying information
			UNSAFE all data elements within the block may contain identifying information
			MIXED some data elements within the block may contain identifying information
>Nonidentifying Private Elements	(0008,0304)	1C	List of Private Data Elements in block that do not contain identifying information (are safe from identity leakage).
			Elements are identified by the lowest 8-bits of the attribute tag (i.e. with a value from 0000H to 00FFH) within the block, stored as an unsigned short integer. Multiple values shall be in increasing order and a given value shall be listed at most once.
			Required if Block Identifying Information Status (0008,0303) equals MIXED.
>Deidentification Action Sequence	(0008,0305)	3	Actions to be performed on element within the block that are not safe from identify leakage.
			One or more Items are permitted in this Sequence.
>>Identifying Private Elements	(0008,0306)	1	List of Private Data Elements in block that may contain identifying information (are unsafe from identity leakage)..
			Elements are identified by the lowest 8-bits of the attribute tag (i.e. with a value from 0000H to 00FFH) within the block, stored as an unsigned short integer. Multiple values shall be in increasing order and a given value shall be listed at most once.
>>Deidentification Action	(0008,0307)	1	Recommended action to be performed during de-identification on elements listed in Identifying Private Elements (0008,0306) within this Item.
			Note
			A specific type of action is suggested in order to minimize the impact of de-identification on the behavior of recipients that use the Private Data Elements.
			Enumerated Values:
			D replace with a non-zero length value that may be a dummy value and consistent with the VR
			Z replace with a zero length value, or a non-zero length value that may be a dummy value and consistent with the VR
			X remove
			U replace with a non-zero length UID that is internally consistent within a set of Instance
			Note

			1. No C (clean) action is specified, since replacement with values of similar meaning known not to contain identifying information and consistent with the VR requires an understanding of the meaning of the value of the element. Whether or not to clean rather than remove or replace values is at the discretion of the implementer.
			2. No suggested dummy value is provided, since the encoding of the value would depend on the VR of the data element.
			3. Further explanation of these actions can be found in PS3.15 Section E.3.1 Clean Pixel Data Option.

428 | **Add C.12.1.1.7:**

C.12.1.1.7 Private Data Element Characteristics

430 The creator of the private Data Elements (identified by the value of Private Creator Reference (0008,0302)) is responsible for managing the Private Data Element Tags associated with them and ensuring that the
432 Private Data Element (0008,0308) and the Private Data Element Keyword (0008,030D) are a unique pair, and that the other associated details in the Data Element Definition Macro are consistent.

434 Implementers are encouraged to describe all Private Data Elements in the Private Data Element Characteristics Sequence (0008,0300).

436 Note: The Private Data Element Characteristics Sequence (0008,0300) may describe Data Elements that are referenced in the current SOP Instance (for example they may be identified as a Selector Attribute), but
438 do not exist as actual Data Elements in the current SOP Instance.

440 **C.12.1.1.7.1 Private Data Element Value Multiplicity**

For data elements with a fixed multiplicity, this attribute shall contain a single integer value, e.g., 3.

442 For data elements with a variable multiplicity, this attribute contains either two or three values. The first value is the minimum multiplicity, the second value is the maximum multiplicity. If the maximum multiplicity
444 is open-ended, 0 is used.   The third value, if present, is the "stride", i.e. the increment between valid multiplicity values. A stride is used when values are added in sets, such as an x/y/z set of coordinate
446 values that is recorded in triplets.If the stride is 1, the third value may be omitted. The stride is not permitted to be 0.

448 Examples:

- VM of 1-3 is expressed as 1,3 or 1,3,1 meaning the multiplicity is permitted to be 1, 2 or 3
450 - VM of 1-n is expressed as 1,0 or 1,0,1
- VM of 0-n is expressed as 0,0 or 0,0,1

452   • VM of 3-3n is expressed as 3,0,3

For a Private Data Element Value Representation (0008,030A) of SQ, the multiplicity shall be 1 and the
454 allowed number of items in a sequence is recorded in Private Data Element Number of Items (0008,030B).

C.12.1.1.7.2   Private Data Element Number of Items

456 For sequences that permit a fixed number of Items, this attribute shall contain a single integer value, e.g.,
3.

458 For sequences with a variable number of Items, this attribute contains two values. The first value is the
minimum number of Items, the second value is the maximum number of Items. If the maximum number of
460 Items is open-ended, 0 is used.

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462 | **Modify Section C.23.3.1.1 to insert reference to Sections C.23.1.1.3.1 and C.23.1.1.3.2** |

C.23.3.1.1 Filter Operations Sequence

464 The items in the Filter Operations Sequence (0072,0400) determine which subset of the images in the
identified Image Set are to be displayed in the associated Display Set image boxes. If there are multiple
466 Items in the Filter Operations Sequence (0072,0400), the filter operations shall be applied in Item order,
and the output of the preceding filter shall serve as the input to the succeeding filter (i.e., an AND
468 operation). **See Sections C.23.4.2.1.1 and C.23.4.2.1.1 for additional details on matching strings and
coded values.**

470 When Filter-by Category (0072,0402) has a value of IMAGE_PLANE, Selector Attribute VR (0072,0050)
shall have a value of "CS", and abstract Enumerated Values shall be used for the value of the associated
472 Selector CS Value (0072,0062) attribute, which may be computed from the values of Image Orientation
(Patient) (0020,0037) or Patient Orientation (0020,0020).

474 …

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476 | ***Add new protocol module sections*** |

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478 ## C.34   PROCEDURE PROTOCOL MODULES

This section describes modules specific to the family of Defined and Performed Procedure Protocol IODs.

480 ### C.34.1   CT Protocol Series

The CT Protocol IODs use the General Series module described in Section C.7.3.1, specialized by the CT
482 Protocol Series Module, to describe the DICOM Series Entity described in Section A.1.2.3, and to define
what constitutes a Series for the context of a Protocol.

484 Table C.34.1-1 specifies the Attributes that describe a CT Protocol series.

Table C.34.1-1. CT Protocol Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of data in this Series.

| | | | Enumerated Values:
    CTPROTOCOL

See Section C.7.3.1.1.1 for further explanation. |

486

488 **C.34.2   Protocol Context**

The context in which the described Protocol is defined or performed. This module is applicable to defined
490 and performed procedure protocols.

Details like the Potential Reasons for Procedure Code Sequence (0018,9909) or the Protocol Planning
492 Information (0018,990F) may be copied from the defined protocol into the performed protocol to support
quality assurance activities like checking whether the contents of the Reason for Requested Procedure
494 Code Sequence (0040,100A) recorded in the performed protocol are consistent with the contents of the
Potential Reasons for Procedure Code Sequence (0018,9909).

496   **Table C.34.2-1**
PROTOCOL CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description

Custodial Organization Sequence	(0040,A07C)	3	Custodial organization for this Protocol instance. Represents the organization that is currently in charge of maintaining this protocol instance.
			    Note: This may or may not be identical to the Institution identified in the Equipment Module.
			    This may or may not be the Institution that originally created this instance.
			Only a single Item is permitted in this Sequence.

>Institution Name	(0008,0080)	2	Name of Custodial Institution or Organization.
>Institution Code Sequence	(0008,0082)	2	Coded identifier of Custodial Institution or Organization. Zero or one Item shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			No Baseline CID is defined.
Responsible Group Code Sequence	(0008,0220)	2	The department, unit or service that is responsible for the management of this Protocol. See C.34.2.3.
>Include 'Code Sequence Macro' Table 8.8-1			Baseline CID is CID 7030 "Institutional Departments, Units and Services".
Protocol Name	(0018,1030)	1	Name for this Protocol.

Potential Scheduled Protocol Code Sequence	(0018,9906)	3	A list of Protocol Codes for which this Protocol may be considered a match. One or more Items are permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1			
Potential Requested Procedure Code Sequence	(0018,9907)	3	A list of Procedure Codes for which this Protocol may be considered a match. One or more Items are permitted in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1			
Potential Reasons for Procedure	(0018,9908)	3	List of reasons deemed appropriate by the Protocol author for a procedure using this Protocol Each reason shall be encoded in a separate value of this multi-value attribute. Note: One of the reasons listed here may be encoded in Reason for the Requested Procedure (0040,1002) within instances generated from running the Protocol.
Potential Reasons for Procedure Code Sequence	(0018,9909)	3	List of reasons deemed appropriate by the Protocol author for a procedure using this Protocol. One or more Items are permitted in this Sequence. Note: One of the reasons listed here may be encoded in Reason for Requested Procedure Code Sequence (0040,100A) within instances generated from running the Protocol.
>Include 'Code Sequence Macro' Table 8.8-1			*No Baseline CID is defined.*
Potential Diagnostic Tasks	(0018,990A)	3	List of diagnostic tasks deemed appropriate by the Protocol author for a procedure using this Protocol. E.g. Detect collections of blood, Identify brain masses.
Contraindications Code Sequence	(0018,990B)	3	List of reasons for which the authors of the Protocol deemed it contraindicated. Note: Constraints on values of patient demographic Attributes such as sex, age or weight are addressed separately in the Patient Specification Module. See C.34.5. One or more Items are permitted in this Sequence.

>Include 'Code Sequence Macro' Table 8.8-1			*Baseline CID is CID 1200 "Contraindications for CT Imaging".*
Predecessor Protocol Sequence	(0018,990E)	3	Defined or Performed Procedure Protocol Instances from which this Defined Procedure Protocol was derived. See C.34.2.1. This attribute is not present in Performed Procedure Protocol Instances since the Referenced Defined Protocol Sequence (0018,990C) is used instead. One or more Items are permitted in this Sequence.
>Include 'SOP Instance Reference Macro' Table 10-11			
Content Creator's Name	(0070,0084)	1	Name of the most recent person (such as a technologist or physician) to significantly modify the content of this SOP Instance. Note: 1. For a Performed Protocol object, this is generally the operator who was the last one to interact with the protocol before it was performed. 2. A history of editors is not recorded here. Such information might conceivably be recovered by reviewing the Attribute value of other instances such as those referenced in Predecessor Protocol Sequence (0018,990E).
Content Creator's Identification Code Sequence	(0070,0086)	3	Identification of the most recent person to significantly modify the content of this SOP Instance. Only a single Item is permitted in this Sequence.
>Include 'Person Identification Macro' Table 10-1			
Protocol Design Rationale	(0018,9910)	3	Explanation of the rationale behind the selected parameter values or changes to them.
Protocol Planning Information	(0018,990F)	3	Description of details and activities related to planning the execution of this Protocol. See C.34.2.2.
Instance Creation Date	(0008,0012)	1	Date the Protocol SOP Instance was created.
Instance Creation Time	(0008,0013)	1	Time the Protocol SOP Instance was created.

498

C.34.2.1   Predecessor Protocol Sequence

500 A Protocol may be a derivation of another Protocol (the "predecessor"). For example, a Protocol may be originally published as a non-model-specific Protocol for a certain purpose. Subsequently, a new Protocol
502 may be derived from the original by making it specific to a certain model of scanner. Derivation may involve adjusting constraints or specifying additional constraints. If a Protocol no longer satisfies any of the

504 indications of the Predecessor Protocol from which it was derived, the Predecessor shall not be referenced in this sequence.

506   Note: Including predecessor information makes it possible to filter a set of Protocols, for example to list all Protocols that are derived versions of a certain known Protocol (e.g., ACRIN 6678), or list only the one
508   that has been specialized for a specific model of equipment.

    Sites that receive a generic Protocol might create a specialized variant to fit their local practice and avoid
510   the tech having to make selections/changes each time it is used.

Only the immediate predecessor shall be referenced, but more than one predecessor may be referenced if
512 multiple distinct predecessors were merged.

C.34.2.2   Protocol Planning Information

514 This information describes activities that are related to the effective performance of the Protocol but are not typically performed in the scanning room. This could include things like:

516 • Instruct patient to fast for 4 hours before imaging
• Obtain creatinine within 7 days before imaging
518 • Schedule scan 12-24hrs before surgery
• Premedicate patient with diphenhydramine 1 hr before imaging
520 • Schedule an additional liver Acquisition Protocol Element 10-15 minutes after contrast injection if the patient has a history of cholangiocarcinoma; note this example would affect both the length of
522 the scheduled time slot and the actual performance with a delayed acquisition
• If available run the followup scan on the same device as the original scan.

524

C.34.2.3   Protocol Management

526 The Protocol Context Module contains Attributes for grouping and managing Protocol objects.

The Responsible Group Code Sequence (0008,0220) can be used by the department or clinical specialty
528 to collect the Protocols for which they are responsible for review and management.

The Potential Scheduled Protocol Code Sequence (0018,9906) and Potential Reasons for Procedure Code
530 Sequence (0018,9909) can gather Protocols associated with a given procedure code or indication respectively.

532 The contents of the Referenced Defined Protocol Sequence (0018,990C) in a collection of Performed Procedure Protocol objects can be used to determine the frequency of usage of the corresponding Defined
534 Procedure Protocol objects.

C.34.3   Patient Protocol Context

536 The patient specific context in which the described Protocol is performed. This module is applicable to performed procedures.

538 **Table C.34.3-1**
PATIENT PROTOCOL CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Referenced Performed Protocol Sequence	(0018,990D)	1	References to Performed Protocol instances describing related prior procedures for this patient. One or more Items shall be included in this Sequence.

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

540

C.34.4   Clinical Trial Context

542 Table C.34.4-1 contains Attributes that identify a clinical trial context independent of any specific Clinical Trial Subjects.

544

Table C.34.4-1
CLINICAL TRIAL CONTEXT MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Clinical Trial Sponsor Name	(0012,0010)	1	The name of the clinical trial sponsor. See C.7.1.3.1.1.
Clinical Trial Protocol ID	(0012,0020)	1	Identifier for the noted protocol. See C.7.1.3.1.2.
Clinical Trial Protocol Name	(0012,0021)	2	The name of the clinical trial protocol. See C.7.1.3.1.3.
Clinical Trial Site ID	(0012,0030)	2	The identifier of the site responsible for submitting clinical trial data. See C.7.1.3.1.4.
Clinical Trial Site Name	(0012,0031)	2	Name of the site responsible for submitting clinical trial data. See C.7.1.3.1.5
Clinical Trial Protocol Ethics Committee Name	(0012,0081)	1C	Name of the Ethics Committee or Institutional Review Board (IRB) responsible for approval of the Clinical Trial. Required if Clinical Trial Protocol Ethics Committee Approval Number (0012,0082) is present.
Clinical Trial Protocol Ethics Committee Approval Number	(0012,0082)	3	Approval number issued by committee described in Clinical Trial Protocol Ethics Committee Name (0012,0081).
Ethics Committee Approval Effectiveness Start Date	(0012,0086)	3	The date the approval identified in Clinical Trial Protocol Ethics Committee Approval Number (0012,0082) becomes effective.
Ethics Committee Approval Effectiveness End Date	(0012,0087)	3	The date the approval identified in Clinical Trial Protocol Ethics Committee Approval Number (0012,0082) ceases to be effective.
Clinical Trial Coordinating Center Name	(0012,0060)	2	The name of the institution that is responsible for coordinating the protocols for the clinical trial. See C.7.3.2.1.1.

546

C.34.5   Patient Specification

548 Table C.34.5-1 contains patient characteristics for which a Protocol may be considered applicable.

Table C.34.5-1
PATIENT SPECIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Patient Specification Sequence	(0018,9911)	1	Constraints on the characteristics of patients to which the protocol is applicable. One or more Items shall be included in this Sequence.
>Include 'Attribute Value Constraint Macro' Table 10.25-1			Only Attributes defined in the Patient Module (See Table C.7-1) or the Patient Study Module (See Table C.7-4a) may be specified as Selector Attributes. See C.34.9.3. The same Attribute shall not be constrained in more than one item in this sequence. Note: Since these constraints are being placed on the attributes that will appear in the Patient Module or Patient Study Module of the resulting instances, the Patient Specification Sequence will not appear in the Selector Sequence Pointer (0072,0052).

Attributes that might commonly be specified in this sequence include:

- Patient's Age (0010,1010), to indicate Protocols for age ranges like adults, pediatrics, infants
- Patient's Sex (0010,0040), to indicate Protocols for males, females, both
- Patient's Weight (0010,1030), to indicate Protocols for different weight ranges

C.34.6   Equipment Specification

Table C.34.6-1 contains equipment characteristics for which a Protocol may be considered appropriate.

Table C.34.6-1
EQUIPMENT SPECIFICATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Equipment Modality	(0008,0221)	1	Modality of the equipment to which the protocol is applicable. See C.7.3.1.1.1 for Defined Terms.
Model Specification Sequence	(0018,9912)	3	Equipment models/versions. See C.34.6.1. Zero or more Items shall be included in this Sequence.
>Manufacturer	(0008,0070)	1	Manufacturer of the equipment.
>Manufacturer's Related Model Group	(0008,0222)	3	Name of a group of related equipment models from the Manufacturer (0008,0070) to which the same protocol applies.

>Manufacturer's Model Name	(0008,1090)	1C	Manufacturer's model name of the equipment. Required if Manufacturer's Related Model Group (0008,0222) is not present. May be present otherwise.
>Software Versions	(0018,1020)	3	Manufacturer's designation of software version of the equipment. See C.7.5.1.1.3.
>General Accessory Sequence	(300A,0420)	3	Accessories or options that further specify the model. One or more Items are permitted in this Sequence.
>>Accessory Code	(300A,00F9)	1	Machine readable identifier for the accessory. E.g. this may indicate accessory equipment such as cardiac gating equipment.
>Device Serial Number	(0018,1000)	3	Serial number of a specific device for which the Protocol is intended.

562 The Protocol details in other modules may implicitly further constrain the appropriate equipment. For example, the specified hardware may not have the ability to perform acquisitions that satisfy the acquisition
564 parameter constraints, to perform reconstructions that satisfy the reconstruction parameter constraints, or to produce images with the desired characteristics.

566 **C.34.6.1   Model Specification Sequence**

Each item in the sequence, contains multiple Attributes to be satisfied at once. It is only necessary to
568 match one item in the sequence. The decision about whether an item is a suitable match is up to the executing device. The intention is to provide values that would allow a scanner device to identify whether a
570 Protocol is appropriate for it.

Note: The values may not necessarily match exactly what the scanner would put into corresponding Attributes
572   in instances it creates.

574 **C.34.7   Instructions**

Table C.34.7-1 contains instructions relating to preparation and performance of the Protocol.

576   **Table C.34.7-1**
INSTRUCTIONS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Instruction Sequence	(0018,9914)	1	Instructions relating to preparation and performance of the Protocol. See C.34.7.1. One or more Items shall be included in this Sequence.

>Instruction Index	(0018,9915)	1	Identifies the order in which instruction sequence items are performed. The value shall be an integer, increasing monotonically by 1, starting from 1.
>Instruction Text	(0018,9916)	1	A short displayable string indicating what should be done.
>Instruction Description	(0018,9917)	3	A detailed description explaining what should be done.
>Instruction Performed Flag	(0018,9918)	2C	Whether or not this instruction was followed in the performed Protocol. Required if the value of SOP Class UID (0008,0016) equals 1.2.840.10008.5.1.4.1.1.200.2 (CT Performed Procedure Protocol Storage). Enumerated Values: YES NO
>Instruction Performed DateTime	(0018,9919)	2C	Date and time the instruction was performed. Required if Instruction Performed Flag (0018,9918) is present with a value of YES.
>Instruction Performance Comment	(0018,991A)	3	Comment about how the instruction was actually performed, about the outcome of performing the instruction or about why the instruction was not performed.

578

C.34.7.1   Instruction Sequence

580 This sequence describes instructions to be performed by the scanner staff in conjunction with the Protocol. The instructions are generally limited to activites that happen inside the scan suite and might include

582 • preparation of the scanner (e.g., running a particular calibration, mounting a head holder or patient grab handles on the table),
584 • preparation of the patient (e.g., asking if they have fasted, placing padding or shielding, giving the patient water as oral contrast, turning the patient prone for the second series in a virtual
586 colonoscopy Protocol),
• instructions to the patient during the imaging procedure (e.g., asking the patient to hold their
588 breath, asking the patient to hyperventilate prior to breathold)
• instructions to the technologist during the imaging procedure (e.g., obtain the spiral acquisition
590 during a single breathhold, take additional images if some condition is true).

The instruction may also include timing or triggering details, for example:

592 • Start the Portal Venous phase Acquisition Protocol Element when an ROI placed over the liver detects a contrast bolus at 50 HU above baseline
594 • Start the Delay phase Acquisition Protocol Element three minutes after start of contrast injection
• Start the AP Localizer Acquisition Protocol Element eight minutes after start of contrast injection
596 and repeat the AP Localizer Acquisition Protocol Element at one minute intervals until adequate ureter opacification is observed, then proceed to the abdomen Acquisition Protocol Element

598   Instructions related to the initial positioning of the patient are included in the Patient Positioning Module. This module may describe subsequent changes in position between steps of the protocol.

600   Equipment preparation instructions would typically be limited to phantom imaging or other calibration procedures related to the individual patient scan. Phantom Imaging and/or Calibration to be performed as
602   general QA/qualification (i.e. not associated with the individual patient scan) shall not be described in this Module.

604   Activities that are associated with the protocol but which are not typically performed in the scanning room, such as the need to obtain creatinine values within 7 days before performing the Protocol, or to
606   premedicate the patient with Benadryl 1 hour before performing the Protocol, are described in the Protocol Planning Information (0018,990F) rather than in this Module.

608   **C.34.8   Patient Positioning**

Table C.34.8-1 contains details about the positioning of the patient before and during the imaging
610   procedure.

Table C.34.8-1
612   **PATIENT POSITIONING MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Protocol Defined Patient Position	(0018,9947)	1	Patient position relative to the equipment described by the procedure protocol. See C.7.3.1.1.2 for Defined Terms and further explanation.
Patient Positioning Instruction Sequence	(0018,991B)	3	Instructions for positioning and aligning the patient for the procedure. E.g., aligning an anatomical landmark with laser crosshairs. One or more Items are permitted in this Sequence. The precise correlation between positioning and scan elements is to be described in the Instruction Text if necessary.
>Instruction Index	(0018,9915)	1	Identifies the order in which instruction sequence items are presented/performed. The value shall be an integer, increasing monotonically by 1, starting from 1.
>Instruction Text	(0018,9916)	1	A displayable string explaining what should be done.
>Instruction Description	(0018,9917)	3	A detailed description explaining what should be done.

>Instruction Performed Flag	(0018,9918)	1C	Whether or not this instruction was performed.
			
			Required if the value of SOP Class UID (0008,0016) equals 1.2.840.10008.5.1.4.1.1.200.2 (CT Performed Procedure Protocol Storage).
			
			Enumerated Values:
			  YES
			  NO

>Instruction Performed Datetime	(0018,9919)	1C	Date and time the instruction was performed. Required if Instruction Performed Flag (0018,9918) is present with a value of YES.
Positioning Method Code Sequence	(0018,991C)	3	Identifies the method for positioning the patient. Only a single Item shall be included in this Sequence. See C.34.8.1.
>Include 'Code Sequence Macro' Table 8.8-1			*Baseline CID is CID 1015 "Patient Alignment Methods"*
Positioning Landmark Sequence	(0018,991D)	3	A coded location identifying the intended landmark used as the basis for positioning. Only a single Item is permitted in this Sequence. See C.34.8.1.
>Include 'Reference Location Macro' Table 10.27-1			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*
Target Frame of Reference UID	(0018,991E)	3	UID of the Frame of Reference of another dataset to which the current procedure is intended to be roughly aligned. Note: 1. For example, in a performed protocol it may be useful to record the Frame of Reference UID used in a prior study that was used as a reference. 2. The Frame of Reference UID (0020,0052) in the image instances resulting from the performance of this protocol will likely be different than this Target Frame of Reference UID since perfect alignment is likely unachievable.

Target Position Reference Indicator	(0020,mx0e)	3	Position Reference Indicator for the Target Frame of Reference UID (0018,991E). See C.34.8.1.
Anatomic Region Sequence	(0008,2218)	2	Identifies the general anatomic region imaged by the Protocol. See C.34.8.2. Zero or one Item shall be included in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1			*Baseline CID is CID 4031.*
>Anatomic Region Modifier Sequence	(0008,2220)	3	Sequence of Items that modifies the anatomic region of interest of this Instance. See C.34.8.2. One or more Items are permitted in this Sequence.
>>Include 'Code Sequence Macro' Table 8.8-1			*Defined CID is CID 2.*
Primary Anatomic Structure Sequence	(0008,2228)	2	Identifies the primary anatomic structure(s) of interest in this Protocol. Zero or more Items shall be included in this Sequence.
>Include 'Code Sequence Macro' Table 8.8-1			
>Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	Sequence of Items that modifies the primary anatomic structure of interest in this Instance. One or more Items are permitted in this Sequence.
>>Include 'Code Sequence Macro' Table 8.8-1			*Defined CID is CID 2.*

614 **C.34.8.1   Positioning Targets**

The specific method by which the referenced localizer images, photos of patient skin marks, landmarks, or
616 frames of reference are used to position the patient, is communicated by referencing the associated code
in the Positioning Method Code Sequence (0018,991C).

618 **C.34.8.2   Anatomic Region & Primary Anatomic Structure**

Primary Anatomic Structure Sequence (0008,2228) shall identify the specific organ or structure that is the
620 focus of the procedure described by the Protocol and will generally correlate with the Reason for Study and
the Procedure Code. Anatomic Region Sequence (0008,2218) shall identify the region of the body
622 spanned by the images produced by the Protocol. For example, a Protocol might identify the Primary
Anatomic Structure as "liver" and the Anatomic Region as "abdomen".

624 The contents of the Anatomic Region Sequence (0008,2218) is not necessarily a precise description of the
full extent of the scan or the reconstructed slices. "Chest" may refer to a scan that spans only part of the
626 chest, the whole chest, or includes parts of regions beyond the chest. For a more precise description of the
extent of the acquisition or reconstructed slices, refer to the Acquisition Start Location Sequence
628 (0018,9931) and Acquisition End Location Sequence (yym8,m8x6) or the Reconstruction Start Location
Sequence (0018,993B) and Reconstruction End Location Sequence (0018,993C).

630 For Protocols that could be used in a variety of anatomic regions, such as one designed for a certain type of metastasis or biopsy, the Primary Anatomic Structure Sequence might contain a generic code like (M-
632 01000, SRT, "Morphologically abnormal structure") and the Anatomic Region Sequence may be empty in the (non-patient-specific) Defined Protocol, but could be populated in the Performed Protocol. In such
634 cases, the Protocol Context module may describe a list of anatomic regions for which the Protocol is intended/appropriate.

636 Note: It is expected that the modality will migrate these codes, as appropriate, into the resulting images to facilitate the selection of hanging protocols and report templates appropriate to the primary anatomic
638 structure or future searches for anatomically relevant priors.

C.34.9 Defined CT Acquisition

640 Table C.34.9-1 contains a specification of acceptable values and ranges of acquisition parameters for an imaging procedure.

642

Table C.34.9-1
DEFINED CT ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Acquisition Protocol Element Specification Sequence	(0018,991F)	1	Specification of the acquisition parameters for acquisition protocol elements in an imaging procedure. There shall be one item in this sequence for each Acquisition Protocol Element in the Protocol. See C.34.9.1. One or more Items shall be included in this Sequence.
>Protocol Element Number	(0018,9921)	1	The Protocol Element Number of the Acquisition Protocol Element being specified in this item.
>Parameters Specification Sequence	(0018,9913)	3	Constraints on one or more acquisition parameters. One or more Items are permitted in this Sequence.
>>*Include 'Attribute Value Constraint Macro' Table 10.25-1*			Only Attributes defined in Table C.34.10-1 (i.e. in the Acquisition Protocol Element Sequence (0018,9920) in the Performed CT Acquisition Module) and private Data Elements associated with this acquisition protocol element may be specified as Selector Attributes. The semantics of values of Constraint Violation Significance (0082,0036) in the macro are assigned in C.34.9.3. The same Attribute shall not appear in more than one item in the sequence with the same values for Selector Sequence Pointer (0072,0052) and Selector Sequence Pointer Items (0074,1057).

>>Modifiable Constraint Flag	(0082,0038)	1C	Specifies whether this constraint may be encoded in a derived instance with a different value. See C.34.9.4. Enumerated Values: YES – the constraint may be modified. NO – the constraint may not be modified. Required if the constraint may not be modified, may be present otherwise.

644

Note: The Performed CT Acquisition Module in the CT Performed Procedure Protocol will generally be "fully
646 populated". The Defined CT Acquisition Module in the CT Defined Procedure Protocol Object may be "sparsely populated" (i.e. contains only the Attributes the system that is specifying the protocol "cares
648 about").

650 Attributes that might commonly be specified here include:

- KVP (0018,0060)
652 - X-ray Tube Current in mA (0018,9330)
- Revolution Time (0018,9305)
654 - Single Collimation Width (0018,9306)
- Total Collimation Width (0018,9307)
656 - Spiral Pitch Factor (0018,9311)
- Exposure Modulation Type (0018,9323)
658 - CTDIvol Notification Trigger (0018,9942) (See C.34.9.2)
- DLP Notification Trigger (0018,9943)
660 - CTDIvol (0018,9345)

662 **C.34.9.1   Acquisition Protocol Elements**

A CT Protocol usually includes more than one Acquisition Protocol Element. For example, a chest Protocol
664 might include three elements in total: two localizer CT radiographs (AP and Lateral), and a single helical scan.

666 Since all parameters will be nested inside an Acquisition Protocol Element Sequence (0018,9920) and some of the parameters will be further nested inside a CT X-Ray Details Sequence (0018,9325), close
668 attention must be paid to the use of the Selector Sequence Pointer (0072,0052) in the Attribute Value Constraint Macro.   Illustrative examples are provided in Table C.34.9-2.

670 **Table C.34.9-2. Example Usage of Selector Macro Attributes for Acquisition Constraints**

Example	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Example Constraint
Constrain the value of Element Name (0018,9922) of the first item in the Acquisition Protocol Element Sequence	(0018,9922)	1	(0018,9920)	1	EQUAL "Localizer (AP)"

Example	Selector Attribute (0072,0026)	Selector Value Number (0072,0028)	Selector Sequence Pointer (0072,0052)	Selector Sequence Pointer Items (0074,1057)	Example Constraint
(0018,9920)					
Constrain the value of Table Speed (0018,9309) of the second item in the Acquisition Protocol Element Sequence (0018,9920)	(0018,9309)	1	(0018,9920)	2	EQUAL 14 mm/sec
Constrain the value of KVP (0018,0060) of the first beam in the CT X-Ray Details Sequence (0018,9325) of the second item in the Acquisition Protocol Element Sequence (0018,9920)	(0018,0060)	1	(0018,9920), (0018,9325)	2\1	RANGE_INCL (120,140)
Constrain the first and second value of Exposure Modulation Type (0018,9323) of the second beam in the CT X-Ray Details Sequence (0018,9325) of the third item in the Acquisition Protocol Element Sequence (0018,9920)	(0018,9323)	1	(0018,9920), (0018,9325)	3\2	EQUAL "ANGULAR"
	(0018,9323)	2	(0018,9920), (0018,9325)	3\2	EQUAL "ORGAN_BASED"

672

C.34.9.2   Dose Related Attributes in Parameter Specification Sequence

674 If CTDIvol Notification Trigger (0018,9942) or DLP Notification Trigger (0018,9943) are present in a parameter specification for an Acquisition Protocol Element, each is intended to communicate a Dose
676 Check (NEMA XR-25-2010) threshold value associated with that Acquisition Protocol Element. As such, a Constraint Type (0082,0032) of EQUAL would be the most appropriate.

678 If CTDIvol (0018,9345) is present in a parameter specification for an Acquisition Protocol Element, the value is intended to communicate an estimate of the CTDIvol for that Acquisition Protocol Element. It is
680 expected that the value would either be a single CTDIvol that represents a typical value given the parameter constraints and defaults provided, or a range that represents the expected value range if the
682 parameters are varied within the defined constraints. The value of CTDIvol is not itself a constraint on the execution of the Protocol, but rather an estimate to help the radiologist, technologist and/or physicist when
684 reviewing and managing sets of Protocols. Constraints and associated behaviors are provided by the CTDIvol Notification Trigger, the DLP Notification Trigger and the NEMA XR-25 Dose Check standard.

686   Note: It should be recognized that the formulae and methods used by any given scanner model to estimate CTDIvol may evolve over time. When such changes occur, devices that generate CT Defined Procedure
688   Protocol instances, are advised to generate new instances using the revised estimation methods.

690 **C.34.9.3   Attribute Value Constraint Macro**

The CT Defined Procedure Protocol SOP Class assigns the following significance to the values of
692 Constraint Violation Significance (0082,0036):
- FAILURE – Violating the constraint is a violation of the Protocol and requires supervisory
694   permission and auditing.
- WARNING – Violating the constraint is a violation of the Protocol and requires operator
696   confirmation and auditing.

- INFORMATIVE – Violating the constraint is not a violation of the Protocol. The constraint
698   represents a guideline. Violation of the guideline may be recorded or shown to the operator.

If the attribute is absent, a value of INFORMATIVE may be assumed.

700

C.34.9.4   Modifiable Constraint Flag

702 New protocol instances derived from original protocol instances with different constraints on a given
attribute "modify" the constraint. This flag may be used by devices that create original instances to specify
704 which constraints can be modified by other devices in derived instances.

For example, a CT device that creates a Defined Procedure Protocol, may indicate that the Element Name
706 (0018,9922) of the Acquisition Protocol Element, or the CTDIvol Notification Trigger (0018,9942)
constraints may be modified, but the Spiral Pitch Factor (0018,9311) constraint may not since the latter
708 depends on correlated changes by the device to other attributes. Such information would be useful to a
protocol management workstation that is letting its operator make changes to the CTDIvol Notification
710 Trigger.

Note: There is a difference between these "derivation" modifications and what an operator does at the time of
712   protocol execution. At execution time, the operator is using the CT device to change Selector Attribute
values and those values are compared to the Constraint Values in the Constraint Macro of the Defined
714   Protocol. The result may (or may not be) stored in a Performed Procedure Protocol instance. At
derivation time, an operator is using a workstation to change Constraint Values in the Constraint Macro
716   and store a new Defined Procedure Protocol Instance.

718 ### C.34.10   Performed CT Acquisition

This Module contains acquisition parameter values for a performed CT imaging procedure. The purpose of
720 this module is to record all relevant parameters, not just to record the values that were constrained in the
executed Defined Protocol (if any).

722 This Module contains Attributes that are "set" on the machine, e.g. to affect its behavior, but not those that
describe the results. The latter may be found in the reconstructed images.

724   **Table C.34.10-1**
                    PERFORMED CT ACQUISITION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Acquisition Protocol Element Sequence	(0018,9920)	2	Parameter values for each Protocol Element in the acquisition protocol. Each item in the sequence describes one Element. Elements are performed in the order of their Protocol Element Number (0018,9921). See C.34.9.1. Zero or more Items shall be included in this Sequence.
>Include Protocol Element Identification Macro Table 10.28-1			
>Acquisition Type	(0018,9302)	1	Description of the method used during acquisition. See C.8.15.3.2.1 for Defined Terms.

>Tube Angle	(0018,9303)	1C	The constant angle at which the x-ray source is located during acquisition. 0 degrees means that the source is located at the highest point of the gantry orbit. Degrees increase from 0 to positive 360 in a clockwise direction as viewed when facing the gantry where the table enters the gantry. Required if Acquisition Type (0018,9302) is CONSTANT_ANGLE.

>Constant Volume Flag	(0018,9333)	1	Identifies that the acquisition was performed by repetitively acquiring the same volume set over a period of time.
			Note: The Acquisition Type (0018,9302) value may be SEQUENCED, SPIRAL or STATIONARY depending on whether table movement is necessary to cover the volume.
			Enumerated Values
			    YES
			    NO

>Fluoroscopy Flag	(0018,9334)	1	Identifies that near real-time display of a block of continuously acquired data was performed.
			Enumerated Values
			    YES
			    NO

>Revolution Time	(0018,9305)	1C	The time in seconds of a complete revolution of the source around the gantry orbit. This value is independent of the Reconstruction Angle (0018,9319) of the frame. Required if Acquisition Type (0018,9302) is other than CONSTANT_ANGLE.
>Single Collimation Width	(0018,9306)	1	The width of a single row of acquired data (in mm). Note: Adjacent physical detector rows may have been combined to form a single effective acquisition row.
>Total Collimation Width	(0018,9307)	1	The width of the total collimation (in mm) over the area of active x-ray detection. Note: This will be equal to the number of effective detector rows multiplied by single collimation width.
>Table Height	(0018,1130)	1	The distance in mm from the top of the patient table to the center of rotation of the source (i.e. the data collection center or isocenter). The distance is positive when the table is below the data collection center.
>Gantry/Detector Tilt	(0018,1120)	1	Nominal angle of tilt in degrees of the scanning gantry. Not intended for mathematical computations. Zero degrees means the gantry is not tilted, negative degrees are when the top of the gantry is tilted away from where the table enters the gantry.
>Table Speed	(0018,9309)	1	The distance in mm that the table moves in one second during the gathering of data.
>Table Feed per Rotation	(0018,9310)	1	Motion of the table (in mm) during a complete revolution of the source around the gantry orbit.

>Spiral Pitch Factor	(0018,9311)	1	Ratio of the Table Feed per Rotation (0018,9310) to the Total Collimation Width (0018,9307).
>CTDIvol	(0018,9345)	1C	Computed Tomography Dose Index (CTDI$_{vol)}$, in mGy according to IEC 60601-2-44, Ed.2.1 (Clause 29.1.103.4), The Volume CTDI$_{vol}$. It describes the average CTDIvol for this Acquisition Protocol Element for the selected CT conditions of operation. Required if Acquisition Type (0018,9302) is not CONSTANT_ANGLE. May be present otherwise.
>CTDI Phantom Type Code Sequence	(0018,9346)	1C	The type of phantom used for CTDI measurement according to IEC 60601-2-44. Required if CTDIvol (0018,9345) is present. Only a single Item shall be included in this Sequence.
>>*Include Code Sequence Macro Table 8.8-1*			*Defined CID 4052 "Phantom Devices".*
>CTDIvol Notification Trigger	(0018,9942)	3	The threshold for the CTDIvol value, in mGy, at which a dose notification is triggered for this Acquisition Protocol Element. See C.34.10.2
>DLP Notification Trigger	(0018,9943)	3	The threshold for the DLP value, in mGy.cm, at which a dose notification is triggered for this Acquisition Protocol Element. See C.34.10.2
>Acquisition Motion	(0018,9930)	1	Motion of scan progression. See C.34.10.1 Defined Terms: SINGLE – scan progresses in a single pass from Acquisition Start Location to Acquisition End Location SHUTTLE – scan progresses from Acquisition Start Location to Acquisition End Location, then reverses direction and scans back to Acquisition Start Location. NO_MOTION – all slices are acquired simultaneously NOT_IMPORTANT – scan either direction is acceptable The value of NOT_IMPORTANT is not permitted in the Performed Procedure Protocol IOD.

>Acquisition Start Location Sequence	(0018,9931)	3	Anatomically oriented transverse location where this acquisition starts. Notes: 1. This represents the nominal start location. Due to overscan, tissue may be irradiated beyond this location. 2. In a Defined Procedure Protocol, this represents the intended start location. The operator may or may not select a location that exactly matches this anatomical location. 3. In a Performed Procedure Protocol, this value may have been copied from the Defined Procedure Protocol and may not represent the exact anatomical location selected by the operator. Only a single item is permitted in the sequence.
>>Include 'Reference Location Macro' Table 10.27-1			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*
>Acquisition End Location Sequence	(0018,9932)	3	Anatomically oriented transverse location where this acquisition ends. Notes: 1. This represents the nominal end location. Due to overscan, tissue may be irradiated beyond this location. 2. In a Defined Procedure Protocol, this represents the intended end location. The operator may or may not select a location that exactly matches this anatomical location. 3. In a Performed Procedure Protocol, this value may have been copied from the Defined Procedure Protocol and may not represent the exact anatomical location selected by the operator. Only a single item is permitted in the sequence.
>>Include 'Reference Location Macro' Table 10.27-1			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*
>CT X-Ray Details Sequence	(0018,9325)	1	Parameter values for each of the X-Ray beams in the Acquisition Protocol Element. Each item in the sequence describes one X-Ray beam. See C.34.10.3 One or more Items shall be included in this sequence.
>>Beam Number	(300A,00C0)	1	Identification number of the beam.
>>KVP	(0018,0060)	1	Peak kilo voltage output of the x-ray generator.
>>Exposure Time in ms	(0018,9328)	1	Duration of exposure for this Acquisition Protocol Element in milliseconds. If Acquisition Type (0018,9302) equals SPIRAL the duration of exposure shall be weighted by the Spiral Pitch Factor (0018,9311).

>>X-Ray Tube Current in mA	(0018,9330)	1	Nominal X-ray tube current in milliamperes.
>>Exposure in mAs	(0018,9332)	1	The exposure expressed in milliampere seconds, for example calculated from exposure time and X-Ray tube current.
>>Auto KVP Selection Type	(0018,9944)	1	The type of automated selection of the kVp value. Defined Terms: NONE – Value is not selected automatically. CNR_BASED – Value is selected based on Contrast to Noise Ratio. DIAMETER_BASED – Value is selected based on patient diameter.
>>Auto KVP Upper Bound	(0018,9945)	3	Upper limit on the value of the auto-selected kVp. Note: Constraints on KVP (0018,0060) represent constraints on the nominal KVP for the scan. Auto KVP Upper Bound (0018,9945) represents a direct constraint on the range of values that may be produced by the automated selection of the kVp value.
>>Auto KVP Lower Bound	(0018,9946)	3	Lower limit on the value of the auto-selected kVp. Note: Constraints on KVP (0018,0060) represent constraints on the nominal KVP for the scan. Auto KVP Lower Bound (0018,9946) represents a direct constraint on the range of values that may be produced by the automated selection of the kVp value.
>>Exposure Modulation Type	(0018,9323)	1	A multivalued label describing the type of current modulation used for the purpose of limiting the dose. Defined Terms: NONE ANGULAR = current is modulated over different tube angles LONGITUDINAL = current is modulated along the axis of the table ECG_BASED = current is modulated based on the cardiac phase ORGAN_BASED = current is modulated based on the organs in the field of view
>>Focal Spot(s)	(0018,1190)	1	Used nominal size of the focal spot in mm. The Attribute may only have one or two values, for devices with variable focal spot, small dimension followed by large dimension.

>>Data Collection Diameter	(0018,0090)	1	The diameter in mm of the region over which data were collected. See C.8.15.3.6.1. Note: In the case of an Acquisition Type (0018,9302) of CONSTANT_ANGLE, the diameter is that in a plane normal to the central ray of the diverging X-ray beam as it passes through the data collection center.

>>Filter Type	(0018,1160)	1	Type of filter(s) inserted into the X-Ray beam.
			Defined Terms:
			    NONE
			    WEDGE
			    BUTTERFLY
			    STRIP
			    MULTIPLE
			    BOWTIE
			
			Note: Multiple filters can be expressed by a combination of terms, e.g., BUTTERFLY+WEDGE.…

>>Cardiac Synchronization Technique	(0018,9037)	1	Cardiac synchronization technique applied during acquisition or processing.
			Enumerated Values:
			    NONE
			    REALTIME
			    PROSPECTIVE
			    RETROSPECTIVE
			    PACED
			
			See C.7.6.18.1

>>Cardiac Signal Source	(0018,9085)	1C	Source of cardiac synchronization signal.
			Defined Terms:
			    ECG = electrocardiogram
			    VCG = vector cardiogram
			    PP = peripheral pulse
			
			Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE.

>>Cardiac RR Interval Specified	(0018,9070)	1C	R-R interval in ms measured prior to or during the scan. Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE.

>>Cardiac Beat Rejection Technique	(0018,9169)	1C	Cardiac arrhythmia rejection technique. Defined Terms: NONE RR_INTERVAL = rejection based on deviation from average RR interval QRS_LOOP = rejection based on deviation from regular QRS loop PVC = rejection based on PVC criteria Required if Cardiac Synchronization Technique (0018,9037) equals PROSPECTIVE or RETROSPECTIVE.
>>Low R-R Value	(0018,1081)	2C	R-R interval low limit for beat rejection, in ms. Required if Cardiac Synchronization Technique (0018,9037) equals PROSPECTIVE or RETROSPECTIVE.
>>High R-R Value	(0018,1082)	2C	R-R interval high limit for beat rejection, in ms. Required if Cardiac Synchronization Technique (0018,9037) equals PROSPECTIVE or RETROSPECTIVE.
>>Skip Beats	(0018,1086)	3	Number of beats prescribed to be skipped after each detected arrhythmia.
>>Cardiac Framing Type	(0018,1064)	1C	Type of framing performed. See C.7.6.18.1.1.1 for description and Defined Terms. Required if type of framing is not time forward from trigger, may be present otherwise.
>>Respiratory Motion Compensation Technique	(0018,9170)	1	Technique to reduce respiratory motion artifacts. Defined Terms: NONE BREATH_HOLD REALTIME GATING TRACKING RETROSPECTIVE CORRECTION See C.7.6.18.2
>>Respiratory Signal Source	(0018,9171)	1C	Signal source from which respiratory motion is derived. Defined Terms: NONE BELT NASAL_PROBE CO2_SENSOR ECG Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE or BREATH_HOLD. May be present otherwise.

>>Respiratory Trigger Delay Threshold	(0020,9256)	1C	Respiratory trigger threshold in percent of the chest expansion for the frame relative to the last Respiratory-Peak. See C.7.6.16.2.17.1 for further explanation. Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE, REALTIME or BREATH_HOLD. May be present otherwise.

>>Respiratory Trigger Type	(0020,9250)	1C	Characteristic of the respiratory signal used to the define the respiratory triggering.
			Defined Terms:
			    TIME
			    AMPLITUDE
			    BOTH
			Required if the value is not TIME. May be present otherwise.

>Requested Series Description	(0018,9937)	3	Requested text to copy into the Series Description (0008,103E) of raw instances resulting from this Acquisition Protocol Element.
>Content Qualification	(0018,9004)	3	Content Qualification Indicator of instances resulting from this Acquisition Protocol Element. Enumerated Values: PRODUCT RESEARCH SERVICE See C.34.12.1

726

C.34.10.1   Acquisition Motion

728 The motion, in patient terms, during acquisition progression. For example, due to the direction of contrast propogation or the need to manage equipment connected to the patient, it may be helpful to specify the
730 acquisition progress in the expected direction of contrast propogation.

A scan that shuttles back and forth can be encoded as multiple elements and each specifies the Start
732 Location and the End Location. Alternatively, a scanner may provide the ability to shuttle in a single scan element, in which case this value indicates the initial direction of motion and further details about the
734 shuttling are likely contained in private Attributes.

C.34.10.2   Dose Notification Triggers

736 The Computed Tomography Dose Check Standard (NEMA XR-25 at http://www.nema.org/stds/xr25.cfm) specifies that a Notification Value may be set for the Computed Tomography Dose Index (CTDIvol) and/or
738 the Dose Length Product (DLP) of each Protocol Element. A Dose Check Protocol Element corresponds to an Acquisition Protocol Element in this IOD.

740 ### C.34.10.3   CT X-Ray Details Sequence

Some systems perform Acquisition Protocol Elements with multiple tubes operating simultaneously, or with
742 a tube switching back and forth between two energy settings. Such acquisitions are encoded with multiple items in this sequence.

744

C.34.11 Defined CT Reconstruction

746 Table C.34.11-1 contains specification of acceptable values and ranges of reconstruction parameters for an imaging procedure.

748

Table C.34.11-1
DEFINED CT RECONSTRUCTION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Reconstruction Protocol Element Specification Sequence	(0018,9933)	1	Specification of the parameters for reconstruction of the acquired data of an imaging procedure. There shall be one item in this sequence for each reconstruction protocol element in the Protocol. See C.34.11.1. One or more Items shall be included in this Sequence.
>Protocol Element Number	(0018,9921)	1	The Protocol Element Number of the Reconstruction Protocol Element being specified in this item.
>Parameters Specification Sequence	(0018,9913)	3	Constraints on reconstruction parameters. One or more Items are permitted in this Sequence.
>>*Include 'Attribute Value Constraint Macro' Table 10.25-1*			Only Attributes defined in Table C.34.12-1 (i.e. in the Reconstruction Protocol Element Sequence (0018,9934) in the Performed CT Reconstruction Module) and private Data Elements associated with this reconstruction protocol element may be specified as Selector Attributes. The semantics of values of Constraint Violation Significance (0082,0036) in the macro are assigned in C.34.9.3. The same Attribute shall not appear in more than one item in the sequence with the same values for Selector Sequence Pointer (0072,0052) and Selector Sequence Pointer Items (0074,1057).

>>Modifiable Constraint Flag	(0082,0038)	1C	Whether this constraint may be encoded in a derived instance with a different value. See C.34.9.4.
			
			Required if the constraint may not be modified, may be present otherwise.
			
			Enumerated Values:
			
			   YES – the constraint may be modified.
			
			   NO – the constraint may not be modified.

750

Attributes that might commonly be specified here include:

752   • Reconstruction Algorithm (0018,9315)

          • Convolution Kernel (0018,1210)

754   • Reconstruction Diameter (0018,1100)

          • Slice Thickness (0018,0050)

756   • Pixel Spacing (0028,0030)

758 **C.34.11.1   Reconstruction Protocol Elements**

A CT Protocol frequently specifies multiple reconstructions. For example, a single helical Acquisition
760 Protocol Element may be reconstructed once as thin slices and a second time as thick slices.

C.34.12   Performed CT Reconstruction

762 This Module contains reconstruction parameter values for a performed CT imaging procedure.

This Module contains Attributes that affect machine behavior but not those that are merely descriptive. The
764 latter may be found in the reconstructed images.

Table C.34.12-1
766   **PERFORMED CT RECONSTRUCTION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Reconstruction Protocol Element Sequence	(0018,9934)	1	Parameter values for each reconstruction protocol element in the Protocol. See C.34.11.1. Elements are performed in the order of their Protocol Element Number (0018,9921). One or more Items shall be included in this Sequence.
>Include Protocol Element Identification Macro Table 10.28-1			
>Source Acquisition Protocol Element Number	(0018,9938)	1	A value corresponding to the Protocol Element Number (0018,9921) of the Acquisition Protocol Element from this Protocol being reconstructed in this reconstruction protocol element. This may be multivalued if multiple acquisitions are combined in a single reconstruction protocol element.
>Source Acquisition Beam Number	(0018,9939)	1	One or more values corresponding to the Beam Number (300A,00C0) in the Acquisition Protocol Element (specified in Source Acquisition Protocol Element Number (0018,9938)) from which data was used in this reconstruction protocol element.

>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if the referenced acquisition protocol element is not in this instance. Shall have a value of 1.2.840.10008.5.1.4.1.1.200.2 (CT Performed Procedure Protocol Storage).
>Referenced SOP Instance UID	(0008,1155)	1C	The UID of the instance containing the acquisition protocol element referenced in Source Acquisition Protocol Element Number (0018,9938). Required if the referenced acquisition protocol element is not in this instance.
>Reconstruction Start Location Sequence	(0018,993B)	1	Anatomically oriented transverse location where this reconstruction starts. Notes: 1. This represents the start of the data used in the reconstruction, not necessarily the slice location of the first reconstructed slice. 2. This represents the intended start location. The operator may or may not have selected a location that exactly matches this anatomical location. 3. In the case where an anatomical reference basis cannot be determined or derived from the Defined Protocol instance, for example when an ad hoc reconstruction is being performed, the implementation may use the acquired volume (128160, DCM, "Acquired Volume") as the reference basis with an appropriate offset. Only a single item is permitted in the sequence.
>>*Include 'Reference Location Macro' Table 10.27-1*			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*

>Reconstruction End Location Sequence	(0018,993C)	1	Anatomically oriented transverse location where this reconstruction ends. Notes: 1. This represents the end of the data used in the reconstruction, not necessarily the slice location of the last reconstructed slice. 2. This represents the intended end location. The operator may or may not have selected a location that exactly matches this anatomical location. 3. In the case where an anatomical reference basis cannot be determined or borrowed from the Defined Protocol instance, for example when an ad hoc reconstruction is being performed, the implementation may use the acquired volume (128160, DCM, "Acquired Volume") as the reference basis with an appropriate offset. Only a single item is permitted in the sequence.
>>Include 'Reference Location Macro' Table 10.27-1			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*
>Reconstruction Algorithm Sequence	(0018,993D)	3	Algorithm used in this reconstruction protocol element. Only a single item is permitted in the sequence.
>>Include Table 10-19 "Algorithm Identification Macro Attributes"			*Baseline CID is CID 10033 "CT Reconstruction Algorithm" for Algorithm Family Code Sequence (0066,002F)*
>Convolution Kernel	(0018,1210)	1	A label describing the convolution kernel or algorithm used to reconstruct the data. A single value shall be present.

>Convolution Kernel Group	(0018,9316)	1	A label describing the group that the Convolution Kernel (0018,1210) belongs. Defined Terms: BRAIN SOFT_TISSUE LUNG BONE CONSTANT_ANGLE
>Reconstruction Diameter	(0018,1100)	1C	The diameter in mm of the region from which data were used in creating the reconstruction of the image. Data may exist outside this region and portions of the patient may exist outside this region. See C.8.15.3.6.1. Required if Reconstruction Field of View (0018,9317) is not present.
>Reconstruction Field of View	(0018,9317)	1C	The field of view width (x-dimension) followed by height (y-dimension) as used for reconstruction in mm. Required if Reconstruction Diameter (0018,1100) is not present.
>Reconstruction Target Center (Patient)	(0018,9318)	3	The x, y, and z coordinates (in the patient coordinate system) of the reconstruction center target point as used for reconstruction in mm. See C.8.15.3.6.1. Note: If the reconstructed image is not magnified or panned the value corresponds with the Data Collection Center (0018,9313) Attribute.
>Reconstruction Target Center Location Sequence	(0018,993E)	3	An anatomically based description of a point in the patient used as the reconstruction center target point. Note: This represents the intended reconstruction center location. They operator may or may not select a location that exactly matches this anatomical location.
>>Include 'Reference Location Macro' Table 10.27-1			*Baseline CID is CID 1000 "CT Transverse Plane Reference Basis" for Reference Basis Code Sequence (0018,9902)* *Baseline CID is CID 1010 "Reference Geometry - Planes" for Reference Geometry Code Sequence (0018,9903)*

>Reconstruction Pixel Spacing	(0018,9322)	1	Physical distance in the patient between the center of each reconstructed pixel, specified by a numeric pair – adjacent row spacing (delimiter) adjacent column spacing in mm. See 10.7.1.3 for further explanation of the value order.
>Rows	(0028,0010)	1	Number of rows in the reconstructed image.
>Columns	(0028,0011)	1	Number of columns in the reconstructed image.
>Reconstruction Angle	(0018,9319)	1	Angle (in degrees) over which the data from which the frame was reconstructed was collected.
>Image Filter	(0018,9320)	3	A label describing the filter applied to the reconstructed image after the original reconstruction has been completed.
>Image Filter Description	(0018,9941)	3	A description of the nature or effect of the Image Filter (0018,9320). E.g., sharpening, noise removing, edge enhancing.
>Derivation Code Sequence	(0008,9215)	3	Additional processing applied to the reconstructed image after image filter (if any)
>>Include Code Sequence Macro Table 8.8-1			
>Slice Thickness	(0018,0050)	1	Nominal reconstructed slice thickness, in mm.
>Spacing Between Slices	(0018,0088)	1	Spacing between slices, in mm. The spacing is measured from the center-to-center of each slice. Note: Slice overlap may be constrained implicitly by constraining the Slice Thickness (0018,0050) and Spacing Between Slices (0018,0088). However, since each constraint is considered independently, the overlap may be any value resulting from the combination of allowable values for thickness and spacing.
>Window Center	(0028,1050)	3	Preferred value for Window Center (0028,1050) in the image instances produced by this reconstruction protocol element.
>Window Width	(0028,1051)	3	Preferred value for Window Width (0028,1051) in the image instances produced by this reconstruction protocol element.

>Requested Series Description	(0018,9937)	3	Requested text to copy into the Series Description (0008,103E) of the images resulting from this reconstruction protocol element.
>Content Qualification	(0018,9004)	3	Content Qualification Indicator of instances resulting from this Reconstruction Protocol Element. Enumerated Values: PRODUCT RESEARCH SERVICE See C.34.12.1

768 **C.34.12.1   Content Qualification**

Content Qualification (0018,9004), if present, specifies the value to be copied into reconstructed instances.
770 For details on the meaning of this attribute in those instances, see section C.8.13.2.1.1.

This attribute does not describe the content qualification of the protocol itself.

772

C.34.13   Defined Storage

774 Table C.34.13-1 contains specification of acceptable values and ranges of storage parameters for an imaging procedure. Storage protocol elements may be used to automatically send the output of particular
776 protocol elements to particular destinations.   For example, a lung protocol might send thick images to PACS for reading and thin images to a CAD workstation for detection of nodules; a cardiac protocol might
778 send an image set to a clinical analysis workstation; and a protocol used for pre-operative hip replacement planning might send images to the orthopedics department.

780 **Table C.34.13-1**
DEFINED STORAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Storage Protocol Element Specification Sequence	(0018,9935)	1	Specification of the parameters for storage of imaging data. There shall be one item in this sequence for each Storage Protocol Element. See C.34.13.1. One or more Items shall be included in this Sequence.
>Protocol Element Number	(0018,9921)	1	The Protocol Element Number of the Storage Protocol Element being specified in this item.
>Parameters Specification Sequence	(0018,9913)	3	Constraints on storage parameters. One or more Items are permitted in this Sequence.

>>*Include 'Attribute Value Constraint Macro' Table 10.25-1*			Only Attributes defined in Table C.34.14-1 (i.e. in the Storage Protocol Element Sequence (0018,9936) in the Performed Storage Module) and private Data Elements associated with this storage protocol element may be specified as Selector Attributes. The semantics of values of Constraint Violation Significance (0082,0036) in the macro are assigned in C.34.9.3. The same Attribute shall not appear in more than one item in the sequence with the same values for Selector Sequence Pointer (0072,0052) and Selector Sequence Pointer Items (0074,1057).

>>Modifiable Constraint Flag	(0082,0038)	1C	Whether this constraint may be encoded in a derived instance with a different value. See C.34.9.4.
			Required if the constraint may not be modified, may be present otherwise.
			Enumerated Values:
			    YES – the constraint may be modified.
			    NO – the constraint may not be modified.

782

Attributes that might be specified here include:

784   • Source Reconstruction Protocol Element Number (0018,993A) of reconstructed slices that will be saved

786   • Source Acquisition Protocol Element Number (0018,9938) if raw data is to be stored

    • Destination AE (2100,0140) where the images will be stored

788   •

790 **C.34.13.1   Storage Protocol Elements**

A CT Protocol frequently specifies multiple storage protocol elements. For example, thin slices may be
792 sent to a 3D workstation, while raw data is stored on a local cache and thick slices are stored to PACS for reading.

794 **C.34.14   Performed Storage**

This Module contains storage parameter values for a performed imaging procedure.

796   **Table C.34.14-1**
                    PERFORMED STORAGE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Storage Protocol Element Sequence	(0018,9936)	1	Parameter values for each storage protocol element in the Protocol. The output instances of the referenced Acquisition or Reconstruction Protocol Elements are stored to the location specified in the Output Information Sequence. See C.34.13.1 One or more Items shall be included in this Sequence. The performing system might not support the requested storage protocol or not be configured for the desired destination. Note: Whether to report failure of one or more of the storage protocol elements as a failure of the protocol is at the discretion of the performing system. The performing system may, additionally or as a fallback, be configured to store output objects to a default destination or retain them locally.
>Include Protocol Element Identification Macro Table 10.28-1			
>Source Acquisition Protocol Element Number	(0018,9938)	1C	A value corresponding to the Element Number (0018,9921) of the Acquisition Protocol Element for which data is stored. Note: Source Acquisition Protocol Element references are for storage of raw acquisition data. Reconstructed slice storage involves reference to the corresponding Reconstruction Protocol Element in the Source Reconstruction Procotol Element Number (0018,993A). This may be multivalued if multiple acquisition protocol element data are being stored together. Required if Source Reconstruction Protocol Element Number (0018,993A) is not present.
>Source Reconstruction Protocol Element Number	(0018,993A)	1C	The Element Number (0018,9921) corresponding to the Reconstruction Protocol Element for which data is stored. This may be multivalued if multiple reconstruction protocol element data are being stored together. Required if Source Acquisition Protocol Element Number (0018,9938) is not present.

>Source Acquisition Beam Number	(0018,9939)	1C	The Beam Number (300A,00C0) in the Acquisition Protocol Element (specified in Source Acquisition Protocol Element Number (0018,9938)) for which data is stored. Multiple values may be specified if data for multiple beams is being stored. Required if SOP Class UID (0008,0016) has a value of 1.2.840.10008.5.1.4.1.1.200.2 (CT Performed Procedure Protocol Storage) and Source Acquisition Protocol Element Number (0018,9938) is present and only some of the beams in the Acquisition Protocol Element are to be stored.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if the referenced acquisition or processing element is not in this instance. Enumerated Value: 1.2.840.10008.5.1.4.1.1.200.2 (CT Performed Procedure Protocol Storage).
>Referenced SOP Instance UID	(0008,1155)	1C	The UID of the Protocol instance containing the element referenced in Source Processing Element Number (0018,993A) or Source Acquisition Protocol Element Number (0018,9938). Required if the referenced acquisition protocol element is not in this instance.
>Output Information Sequence	(0040,4033)	1	References to acquired and reconstructed data objects stored as part of this storage protocol element. One or more Items shall be included in this Sequence. Note: It is expected that the storage destinations for Radiation Dose SR instances and Performed Protocol objects will be managed by direct configuration of the acquisition device rather than using this sequence on a protocol by protocol basis.
>>*Include Table 10-3c "Storage Macro Attributes"*			

798

800

Changes to NEMA Standards Publication PS 3.4

802 # Digital Imaging and Communications in Medicine (DICOM)

Part 4: Service Class Specifications

804

Add SOP Classes to Table B.5-1

806 **B.5   STANDARD SOP CLASSES**

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

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
…		
CT Performed Procedure Protocol Storage	1.2.840.10008.5.1.4.1.1.200.2	**CT Performed Procedure Protocol IOD**
…		

810 ***Add new section to describe SCP requirements for CT Performed Procedure Protocol Storage***

B.5.1.21 CT Performed Procedure Protocol Storage SOP Class

812 The CT Performed Procedure Protocol Storage SOP Class encodes the acquisition and reconstruction protocol parameter values used during a specific performed CT procedure and related details.

814 For a device that is both a SCU and a SCP of the CT Performed Procedure Protocol Storage SOP Class, in addition to the behavior for the Storage Service Class specified in Section B.2.2, the following additional

816 requirements are specified for CT Performed Procedure Protocol Storage SOP Classes:

- A SCP of this SOP Class shall support Level 2 Conformance as defined in Section B.4.1.

818   Note: This requirement means that all Type 1, Type 2, and Type 3 Attributes defined in the Information Object Definition and Private Attributes associated with the SOP Class will be stored and may be accessed.

820

Add Defined Protocol SOP to GG.3

822 # GG.3 SOP Classes

The application-level services addressed by the Non-Patient Object Storage Service Class definition are
824 specified in the SOP Classes specified in Table GG.3-1.

Table GG.3-1. Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification (defined in PS3.3)
Hanging Protocol Storage	1.2.840.10008.5.1.4.38.1	Hanging Protocol IOD
Color Palette Storage	1.2.840.10008.5.1.4.39.1	Color Palette Storage IOD
Generic Implant Template Storage	1.2.840.10008.5.1.4.43.1	Generic Implant Template IOD
Implant Assembly Template Storage	1.2.840.10008.5.1.4.44.1	Implant Assembly Template IOD
Implant Template Group Storage	1.2.840.10008.5.1.4.45.1	Implant Template Group IOD
CT Defined Procedure Protocol Storage	**1.2.840.10008.5.1.4.1.1.200.1**	**CT Defined Procedure Protocol IOD**

826

Add GG.6.4 with SOP-specific details

---

828 **GG.6.4 CT Defined Procedure Protocol Storage SOP Class**

An implementation that conforms to the CT Defined Procedure Protocol Storage SOP Class as an SCP
830 shall not modify constraints for which the value of the Modifiable Constraint Flag (0082,0038) is NO.

Modifying protocol constraints changes the semantics of a CT Defined Procedure Protocol Storage SOP
832 Instance.

834

Add a new annex for Defined Procedure Protocol Query/Retrieve Service Class (since Defined is
836 *not in the patient hierarchy, and we have to describe SCP requirements for CT Defined Protocol*
Query/Retrieve)

---

838 **HH Defined Procedure Protocol Query/Retrieve Service Classes**

HH.1 OVERVIEW

840 **HH.1.1 Scope**

The Defined Procedure Protocol Query/Retrieve Service Classes define application-level classes-of-service that
842 facilitate access to Defined Procedure Protocol composite objects.

844 **HH.1.2 Conventions**

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

Note

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

852 Matching Key Attributes may be of Type "required" (R) or "optional" (O). Return Key Attributes may be of Type 1, 1C,
     2, 2C, 3 as defined in PS3.5.

854

HH.1.3 Query/Retrieve Information Model

856 In order to serve as an SCP of the Defined Procedure Protocol Query/Retrieve Service Class, a DICOM AE possesses
     information about the Attributes of a number of Defined Procedure Protocol composite SOP Instances. The information
858 is organized into an Information Model. The Information Models for the different SOP Classes specified in this Annex
     are defined in Section HH.6.

860

HH.1.4 Service Definition

862 Two peer DICOM AEs implement a SOP Class of a Defined Procedure Protocol Query/Retrieve Service Class with
     one serving in the SCU role and one serving in the SCP role. SOP Classes of the Defined Procedure Protocol
864 Query/Retrieve Service Classes are implemented using the DIMSE-C C-FIND, C-MOVE and C-GET services as
     defined in PS3.7.

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

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

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

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

874 ## HH.2 DEFINED PROCEDURE PROTOCOL INFORMATION MODELS DEFINITIONS

     The Defined Procedure Protocol Information Models are identified by the SOP Class negotiated at Association
876 establishment time. Each SOP Class is composed of both an Information Model and a DIMSE-C Service Group.

     The Defined Procedure Protocol Information Models are defined in Section HH.6, with the Entity-Relationship Model
878 Definition and Key Attributes Definition analogous to those defined in the Worklist Information Model Definition of the
     Basic Worklist Management Service.

880

HH.3 DEFINED PROCEDURE PROTOCOL INFORMATION MODELS

882 The Defined Procedure Protocol Information Models are based upon a one level entity:

     • Defined Procedure Protocol object instance.

884 The Defined Procedure Protocol object instance contains Attributes associated with the Procedure Protocol IE of the
     Composite IODs as defined in PS3.3.

886

HH.4 DIMSE-C SERVICE GROUPS

888 ### HH.4.1 C-FIND Operation

     See the C-FIND Operation definition for the Basic Worklist Management Service Class (K.4.1), and substitute "
890 Defined Procedure Protocol " for "Worklist". The "Worklist" Search Method shall be used.

892 The SOP Class UID identifies the Defined Procedure Protocol Information Model against which the C-FIND is to be performed. The Key Attributes and values allowable for the query are defined in the SOP Class definitions for the Defined Procedure Protocol Information Model.

894

HH.4.1.1 Service Class User Behavior

896 No SOP Class specific SCU behavior is defined.

898 ### HH.4.1.2 Service Class Provider Behavior

No SOP Class specific SCP behavior is defined.

900

HH.4.2 C-MOVE Operation

902 See the C-MOVE Operation definition for the Query/Retrieve Service Class (C.4.2). No Extended Behavior or Relational-Retrieve is defined for the Defined Procedure Protocol Query/Retrieve Service Classes.

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

Note

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

910 ### HH.4.3 C-GET Operation

See the C-GET Operation definition for the Query/Retrieve Service Class (C.4.2). No Extended Behavior or Relational-
912 Retrieve is defined for the Defined Procedure Protocol Query/Retrieve Service Classes.

Note

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

916 ### HH.5 ASSOCIATION NEGOTIATION

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

918

HH.6 SOP CLASS DEFINITIONS

920 ### HH.6.1 Defined Procedure Protocol Information Model

HH.6.1.1 E/R Models

922 The Defined Procedure Protocol Information Model consists of a single entity. In response to a given C-FIND request, the SCP shall send one C-FIND response per matching Defined Procedure Protocol Instance.

924

926 **Figure HH.6-1. Defined Procedure Protocol Information Model E/R Diagram**

928 **HH.6.1.2 Defined Procedure Protocol Attributes**

Table HH.6-1 defines the Attributes of the Defined Procedure Protocol Information Model:

930 **Table HH.6-1. Attributes for the Defined Procedure Protocol Information Model**

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Matching Type
SOP Common				
Specific Character Set	(0008,0005)	-	1C	This Attribute is required if expanded or replacement character sets are used. See Section C.2.2.2 and Section C.4.1.1.
SOP Class UID	(0008,0016)	R	1	
SOP Instance UID	(0008,0018)	U	1	
Protocol Context				
Custodial Organization Sequence	(0040,A07C)	R	2	
>Institution Name	(0008,0080)	R	2	
>Institution Code Sequence	(0008,0082)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>>Code Meaning	(0008,0104)	-	1	
Responsible Group Code Sequence	(0008,0220)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Protocol Name	(0018,1030)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Potential Scheduled Protocol Code Sequence	(0018,9906)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Matching Type
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Potential Requested Procedure Code Sequence	(0018,9907)	R	1	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Potential Reasons for Procedure	(0018,9908)	-	2	
Potential Reasons for Procedure Code Sequence	(0018,9909)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	
Potential Diagnostic Tasks	(0018,990A)	-	2	
Predecessor Protocol Sequence	(0018,990E)	R	2	
>Referenced SOP Class UID	(0008,1150)	R	1	Shall be retrieved with List of UID Matching.
>Referenced SOP Instance UID	(0008,1155)	R	1	Shall be retrieved with List of UID Matching.
Content Creator's Name	(0070,0084)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Instance Creation Date	(0008,0012)	R	1	Shall be retrieved with Single Value or Range Matching. See Instance Creation Time for further details.
Instance Creation Time	(0008,0013)	R	1	Shall be retrieved with Single Value or Range Matching.

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Matching Type
				If both Instance Creation Date and Instance Creation Time are specified for Range Matching, they are to be treated as as if they were a single DateTime Attribute e.g.,the date range July 5 to July 7 and the time range 10am to 6pm specifies the time period starting on July 5, 10am until July 7, 6pm.
Clinical Trial Context				
Clinical Trial Sponsor Name	(0012,0010)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Clinical Trial Protocol ID	(0012,0020)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Equipment Specification				
Equipment Modality	(0008,0221)	R	1	
Model Specification Sequence	(0018,9912)	R	2	
Manufacturer	(0008,0070)	R	1	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Manufacturer's Related Model Group	(0008,0222)	R	2	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Manufacturer's Model Name	(0008,1090)	R	2	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
Software Versions	(0018,1020)	R	2	Shall be retrieved with Single Value, Wild Card, or Universal Matching.
>Device Serial Number	(0018,1000)	-	2	
Patient Positioning				
Anatomic Region Sequence	(0008,2218)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	

Description / Module	Tag	Matching Key Type	Return Key Type	Remark / Matching Type
Primary Anatomic Structure Sequence	(0008,2228)	R	2	This Attribute shall be retrieved with Sequence or Universal matching.
>Code Value	(0008,0100)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Coding Scheme Designator	(0008,0102)	R	1	This Attribute shall be retrieved with Single Value or Universal matching.
>Code Meaning	(0008,0104)	-	1	

932

HH.6.1.3 Conformance Requirements

934 An implementation may conform to one or more of the Defined Procedure Protocol Query/Retrieve SOP Classes as an SCU or SCP. The Conformance Statement shall be in the format defined in PS3.2.

936 **HH.6.1.3.1 SCU Conformance**

HH.6.1.3.1.1 C-FIND SCU Conformance

938 An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class shall support queries against the Defined Procedure Protocol Information Model using the C-FIND SCU
940 Behavior described for the Basic Worklist Management Service Class (see Section K.4.1.2 and Section HH.4.1).

942 An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class as an SCU shall state in its Conformance Statement whether it requests Type 3 Return Key Attributes, and
944 shall list these Optional Return Key Attributes.

An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class
946 as an SCU shall state in its Conformance Statement how it makes use of Specific Character Set (0008,0005) when encoding queries and interpreting responses.

948 **HH.6.1.3.1.2 C-MOVE SCU Conformance**

An implementation that conforms to the Defined Procedure Protocol Information Model - MOVE SOP Class
950 as an SCU shall support transfers against the Defined Procedure Protocol Information Model, using the C-MOVE SCU baseline behavior described for the Query/Retrieve Service Class (see Section C.4.2.2.1 and
952 Section HH.4.2).

HH.6.1.3.1.3 C-GET SCU Conformance

954 An implementation that conforms to the Defined Procedure Protocol Information Model - GET SOP Class as an SCU shall support transfers against the Defined Procedure Protocol Information Model, using the C-
956 GET SCU baseline behavior described for the Query/Retrieve Service Class (see Section C.4.3.2).

HH.6.1.3.2 SCP Conformance

958 **HH.6.1.3.2.1 C-FIND SCP Conformance**

An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class
960 as an SCP shall support queries against the Defined Procedure Protocol Information Model, using the C-FIND SCP Behavior described for the Basic Worklist Management Service Class (see Section K.4.1.3).

962   Note: The contents of the Model Specification Sequence (0018,9912) would be useful to index for systems that
                    support query or selection of appropriate Protocols for specific systems.

964

An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class
966 as an SCP shall state in its Conformance Statement whether it supports Type 3 Return Key Attributes, and
shall list these Optional Return Key Attributes.

968 An implementation that conforms to the Defined Procedure Protocol Information Model - FIND SOP Class
as an SCP shall state in its Conformance Statement how it makes use of Specific Character Set
970 (0008,0005) when interpreting queries, performing matching and encoding responses.

HH.6.1.3.2.2 C-MOVE SCP Conformance

972 An implementation that conforms to the Defined Procedure Protocol Information Model - MOVE SOP Class
as an SCP shall support transfers against the Defined Procedure Protocol Information Model, using the C-
974 MOVE SCP baseline behavior described for the Query/Retrieve Service Class (see Section C.4.2.3.1).

         Note: It is expected that a device that does not match the contents of the Model Specification Sequence
976   (0018,9912) will not execute the Protocol.

978 An implementation that conforms to the Defined Procedure Protocol Information Model - MOVE SOP Class
as an SCP, which generates transfers using the C-MOVE operation, shall state in its Conformance
980 Statement appropriate Storage Service Class, under which it shall support the C-STORE sub-operations
generated by the C-MOVE.

HH.6.1.3.2.3 C-GET SCP Conformance

982

An implementation that conforms to the Defined Procedure Protocol Information Model - GET SOP Class
984 as an SCP shall support retrievals against the Defined Procedure Protocol Information Model using the C-
GET SCP baseline behavior described for the Query/Retrieve Service Class in Section C.4.3.3.

986

HH.6.1.4 SOP Classes

988 The SOP Classes of the Defined Procedure Protocol Query/Retrieve Service Class identify the Information
Models, and the DIMSE-C operations supported.

990   **Table HH.6.1.4-1. Defined Procedure Protocol SOP Classes**

SOP Class Name	SOP Class UID
Defined Procedure Protocol Information Model - FIND	1.2.840.10008.5.1.4.20.1
Defined Procedure Protocol Information Model - MOVE	1.2.840.10008.5.1.4.20.2
Defined Procedure Protocol Information Model - GET	1.2.840.10008.5.1.4.20.3

992

994

Changes to NEMA Standards Publication PS 3.6

996

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

998

Add the following rows to Section 6

Tag	Name	Keyword	VR	VM
(0008,0220)	Responsible Group Code Sequence	ResponsibleGroupCodeSequence	SQ	1
(0008,0221)	Equipment Modality	EquipmentModality	CS	1
(0008,0222)	Manufacturer's Related Model Group	ManufacturerRelatedModelGroup	LO	1
(0008,0308)	Private Data Element	PrivateDataElement	US	1
(0008,0309)	Private Data Element Value Multiplicity	PrivateDataElementValueMultiplicity	UL	1-3
(0008,030A)	Private Data Element Value Representation	PrivateDataElementValueRepresentation	CS	1
(0008,030B)	Private Data Element Number of Items	PrivateDataElementNumberOfItems	UL	1-2
(0008,030C)	Private Data Element Name	PrivateDataElementName	UC	1
(0008,030D)	Private Data Element Keyword	PrivateDataElementKeyword	UC	1
(0008,030E)	Private Data Element Description	PrivateDataElementDescription	UT	1
(0008,030F)	Private Data Element Encoding	PrivateDataElementEncoding	UT	1
(0008,0310)	Private Data Element Definition Sequence	PrivateDataElementDefinitionSequence	SQ	1
(0010,1022)	Patient's Body Mass Index	PatientBodyMassIndex	DS	1
(0010,1023)	Measured AP Dimension	MeasuredAPDimension	DS	1
(0010,1024)	Measured Lateral Dimension	MeasuredLateralDimension	DS	1
(0012,0086)	Ethics Committee Approval Effectiveness Start Date	EthicsCommitteeApprovalEffectivenessStartDate	DA	1
(0012,0087)	Ethics Committee Approval Effectiveness End Date	EthicsCommitteeApprovalEffectivenessEndDate	DA	1
(0018,9900)	Reference Location Label	ReferenceLocationLabel	LO	1
(0018,9901)	Reference Location Description	ReferenceLocationDescription	UT	1
(0018,9902)	Reference Basis Code Sequence	ReferenceBasisCodeSequence	SQ	1
(0018,9903)	Reference Geometry Code Sequence	ReferenceGeometryCodeSequence	SQ	1

Tag	Name	Keyword	VR	VM
(0018,9904)	Offset Distance	OffsetDistance	DS	1
(0018,9905)	Offset Direction	OffsetDirection	CS	1
(0018,9906)	Potential Scheduled Protocol Code Sequence	PotentialScheduledProtocolCodeSequence	SQ	1
(0018,9907)	Potential Requested Procedure Code Sequence	PotentialRequestedProcedureCodeSequence	SQ	1
(0018,9908)	Potential Reasons for Procedure	PotentialReasonsForProcedure	UC	1-n
(0018,9909)	Potential Reasons for Procedure Code Sequence	PotentialReasonsForProcedureCodeSequence	SQ	1
(0018,990A)	Potential Diagnostic Tasks	PotentialDiagnosticTasks	UC	1-n
(0018,990B)	Contraindications Code Sequence	ContraindicationsCodeSequence	SQ	1
(0018,990C)	Referenced Defined Protocol Sequence	ReferencedDefinedProtocolSequence	SQ	1
(0018,990D)	Referenced Performed Protocol Sequence	ReferencedPerformedProtocolSequence	SQ	1
(0018,990E)	Predecessor Protocol Sequence	PredecessorProtocolSequence	SQ	1
(0018,990F)	Protocol Planning Information	ProtocolPlanningInformation	UT	1
(0018,9910)	Protocol Design Rationale	ProtocolDesignRationale	UT	1
(0018,9911)	Patient Specification Sequence	PatientSpecificationSequence	SQ	1
(0018,9912)	Model Specification Sequence	ModelSpecificationSequence	SQ	1
(0018,9913)	Parameters Specification Sequence	ParametersSpecificationSequence	SQ	1
(0018,9914)	Instruction Sequence	InstructionSequence	SQ	1
(0018,9915)	Instruction Index	InstructionIndex	US	1
(0018,9916)	Instruction Text	InstructionText	LO	1
(0018,9917)	Instruction Description	InstructionDescription	UT	1
(0018,9918)	Instruction Performed Flag	InstructionPerformedFlag	CS	1
(0018,9919)	Instruction Performed DateTime	InstructionPerformedDateTime	DT	1
(0018,991A)	Instruction Performance Comment	InstructionPerformanceComment	UT	1
(0018,991B)	Patient Positioning Instruction Sequence	PatientPositioningInstructionSequence	SQ	1
(0018,991C)	Positioning Method Code Sequence	PositioningMethodCodeSequence	SQ	1
(0018,991D)	Positioning Landmark Sequence	PositioningLandmarkSequence	SQ	1
(0018,991E)	Target Frame of Reference UID	TargetFrameOfReferenceUID	UI	1
(0018,991F)	Acquisition Protocol Element Specification Sequence	AcquisitionProtocolElementSpecificationSequence	SQ	1
(0018,9920)	Acquisition Protocol Element Sequence	AcquisitionProtocolElementSequence	SQ	1
(0018,9921)	Protocol Element Number	ProtocolElementNumber	US	1
(0018,9922)	Protocol Element Name	ProtocolElementName	LO	1

Tag	Name	Keyword	VR	VM
(0018,9923)	Protocol Element Characteristics Summary	ProtocolElementCharacteristicsSummary	UT	1
(0018,9924)	Protocol Element Purpose	ProtocolElementPurpose	UT	1
(0018,9930)	Acquisition Motion	AcquisitionMotion	CS	1
(0018,9931)	Acquisition Start Location Sequence	AcquisitionStartLocationSequence	SQ	1
(0018,9932)	Acquisition End Location Sequence	AcquisitionEndLocationSequence	SQ	1
(0018,9933)	Reconstruction Protocol Element Specification Sequence	ReconstructionProtocolElementSpecificationSequence	SQ	1
(0018,9934)	Reconstruction Protocol Element Sequence	ReconstructionProtocolElementSequence	SQ	1
(0018,9935)	Storage Protocol Element Specification Sequence	StorageProtocolElementSpecificationSequence	SQ	1
(0018,9936)	Storage Protocol Element Sequence	StorageProtocolElementSequence	SQ	1
(0018,9937)	Requested Series Description	RequestedSeriesDescription	LO	1
(0018,9938)	Source Acquisition Protocol Element Number	SourceAcquisitionProtocolElementNumber	US	1-n
(0018,9939)	Source Acquisition Beam Number	SourceAcquisitionBeamNumber	US	1-n
(0018,993A)	Source Reconstruction Protocol Element Number	SourceReconstructionProtocolElementNumber	US	1-n
(0018,993B)	Reconstruction Start Location Sequence	ReconstructionStartLocationSequence	SQ	1
(0018,993C)	Reconstruction End Location Sequence	ReconstructionEndLocationSequence	SQ	1
(0018,993D)	Reconstruction Algorithm Sequence	ReconstructionAlgorithmSequence	SQ	1
(0018,993E)	Reconstruction Target Center Location Sequence	ReconstructionTargetCenterLocationSequence	SQ	1
(0018,9941)	Image Filter Description	ImageFilterDescription	UT	1
(0018,9942)	CTDIvol Notification Trigger	CTDIvolNotificationTrigger	FD	1
(0018,9943)	DLP Notification Trigger	DLPNotificationTrigger	FD	1
(0018,9944)	Auto KVP Selection Type	AutoKVPSelectionType	CS	1
(0018,9945)	Auto KVP Upper Bound	AutoKVPUpperBound	FD	1
(0018,9946)	Auto KVP Lower Bound	AutoKVPLowerBound	FD	1
(0018,9947)	Protocol Defined Patient Position	ProtocolDefinedPatientPosition	CS	1
(0082,0038)	Modifiable Constraint Flag	ModifiableConstraintFlag	CS	1

1000

Modify the following rows in Section 6

Tag	Name	Keyword	VR	VM
(0018,9323)	Exposure Modulation Type	ExposureModulationType	CS	1-**n**

- Standard -

Tag	Name	Keyword	VR	VM

1002 **Add the following rows to Table A-1**

**Table A-1
UID Values**

1004

UID Value	UID Name	UID Type	Part
…			
1.2.840.10008.5.1.4.1.1.200.1	**CT Defined Procedure Protocol Storage**	**SOP Class**	**PS 3.4**
1.2.840.10008.5.1.4.1.1.200.2	**CT Performed Procedure Protocol Storage**	**SOP Class**	**PS 3.4**
1.2.840.10008.5.1.4.20.1	**Defined Procedure Protocol Information Model - FIND**	**SOP Class**	**PS 3.4**
1.2.840.10008.5.1.4.20.2	**Defined Procedure Protocol Information Model - MOVE**	**SOP Class**	**PS 3.4**
1.2.840.10008.5.1.4.20.3	**Defined Procedure Protocol Information Model - GET**	**SOP Class**	**PS 3.4**
…			

1006 **Add the following rows to Table A-3**

**Table A-3
Context Group UID Values**

1008

Context UID	Context Identifier	Context Group Name
…		
1.2.840.10008.6.1.1121	**CID 1000**	**CT Transverse Plane Reference Basis**
1.2.840.10008.6.1.1122	**CID 1001**	**Anatomical Reference Basis**
1.2.840.10008.6.1.1123	**CID 1002**	**Anatomical Reference Basis - Head**
1.2.840.10008.6.1.1124	**CID 1003**	**Anatomical Reference Basis - Spine**
1.2.840.10008.6.1.1125	**CID 1004**	**Anatomical Reference Basis - Chest**
1.2.840.10008.6.1.1126	**CID 1005**	**Anatomical Reference Basis - Abdomen/Pelvis**
1.2.840.10008.6.1.1127	**CID 1006**	**Anatomical Reference Basis - Extremities**
1.2.840.10008.6.1.1128	**CID 1010**	**Reference Geometry - Planes**
1.2.840.10008.6.1.1129	**CID 1011**	**Reference Geometry - Points**
1.2.840.10008.6.1.1130	**CID 1015**	**Patient Alignment Methods**
1.2.840.10008.6.1.1131	**CID 1200**	**Contraindications for CT Imaging**
…		

1010

1012

Changes to NEMA Standards Publication PS 3.16

1014

Digital Imaging and Communications in Medicine (DICOM)

Part 16: Content Mapping Resource

1016

CID 1000   CT Transverse Plane Reference Basis

1018 The items in this context group provide the basis for defining transverse planes associated with the limits
of CT acquisitions and reconstructions. It includes body structures, morphologic abnormalities and physical
1020 objects that may be the subject or serve as points of reference for imaging.

Context ID 1000
1022   **CT Transverse Plane Reference Basis**
Type :   Extensible   Version :   20160905

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
Include CID 1001 "Anatomical Reference Basis"				
SRT	M-01000	Morphologically abnormal structure	49755003	C0332447
SRT	A-12000	Orthopedic device	16349000	C0029352
SRT	A-11100	Cardiac pacemaker	14106009	C0030163
SRT	A-04010	Implant, device	40388003	C0021102
SRT	A-25500	Stent, device	65818007	C0038257
DCM	128160	Acquired Volume		

1024

CID 1001   Anatomical Reference Basis

1026 The items in this context group are body structures commonly used as a reference basis for imaging.

Context ID 1001
1028   **Anatomical Reference Basis**
Type :   Extensible   Version :   20160905

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
Include CID 1002 "Anatomical Reference Basis - Head"				
Include CID 1003 "Anatomical Reference Basis - Spine"				
Include CID 1004 "Anatomical Reference Basis - Chest"				
Include CID 1005 "Anatomical Reference Basis – Abdomen/Pelvis"				
Include CID 1006 "Anatomical Reference Basis - Extremities"				

1030

1032 **CID 1002   Anatomical Reference Basis - Head**

The items in this context group are body structures in the head commonly used as a reference basis for
1034 imaging.

Context ID 1002
1036 **Anatomical Reference Basis - Head**
Type :   Extensible   Version :   20160905

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-45010	Carotid Artery	69105007	C0007272
SRT	T-AB200	External Auditory Meatus	84301002	C0013444
SRT	T-11106	Foramen Magnum	24532009	C0016519
SRT	T-22200	Frontal sinus	55060009	C0016734
SRT	T-11134	Internal Auditory Meatus	61671002	C0222711
SRT	T-AA813	Lateral Canthus	61242005	C0229246
SRT	T-11180	Mandible	91609006	C0024687
SRT	T-11133	Mastoid bone	59066005	C0446908
SRT	T-AB500	Mastoid cells and antra	91716001	C0229422
SRT	T-22100	Maxillary sinus	15924003	C0024957
FMA	264779	Nasion		C0934420
SRT	T-D14AE	Orbital structure	363654007	C0029180
SRT	T-D1460	Pituitary Fossa	42575006	C0036609
SRT	T-11100	Skull	89546000	C0037303
SRT	T-11130	Temporal Bone	60911003	C0039484
SRT	T-D1120	Vertex of Head	88986008	C0230003

1038   Notes:

1. (T-11134, SRT, "Internal Auditory Meatus") is also known as the "Internal Auditory Canal".
1040   2. (T-AB200, SRT, "External Auditory Meatus") is also known as the "External Auditory Canal".

3. (T-D1460, SRT, "Pituitary Fossa") is also known as the "Sella Turcica".

1042

CID 1003   Anatomical Reference Basis - Spine

1044 The items in this context group are body structures in the spine commonly used as a reference basis for imaging.

1046

Context ID 1003
Anatomical Reference Basis - Spine

1048   **Type :   Extensible   Version :   20160905**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-11610	C1 vertebra	14806007	C0004170
SRT	T-D005D	Level of C2/C3 intervertebral disc	243902007	C0446383
SRT	T-D005E	Level of C3/C4 intervertebral disc	243903002	C0446384
SRT	T-D005F	Level of C4/C5 intervertebral disc	243904008	C0446385
SRT	T-D007C	Level of C5/C6 intervertebral disc	243905009	C0446386
SRT	T-D007D	Level of C6/C7 intervertebral disc	243906005	C0446387
SRT	T-D009C	Level of C7/T1 intervertebral disc	243925008	C0446406
SRT	T-D0097	Level of L1/L2 intervertebral disc	243920003	C0446401
SRT	T-D0098	Level of L2/L3 intervertebral disc	243921004	C0446402
SRT	T-D0099	Level of L3/L4 intervertebral disc	243922006	C0446404
SRT	T-D009A	Level of L4/L5 intervertebral disc	243923001	C0446403
SRT	T-D009E	Level of L5/S1 intervertebral disc	243927000	C0446408
SRT	T-D007F	Level of T1/T2 intervertebral disc	243908006	C0446389
SRT	T-D0094	Level of T10/T11 intervertebral disc	243917006	C0446398
SRT	T-D0095	Level of T11/T12 intervertebral disc	243918001	C0446399
SRT	T-D009D	Level of T12/L1 intervertebral disc	243926009	C0446407
SRT	T-D008B	Level of T2/T3 intervertebral disc	243909003	C0446390
SRT	T-D008C	Level of T3/T4 intervertebral disc	243910008	C0446391
SRT	T-D008D	Level of T4/T5 intervertebral disc	243911007	C0446392
SRT	T-D008E	Level of T5/T6 intervertebral disc	243912000	C0446393
SRT	T-D008F	Level of T6/T7 intervertebral disc	243913005	C0446394
SRT	T-D0091	Level of T7/T8 intervertebral disc	243914004	C0446395
SRT	T-D0092	Level of T8/T9 intervertebral disc	243915003	C0446396
SRT	T-D0093	Level of T9/T10 intervertebral disc	243916002	C0446397

1050 **CID 1004   Anatomical Reference Basis - Chest**

The items in this context group are body structures in the chest commonly used as a reference basis for
1052 imaging.

Context ID 1004
1054 **Anatomical Reference Basis - Chest**
Type :   Extensible   Version :   20160905

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-15420	Acromioclavicular Joint	85856004	C0001208
SRT	T-42300	Aortic Arch	57034009	C0003489
SRT	T-32004	Apex of heart	13383001	C0225811
SRT	T-25201	Carina	28700002	C0225594
SRT	T-41065	Coronary artery graft	264293000	C0440761
SRT	T-D3400	Diaphragm	5798000	C0011980
SRT	T-32000	Heart	80891009	C0018787
SRT	T-28000	Lung	39607008	C0024109
SRT	T-12280	Scapula	79601000	C0036277
SRT	T-D2220	Shoulder region structure	16982005	C0037004
SRT	T-15610	Sternoclavicular Joint	7844006	C0038291
SRT	T-11210	Sternum	56873002	C0038293
SRT	T-11218	Suprasternal Notch	26493002	C0222769
SRT	T-D3160	Thoracic Inlet	42973007	C0230137
SRT	T-11227	Xiphoid Process	20298003	C0043356

1056

Notes:

1058   1. (T-11218, SRT, "Suprasternal Notch") is also known as the "Jugular Notch (of Sternum)" and the "Sternal
           Notch".

1060

CID 1005   Anatomical Reference Basis - Abdomen/Pelvis

1062 The items in this context group are body structures in the abdomen and pelvis commonly used as a
reference basis for imaging.

Context ID 1005
1064 **Anatomical Reference Basis - Abdomen/Pelvis**
1066 **Type :   Extensible   Version :   20160905**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-12390	Acetabulum	37783008	C0000962
SRT	T-B3000	Adrenal gland	23451007	C0001625

SRT	R-10258	Common iliac artery bifurcation	413896006	C1531837
SRT	T-12711	Femoral head	2812003	C0015813
SRT	T-15710	Hip joint	24136001	C0019558
SRT	T-1234A	Iliac Crest	29850006	C0223651
SRT	T-12350	Ischium	85710004	C0022122
SRT	T-71000	Kidney	64033007	C0022646
SRT	T-12714	Lesser trochanter	55499008	C0223866
SRT	T-62000	Liver	10200004	C0023884
SRT	T-65000	Pancreas	15776009	C0030274
SRT	T-11AD0	Sacrum	54735007	C0036037
SRT	T-15690	Symphysis pubis	82561000	C0034015

1068   Notes:

1. (T-15690, SRT, "Symphysis pubis") is also known as the "Pubic Symphysis".

1070

CID 1006   Anatomical Reference Basis - Extremities

1072 The items in this context group are body structures in the extremities commonly used as a reference basis for imaging.

1074   **Context ID 1006**
Anatomical Reference Basis - Extremities
1076   **Type :   Extensible   Version :   20160905**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	T-15750	Ankle joint	70258002	C0003087
SRT	T-15430	Elbow joint	16953009	C0013770
SRT	T-D9700	Foot	56459004	C0016504
SRT	T-15720	Knee joint	49076000	C0022745
SRT	T-127A7	Malleolar structure of tibia	314796009	C1282383
SRT	T-12540	Metacarpal	36455000	C0025526
SRT	T-12730	Patella	64234005	C0030647
SRT	T-12450	Scaphoid	30518006	C0223724
SRT	T-12780	Talus	67453005	C0039277
SRT	T-1273F	Tibial Plateau	306783000	C0584640
SRT	T-D9800	Toe	29707007	C0040357
SRT	T-15460	Wrist joint	74670003	C1322271

1078   Notes:

1. (T-12450, SRT, "Scaphoid") is also known as the "Radial Carpal".

1080

CID 1010 Reference Geometry - Planes

1082 The items in this context group identify a specific plane associated with a reference basis (see CID 1000).
The plane is defined by the intersection of the scan plane with the specified extent of the reference basis.

1084 **Context ID 1010**
Reference Geometry - Planes
1086 **Type: Non-Extensible** **Version: 20160905**

Coding Scheme Designator	Code Value	Code Meaning
DCM	128128	Plane through Anterior Extent
DCM	128123	Plane through Distal Extent
DCM	128121	Plane through Inferior Extent
DCM	128125	Plane through Lateral Extent
DCM	128126	Plane through Leftmost Extent
DCM	128124	Plane through Medial Extent
DCM	128130	Plane through Center
DCM	128129	Plane through Posterior Extent
DCM	128122	Plane through Proximal Extent
DCM	128127	Plane through Rightmost Extent
DCM	128120	Plane through Superior Extent

1088 **CID 1011 Reference Geometry - Points**

The items in this context group identify a specific point associated with a reference basis (see CID 1000).

1090 **Context ID 1011**
Reference Geometry - Points
1092 **Type: Non-Extensible** **Version: 20160905**

Coding Scheme Designator	Code Value	Code Meaning
DCM	128137	Geometric Centerpoint
DCM	128138	Center of Mass

1094 **CID 1015   Patient Alignment Methods**

The items in this context group identify methods for aligning a patient (or other imaging subject) in a
1096 scanner.

Context ID 1015
1098 **Patient Alignment Methods**
Type: Non-Extensible   Version: 20160905

Coding Scheme Designator	Code Value	Code Meaning
DCM	128151	Laser Cross-hairs

1100

1101 **CID 1200   Contraindications for CT Imaging**

1102 The items in this context group identify possible contraindications for specific CT imaging protocols.
Contraindications for CT imaging in general, irrespective of the Protocol used, are not included here.

1104 **Context ID 1200**
Contraindications for CT Imaging
1106 **Type: Extensible   Version: 20160905**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
SRT	DF-10F42	X-ray Contrast Media Allergy	293638001	C0570563
SRT	DF-10F41	Contrast Media Allergy	293637006	C0570562
SRT	F-84000	Patient currently pregnant	77386006	C0549206
SRT	D7-11007	Impaired Renal Function	236423003	C1565489

1108 **Modify CID 7030 as shown**

CID 7030 Institutional Departments, Units and Services

1110 **Type: Extensible**
Version:~~20090717~~20160905

1112 **Table CID 7030. Institutional Departments, Units and Services**

Coding Scheme Designator	Code Value	Code Meaning
DCM	**128170**	**Abdominal Radiology**
SRT	R-300E3	Accident and Emergency
SRT	R-30246	Allergy and Immunology
SRT	R-3023A	Anesthesiology
SRT	R-30247	Audiology

Coding Scheme Designator	Code Value	Code Meaning
SRT	R-421EB	Clinical Biochemistry
DCM	**128171**	**Biomedical Engineering**
SRT	R-3027F	Breast Surgery
SRT	R-3060E	Burns Intensive Care
SRT	R-30240	Cardiac Intensive Care
SRT	R-30282	Cardiac Surgery
SRT	R-30248	Cardiology
SRT	R-30280	Cardiothoracic Surgery
DCM	**128172**	**Cardiovascular Radiology**
SRT	R-30276	Child and Adolescent Psychiatry
SRT	R-3023B	Clinical Oncology
SRT	R-3028E	Colorectal Surgery
SRT	**R-4221E**	**Computerized Tomography Service**
SRT	R-4225D	Cytology
SRT	R-30283	Dental Surgery
SRT	R-30250	Dermatology
SRT	R-3061B	Diagnostic Imaging
SRT	R-3028A	Endocrine Surgery
SRT	R-30252	Endocrinology
SRT	R-421D4	Endoscopy
SRT	R-3028B	Gastrointestinal Surgery
SRT	R-30254	General Medicine
SRT	R-3028F	General Surgery
SRT	R-3025A	Geriatric Medicine
SRT	R-30264	Gynecology
SRT	R-30290	Hand Surgery

Coding Scheme Designator	Code Value	Code Meaning
SRT	R-3026F	Hematology
SRT	R-4223B	Hepatobiliary Surgery
SRT	R-3061D	Histopathology
SRT	R-3025B	Infectious Disease
DCM	**128173**	**Information Technology**
SRT	R-3023D	Intensive Care
SRT	**R-FF0C4**	**Interventional Radiology Service**
SRT	R-3061E	Medical Intensive Care
SRT	R-30270	Medical Microbiology
DCM	**128174**	**Medical Physics**
SRT	**R-4221D**	**Magnetic Resonance Imaging Service**
DCM	**128175**	**Musculoskeletal Radiology**
SRT	R-3025D	Nephrology
SRT	R-305CE	Neonatal Intensive Care
SRT	R-3025E	Neurology
UMLS	**C2183225**	**Neuroradiology**
SRT	R-4223C	Neurosurgery
SRT	R-3025F	Nuclear Medicine
SRT	R-30265	Obstetrics
SRT	R-30263	Obstetrics and Gynecology
SRT	R-3025C	Ophthalmology
SRT	R-42207	Optometry
SRT	R-30285	Oral Surgery
SRT	R-30294	Orthopedic Surgery
SRT	R-30289	Otorhinolaryngology
SRT	R-3026A	Pain Management

Coding Scheme Designator	Code Value	Code Meaning
SRT	R-30260	Palliative Care
SRT	R-3026B	Pathology
SRT	R-30243	Pediatric Intensive Care
SRT	R-305EA	Pediatric Medicine
SRT	R-30269	Pediatric Oncology
DCM	**128177**	**Pediatric Radiology**
SRT	R-305E9	Pediatric Surgery
SRT	S-8000A	Primary Care Department
SRT	R-30261	Rehabilitation
SRT	R-302A2	Physiotherapy
SRT	R-30297	Plastic Surgery
SRT	R-30275	Psychiatry
SRT	R-42219	Psychology
SRT	R-3024B	Pulmonology
SRT	R-3023C	Radiotherapy
SRT	R-3027B	Radiology
SRT	R-30262	Rheumatology
SRT	R-42203	Speech and Language Therapy
SRT	R-3027D	Stroke
SRT	R-3027E	Surgery
SRT	R-305EB	Surgical Intensive Care
SRT	R-30281	Thoracic Surgery
DCM	**128179**	**Thoracic Radiology**
SRT	R-30298	Transplant Surgery
SRT	R-30299	Trauma Surgery
SRT	R-30616	Tropical Medicine

Coding Scheme Designator	Code Value	Code Meaning
SRT	R-42246	Ultrasonography
SRT	R-3029A	Urology
SRT	R-3029B	Vascular Surgery

1114   Note

        In SNOMED, there is often a choice of unit, department or service concepts; in DICOM, the department
1116   concept is preferred and used in this context group.

1118   **Add the following rows to Annex D**

DICOM Code Definitions (Coding Scheme Designator "DCM" Coding Scheme Version "01")

Code Value	Code Meaning	Definition	Notes
128120	Plane through Superior Extent	A plane passing through the superior extent (i.e. towards the head) of the referenced feature	
128121	Plane through Inferior Extent	A plane passing through the inferior extent (i.e. towards the feet) of the referenced feature	
128122	Plane through Proximal Extent	A plane passing through the proximal extent (i.e. towards the torso) of the referenced feature	
128123	Plane through Distal Extent	A plane passing through the distal extent (i.e. towards the end of the extremity) of the referenced feature	
128124	Plane through Medial Extent	A plane passing through the medial extent (i.e. towards the midline of the body) of the referenced feature	
128125	Plane through Lateral Extent	A plane passing through the lateral extent (i.e. away from the midline of the body) of the referenced feature	
128126	Plane through Leftmost Extent	A plane passing through the leftmost extent of the referenced feature	
128127	Plane through Rightmost Extent	A plane passing through the rightmost extent of the referenced feature	
128128	Plane through Anterior Extent	A plane passing through the anterior extent of the referenced feature	
128129	Plane through Posterior Extent	A plane passing through the posterior extent of the referenced feature	
128130	Plane through Center	A plane passing approximately through the center of the referenced feature	

128137	Geometric Centerpoint	The geometric center point of a feature, such as an organ, implanted device or morphologic anomaly.	
128138	Center of Mass	The center of mass of a feature, such as an organ, implanted device or morphologic anomaly	
128144	Impaired Renal Function	The procedure is contraindicated for patients with impaired renal function.	
128151	Laser Cross-hairs	Positioning the patient based on alignment of laser cross-hairs.	
128160	Acquired Volume	The anatomical region represented in the acquired data.	
128170	Abdominal Radiology	Organizational department or section responsible for Abdominal Radiology	
128171	Biomedical Engineering	Organizational department or section responsible for Biomedical Engineering	
128172	Cardiovascular Radiology	Organizational department or section responsible for Cardiovascular Radiology	
128173	Information Technology	Organizational department or section responsible for Information Technology	
128174	Medical Physics	Organizational department or section responsible for Medical Physics	
128175	Musculoskeletal Radiology	Organizational department or section responsible for Musculoskeletal Radiology	
128177	Pediatric Radiology	Organizational department or section responsible for Pediatric Radiology	
128179	Thoracic Radiology	Organizational department or section responsible for Thoracic Radiology	

1120

1122

Changes to NEMA Standards Publication PS 3.17

1124

Digital Imaging and Communications in Medicine (DICOM)

Part 17: Explanatory Information

1126

Add the following New Annex to PS3.17

1128   # Annex AAAA   Protocol Storage Examples and Concepts (Informative)

1130   The following examples are provided to illustrate the usage of the CT Defined and Performed Procedure Protocol IODs. They do NOT represent recommended scanning practice. In some cases they have been influenced by published protocols, but the examples here may not fully encode those published protocols
1132   and no attempt has been made to keep them up-to-date.

AAAA.1 PROTOCOL STORAGE CONCEPTS

1134   ### AAAA.1.1 Use Cases

1136   The primary applications (use cases) considered during the development of the CT Procedure Protocol Storage IODs were the following:

1138   - Managing protocols within a site for consistency and dose management
     (Using Defined Protocols)

1140   - Recording protocol details for a performed study so the same or similar values can be used when performing followup or repeat studies, especially for oncology which does comparative measurements
1142   (Using Performed Protocols)

1144   - Vendor troubleshooting image quality issues that may be due to poor protocol/technique
     (Using Performed Protocols, Defined Protocols)

1146   - Distributing departmental, "best practice" or reference protocols (such as AAPM) to modality systems
     (Using Defined Protocols)

1148   - Backing up protocols from a modality to PACS or removable media (e.g., during system upgrades or replacement). Most vendors have a proprietary method for doing this which would essentially
1150   become redundant when Protocol Management is implemented.
     (Using Defined Protocols)

1152
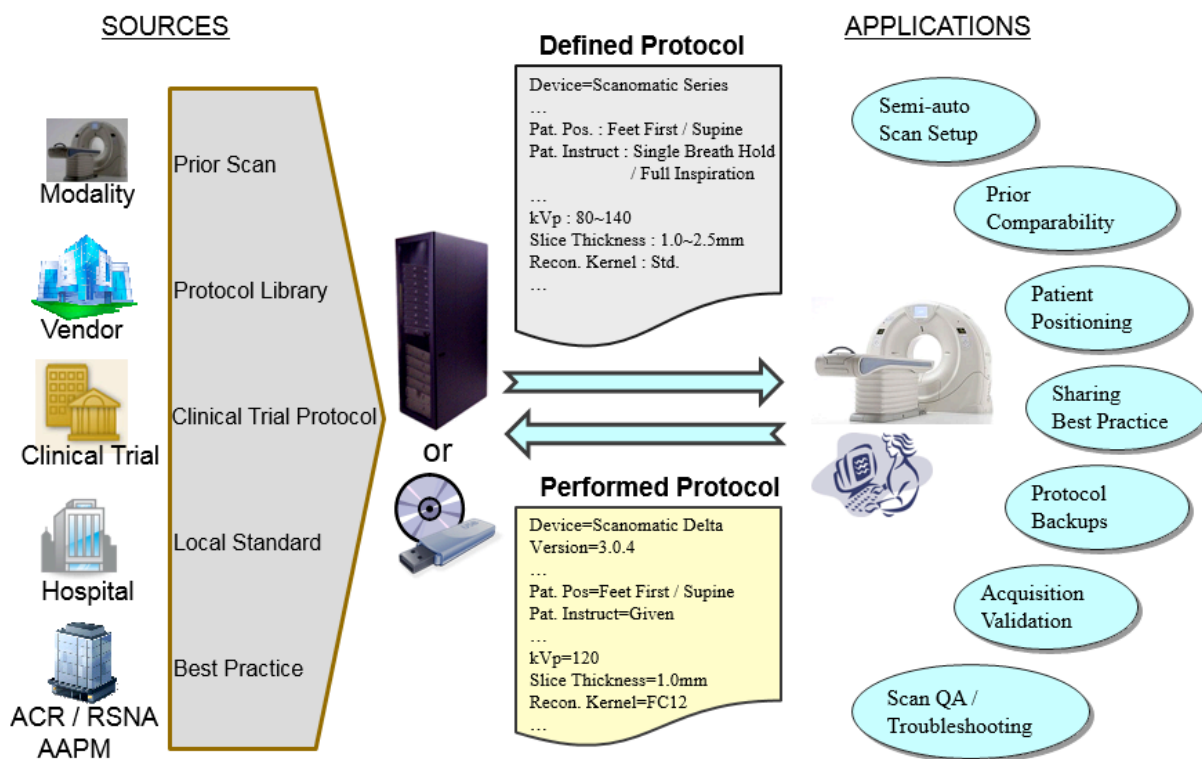
1154   Additional potential applications include:

- Making more detailed protocol information available to rendering or processing applications that
1156   would allow them to select processing that corresponds to the acquisition protocol, to select
        parameters appropriate to the acquisition characteristics, and to select the right series to
1158   process/display.
        (Using Performed Protocols)

1160   - Improving imaging consistency in terms of repeatable technique, performance, quality and image
        charateristics. Would benefit from associated image quality metrics and other physics work.
1162   (Using Defined Protocols and Performed Protocols)

- Distributing clinical trial protocols (general purpose or scanner model specific) to participating sites
1164   (Using Defined Protocols)

- Recording protocol details for a performed study to submit with clinical trial images for technique
1166   validation
        (Using Performed Protocols)

1168   - Tracking/extracting details of Performed Protocol such as timestamps, execution sequence and
        technique for QA, data mining, etc.
1170   (Using Performed Protocols)

- Making more detailed protocol information available to radiologists reviewing a study and   priors,
1172   or comparing similar studies of different patients.
        (Using Performed Protocols)

1174   **AAAA.1.2 Workflow**

Using non-Patient-specific Protocols

1176   In most cases, the scanner uses any protocol details in the modality worklist item to present to the
         technologist a list of matching Defined Protocols on this scanner.

1178   **Preparing and executing Patient-specific Protocols**

         In the simplest form, this process could be driven with a combination of the Modality Worklist and
1180   Defined Protocols.

              Radiologist at the RIS:
1182   •   Selects a patient procedure on the upcoming Modality Worklist
         •   Adds tech notes to the Worklist entry (e.g., "Use Defined Protocol X; Decrease parameter Y…")
1184
              Technologist at the modality:
1186   •   Selects the patient procedure on the upcoming Modality Worklist
         •   Reads the tech notes
1188   •   Selects the identified Defined Protocol and adjusts as described

1190   Modality
         •   Executes procedure
1192   •   Stores the Performed Protocol to study folder on PACS

1194   Radiologist
         •   (Optionally) Reviews the Performed Protocols

1196

1198   In special cases, the radiologist might attend the scan and modify the protocol directly on the console.

         Note that the primary record of adjustments is the Performed Protocol object (which can be compared
1200   to the referenced Defined Protocol object).

         A new Defined Protocol is not typically saved unless the intent is to have a new Defined Protocol
1202   available in the Library.

1204   **AAAA.2   ROUTINE ADULT HEAD PROTOCOL**

         The examples in this Annex are intended to illustrate the encoding mechanisms of the DICOM CT Protocol
1206   Storage IODs, not to suggest particular values for clinical use.   Further, these examples do not contain
         the many detailed attributes one would expect from a fully executable defined protocol generated by a CT
1208   scanner, but they do demonstrate the usage of many common attributes.

         This section includes Defined Protocol examples of a Routine Adult Head Protocol for several different
1210   scanner models. The protocol is presented as adjusted by a fictitious Mercy Hospital from a reference
         protocol referenced in the Predecessor Protocol Sequence.   Although the examples in this section were
1212   originally derived from protocol documents previously published by the AAPM, some values here were
         modified and are likely out of date.   Parties interested in the current AAPM protocols are encouraged to
1214   visit http://www.aapm.org/pubs/CTProtocols/

         AAAA.2.1   Common Context
1216   Table AAAA.2-1 is basically the same for each model so it is shown here rather than duplicating it. The
         second half for two different scanner models is then shown below in Table AAAA.2-2 and AAAA.2-3.

1218   **Table AAAA.2-1 Routine Adult Head - Context**

Attribute	Tag	Value
Equipment Modality	(0008,0221)	CT
Custodial Organization Sequence	(0040,A07C)	
>Institution Name	(0008,0800)	Mercy Hospital
>Institution Code Sequence	(0008,0082)	
Responsible Group Code Sequence	(0008,0220)	(C2183225,UMLS, "Neuroradiology")
Protocol Name	(0018,1030)	AAPM Routine Adult Head (Brain)
Potential Scheduled Protocol Code Sequence	(0018,9906)	(24725-4, LN, "CT HEAD"), (24726-2, LN, "CT HEAD WITHOUT THEN WITH IV CONTRAST"), (24727-0, LN, "CT HEAD WITH IV CONTRAST") …
Potential Reasons for Procedure	(0018,9908)	Acute head trauma\ Suspected acute intracranial hemorrhage\ Immediate postoperative evaluation following brain surgery\ Suspected shunt malfunctions, or shunt revisions\ Mental status change\ Increased intracranial pressure\ Headache\ Acute neurologic deficits\ Suspected hydrocephalus\ Evaluating psychiatric disorders\ Brain herniation\ Drug toxicity\ Suspected mass or tumor\ Seizures\ Syncope\ Detection of calcification\ When magnetic resonance imaging (MRI) imaging is unavailable or contraindicated, or if the supervising physician deems CT to be most appropriate.
Potential Diagnostic Tasks	(0018,990A)	Detect collections of blood\ Identify brain masses\ Detect brain edema or ischemia\ Identify shift in the normal locations of the brain structures including in the cephalad or caudal directions\ Evaluate the location of shunt hardware and the size of the ventricles\ Evaluate the size of the sulci and relative changes in symmetry\

		Detect abnormal collections\ Detect calcifications in the brain and related structures\ Evaluate for fractures in the calvarium (skull)\ Detect any intracranial air
Predecessor Protocol Sequence	(0018,990E)	
Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.200.1
Referenced SOP Instance UID	(0008,1155)	9.8.7.6.5.12345.2
Content Creator's Name	(0070,0084)	Braindoc^Barry^^^MD
Protocol Design Rationale	(0018,9910)	Tube Current Modulation (or Automatic Exposure Control) may be used, but is often turned off; According to ACR CT Accreditation Program guidelines: - The diagnostic reference level (in terms of volume CTDI) is 75 mGy. - The pass/fail limit (in terms of volume CTDI) is 80 mGy. - These values are for a routine adult head scan and may be significantly different (higher or lower) for a given patient with unique indications. NOTE: All volume CTDI values are for the 16-cm diameter CTDI phantom. Additional Resources ACR–ASNR Practice Guideline For The Performance Of Computed Tomography (CT) Of The Brain, http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/CT. ACR CT Accreditation Program information, including Clinical Image Guide and Phantom Testing Instructions, http://www.acr.org/Quality-Safety/Accreditation/CT.
Protocol Planning Information	(0018,990F)	Contrast use as indicated by radiologist
Instance Creation Date	(0008,0012)	20150601
Instance Creation Time	(0008,0013)	124200
Instruction Sequence	(0018,9914)	
>Instruction Index	(0018,9915)	1
>Instruction Text	(0018,9916)	"Contrast, if directed. See Instruction Description."
>Instruction Description	(0018,9917)	"Some indications require injection of intravenous or intrathecal contrast media during imaging of the brain. Intravenous contrast administration should be performed as directed by the supervising radiologist using appropriate injection protocols and in accordance with the ACR Practice Guideline for

		the Use of Intravascular Contrast Media. A typical amount would be 100 cc at 300 mg/cc strength, injected at 1 cc/sec. A delay of 4 minutes between contrast injection and the start of scanning is typical."
Protocol Defined Patient Position	(0018,9947)	HFS
Patient Positioning Instruction Sequence	(0018,991B)	
>Instruction Index	(0018,9915)	1
>Instruction Text	(0018,9916)	"Head in the head-holder whenever possible."
>Instruction Index	(0018,9915)	2
>Instruction Text	(0018,9916)	"Arms resting along body and support lower legs."
>Instruction Index	(0018,9915)	3
>Instruction Text	(0018,9916)	"Center table height so EAM is at center of gantry."
>Instruction Index	(0018,9915)	4
>Instruction Text	(0018,9916)	"Align scan to reduce lens exposure."
>Instruction Description	(0018,9917)	"To reduce or avoid ocular lens exposure, the scan angle should be parallel to a line created by the supraorbital ridge and the inner table of the posterior margin of the foramen magnum. This may be accomplished by either tilting the patient's chin toward the chest ("tucked" position) or tilting the gantry. While there may be some situations where this is not possible due to scanner or patient positioning limitations, it is considered good practice to perform one or both of these maneuvers whenever possible."
Anatomic Region Sequence	(0008,2218)	(T-D1100, SRT, "Head")

1220

AAAA.2.2   Scantech Industries

1222   The first part of this example is shown above in Table AAAA.2-1.

Table AAAA.2-2 Routine Adult Head - Details - Scantech

Attribute	Tag	Value
Model Specification Sequence	(0018,9912)	
>Manufacturer	(0008,0070)	Scantech
>Manufacturer's Related Model Group	(0008,0222)	Scanomatic
>Software Versions	(0018,1020)	VCT34
Patient Specification Sequence	(0018,9911)	
>See Table AAAA.2-1a Patient Specification		
Acquisition Protocol Element Specification Sequence	(0018,991F)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	

>>See Table AAAA.2-1b First Acquisition Protocol Element Specification		
>Protocol Element Number	(0018,9921)	2
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-1c Second Acquisition Protocol Element Specification		
Reconstruction Protocol Element Specification Sequence	(0018,9933)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-1d First Reconstruction Protocol Element Specification		
Private Data Element Characteristics Sequence	(0008,0300)	
>Private Group Reference	(0008,0301)	0x0021
>Private Creator Reference	(0008,0302)	"SCANTECH PRIVATE CT ELEMENTS"
>Private Data Element Definition Sequence	(0008,0310)	
>>Private Data Element	(0008,0308)	0099
>>Private Data Element Value Multiplicity	(0008,0309)	1
>>Private Data Element Value Representation	(0008,030A)	DS
>>Private Data Element Keyword	(0008,030D)	mAsQualityPoint
>>Private Data Element Name	(0008,030C)	mAs Quality Point
>>Private Data Element Description	(0008,030E)	mAs Quality Point is a parameter for the proprietary tube current modulation algorithm.
>Block Identifying Information Status	(0008,0303)	SAFE

1224

The following tables reflect the semantic contents of constraint sequences but not the actual structure of
1226 the IOD.   The centered rows in italics clarify the context of the constrained attributes that follow by
indicating which sequence in the performed module contains the constrained attribute (as specified in the
1228 Selector Sequence Pointer).

Table AAAA.2-2a Patient Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Patient's Age	(0010,1010)	1	absent	absent	GREATER_ THAN	"16Y"

1230

Table AAAA.2-2b First Acquisition Protocol Element Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquisition Protocol Element Sequence (0018,9920)						

Protocol Element Name	(0018,9922)	1	(0018,9920)	1	EQUAL	Localizer: Lateral
Acquisition Type	(0018,9302)	1	(0018,9920)	1	EQUAL	CONSTANT_ANGLE
Tube Angle	(0018,9303)	1	(0018,9920)	1	EQUAL	90
Constant Volume Flag	(0018,9333)	1	(0018,9920)	1	EQUAL	NO
Fluoroscopy Flag	(0018,9334)	1	(0018,9920)	1	EQUAL	NO
Acquisition Motion	(0018,9930)	1	(0018,9920)	1	EQUAL	FORWARD
>Acquisition Start Location Sequence (0018,9931)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9931)	1\1	EQUAL	"Top of Skull"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9931)	1\1	EQUAL	(T-11100, SRT, "Skull")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9931)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Acquisition End Location Sequence (0018,9932)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9932)	1\1	EQUAL	"256mm Inferior"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9932)	1\1	EQUAL	(T-11100, SRT, "Skull")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9932)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
Offset Distance	(0018,9904)	1	(0018,9920), (0018,9932)	1\1	EQUAL	256
Offset Direction	(0018,9905)	1	(0018,9920), (0018,9932)	1\1	EQUAL	INFERIOR
>CT X-Ray Details Sequence (0018,9940) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9940)	1\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9940)	1\1	EQUAL	120
X-ray Tube Current in mA	(0018,9330)	1	(0018,9920), (0018,9940)	1\1	EQUAL	50

1232

Table AAAA.2-2c Second Acquisition Protocol Element Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquisition Protocol Element Sequence (0018,9920)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	2	EQUAL	Helical
Acquisition Type	(0018,9302)	1	(0018,9920)	2	EQUAL	SPIRAL

Constant Volume Flag	(0018,9333)	1	(0018,9920)	2	EQUAL	NO
Fluoroscopy Flag	(0018,9334)	1	(0018,9920)	2	EQUAL	NO
Revolution Time	(0018,9305)	1	(0018,9920)	2	EQUAL	1.0
Single Collimation Width	(0018,9306)	1	(0018,9920)	2	EQUAL	0.6
Total Collimation Width	(0018,9307)	1	(0018,9920)	2	EQUAL	38.4
Table Speed	(0018,9309)	1	(0018,9920)	2	EQUAL	21.12
Table Speed per Rotation	(0018,9310)	1	(0018,9920)	2	EQUAL	21.12
Spiral Pitch Factor	(0018,9311)	1	(0018,9920)	2	EQUAL	0.55
CTDIvol	(0018,9345)	1	(0018,9920)	2	EQUAL	59.3
CTDI Phantom Type Code Sequence	(0018,9346)	1	(0018,9920)	2	EQUAL	(DCM,113690, "IEC Head Dosimetry Phantom")
CTDIvol Notification Trigger	(0018,9942)	1	(0018,9920)	2	EQUAL	80
Acquisition Motion	(0018,9930)	1	(0018,9920)	2	EQUAL	FORWARD
>Acquisition Start Location Sequence (0018,9931)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9931)	2\1	EQUAL	"C1 Lamina"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9931)	2\1	EQUAL	(14806007, SRT, "Atlas")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9931)	2\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Acquisition End Location Sequence (0018,9932)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9932)	2\1	EQUAL	"Top of Skull"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9932)	2\1	EQUAL	(T-11100, SRT,Skull)
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9932)	2\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>CT X-Ray Details Sequence (0018,9940) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9940)	2\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9940)	2\1	EQUAL	120
private tag	(0021,1099)	1	(0018,9920), (0018,9940)	2\1	EQUAL	390
Exposure Modulation Type	(0018,9323)	1	(0018,9920), (0018,9940)	2\1	EQUAL	LONGITUDINAL
Data Collection Diameter	(0018,0090)	1	(0018,9920), (0018,9325)	2\1	EQUAL	300

>CT X-Ray Details Sequence (0018,9325) – Second Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	2\2	EQUAL	2
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	2\2	EQUAL	120
private tag	(0021,1099)	1	(0018,9920), (0018,9325)	2\2	EQUAL	390
Exposure Modulation Type	(0018,9323)	1	(0018,9920), (0018,9325)	2\2	EQUAL	LONGITUDINAL
Data Collection Diameter	(0018,0090)	1	(0018,9920), (0018,9325)	2\2	EQUAL	300

1234

Table AAAA.2-2d First Reconstruction Protocol Element Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Reconstruction Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9934)	1	EQUAL	"Transverse Recon"
Content Qualification	(0018,9004)	1	(0018,9934)	1	EQUAL	PRODUCT
Requested Series Description	(0018,9937)	1	(0018,9934)	1	EQUAL	"Axial w/o"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	1	EQUAL	2
Source Acquisition Beam Number	(0018,9939)	1	(0018,9934)	1	EQUAL	"1\2"
Convolution Kernel	(0018,1210)	1	(0018,9934)	1	EQUAL	"C3p0"
Convolution Kernel Group	(0018,9316)	1	(0018,9934)	1	EQUAL	"BRAIN"
Rows	(0028,0010)	1	(0018,9934)	1	EQUAL	512
Columns	(0028,0011)	1	(0018,9934)	1	EQUAL	512
Slice Thickness	(0018,0050)	1	(0018,9934)	1	EQUAL	5
Spacing Between Slices	(0018,0088)	1	(0018,9934)	1	EQUAL	5
>Reconstruction Start Location Sequence (0018,993B)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993B)	1\1	EQUAL	"Top of Frontal Sinus"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(T-22200, SRT, "Frontal sinus")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")

>Reconstruction End Location Sequence (0018,993C)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993C)	1\1	EQUAL	"Top of Skull"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(T-11100, SRT, "Skull")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")

1236

AAAA.2.3   Acme

The first part of this example is shown above in Table AAAA.2-1.

Notes: 1. The author of this protocol chose to use the code for the vertex of the head rather than the skull as the basis for the plane defining the extent of the scan and reconstructions.

2. The Requested Series Description (0018,9937) is the same for both localizer acquisitions, however DICOM does not mandate series organization behavior so this does not guarantee that both localizers will be placed in the same series.

Table AAAA.2-3 AAPM Routine Brain Details - Acme

1246

Attribute	Tag	Value
Model Specification Sequence	(0018,9912)	
>Manufacturer	(0008,0070)	ACME
>Manufacturer's Model Name	(0008,1090)	Alpha
>Software Versions	(0018,1020)	V1.63\1.70
>Manufacturer	(0008,0070)	ACME
>Manufacturer's Model Name	(0008,1090)	Alpha Plus
>Software Versions	(0018,1020)	V1.63\1.70
Patient Specification Sequence	(0018,9911)	
>See Table AAAA.2-2a Patient Specification		
Acquisition Protocol Element Specification Sequence	(0018,991F)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2b First Acquisition Protocol Element Specification		
>Protocol Element Number	(0018,9921)	2
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2c Second Acquisition Protocol Element Specification		
>Protocol Element Number	(0018,9921)	3
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2d Third Acquisition Protocol Element Specification		
Reconstruction Protocol Element Specification Sequence	(0018,9933)	

>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2e First Reconstruction Protocol Element Specification		
>Protocol Element Number	(0018,9921)	2
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2f Second Reconstruction Protocol Element Specification		
Storage Protocol Element Specification Sequence	(0018,9935)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2g First Storage Protocol Element Specification		
>Protocol Element Number	(0018,9921)	2
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2h Second Storage Protocol Element Specification		
>Protocol Element Number	(0018,9921)	3
>Parameters Specification Sequence	(0018,9913)	
>>See Table AAAA.2-2i Third Storage Protocol Element Specification		

1248 The following tables reflect the semantic contents of constraint sequences but not the actual structure of the IOD.   The centered rows in italics clarify the context of the constrained attributes that follow by
1250 indicating which sequence in the performed module contains the constrained attribute (as specified in the Selector Sequence Pointer).

1252 **Table AAAA.2-3a Patient Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Patient's Age	(0010,1010)	1	absent	absent	GREATER_ THAN	"16Y"

1254 **Table AAAA.2-3b First Acquisition Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquistion Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	1	EQUAL	Localizer: Lateral
Content Qualification	(0018,9004)	1	(0018,9934)	1	EQUAL	PRODUCT
Requested Series Description	(0018,9937)	1	(0018,9934)	1	EQUAL	"Localizers"
Acquisition Type	(0018,9302)	1	(0018,9920)	1	EQUAL	CONSTANT_ANGLE

Tube Angle	(0018,9303)	1	(0018,9920)	1	EQUAL	90
Acquisition Motion	(0018,9930)	1	(0018,9920)	1	EQUAL	FORWARD
>Acquisition Start Location Sequence (0018,9931)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9931)	1\1	EQUAL	"Top of Head"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9931)	1\1	EQUAL	(T-D1120, SRT, "Vertex of Head")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9931)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Acquisition End Location Sequence (0018,9932)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9932)	1\1	EQUAL	"Bottom of 256mm Localizer"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9932)	1\1	EQUAL	(T-D1120, SRT, "Vertex of Head")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9932)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
Offset Distance	(0018,9904)	1	(0018,9920), (0018,9932)	1\1	EQUAL	256
Offset Direction	(0018,9905)	1	(0018,9920), (0018,9932)	1\1	EQUAL	INFERIOR
>CT X-Ray Details Sequence (0018,9325) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	1\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	1\1	EQUAL	120
X-ray Tube Current in mA	(0018,9330)	1	(0018,9920), (0018,9325)	1\1	EQUAL	50

1256   **Table AAAA.2-3c Second Acquisition Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquistion Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	2	EQUAL	Localizer: AP
Content Qualification	(0018,9004)	1	(0018,9934)	2	EQUAL	PRODUCT
Requested Series Description	(0018,9937)	1	(0018,9934)	2	EQUAL	"Localizers"
Acquisition Type	(0018,9302)	1	(0018,9920)	2	EQUAL	CONSTANT_ANGLE
Tube Angle	(0018,9303)	1	(0018,9920)	2	EQUAL	0
Acquisition Motion	(0018,9930)	1	(0018,9920)	2	EQUAL	FORWARD

>Acquisition Start Location Sequence (0018,9931)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9931)	2\1	EQUAL	"Top of Head"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9931)	2\1	EQUAL	(T-D1120, SRT, "Vertex of Head")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9931)	2\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Acquisition End Location Sequence (0018,9932)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9932)	2\1	EQUAL	"Bottom of 256mm Localizer"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9932)	2\1	EQUAL	(T-D1120, SRT, "Vertex of Head")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9932)	2\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
Offset Distance	(0018,9904)	1	(0018,9920), (0018,9932)	2\1	EQUAL	256
Offset Direction	(0018,9905)	1	(0018,9920), (0018,9932)	2\1	EQUAL	INFERIOR
>CT X-Ray Details Sequence (0018,9325) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	2\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	2\1	EQUAL	120
X-ray Tube Current in mA	(0018,9330)	1	(0018,9920), (0018,9325)	2\1	EQUAL	50

1258   **Table AAAA.2-3d Third Acquisition Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquistion Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	3	EQUAL	Helical
Content Qualification	(0018,9004)	1	(0018,9934)	3	EQUAL	PRODUCT
Requested Series Description	(0018,9937)	1	(0018,9934)	3	EQUAL	"Raw Data Brain"
Acquisition Type	(0018,9302)	1	(0018,9920)	3	EQUAL	SPIRAL
Revolution Time	(0018,9305)	1	(0018,9920)	3	EQUAL	0.75
Single Collimation Width	(0018,9306)	1	(0018,9920)	3	EQUAL	0.5
Total Collimation Width	(0018,9307)	1	(0018,9920)	3	EQUAL	16

Table Speed	(0018,9309)	1	(0018,9920)	3	EQUAL	14
Table Speed per Rotation	(0018,9310)	1	(0018,9920)	3	EQUAL	10.5
Spiral Pitch Factor	(0018,9311)	1	(0018,9920)	3	EQUAL	0.656
CTDIvol	(0018,9345)	1	(0018,9920)	3	EQUAL	55.7
CTDI Phantom Type Code Sequence	(0018,9346)	1	(0018,9920)	3	EQUAL	(DCM,113690, "IEC Head Dosimetry Phantom")
CTDIvol Notification Trigger	(0018,9942)	1	(0018,9920)	3	EQUAL	80
Acquisition Motion	(0018,9930)	1	(0018,9920)	3	EQUAL	FORWARD
>Acquisition Start Location Sequence (0018,9931)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9931)	3\1	EQUAL	"C1 Lamina"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9931)	3\1	EQUAL	(T-11610, SRT, "C1 vertebra")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9931)	3\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Acquisition End Location Sequence (0018,9932)						
Reference Location Label	(0018,9900)	1	(0018,9920), (0018,9932)	3\1	EQUAL	"Top of Head"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9920), (0018,9932)	3\1	EQUAL	(T-D1120, SRT, "Vertex of Head")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9920), (0018,9932)	3\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>CT X-Ray Details Sequence (0018,9325) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	3\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	3\1	EQUAL	120
X-ray Tube Current in mA	(0018,9330)	1	(0018,9920), (0018,9325)	3\1	EQUAL	220
Exposure Modulation Type	(0018,9323)	1	(0018,9920), (0018,9325)	3\1	EQUAL	NONE
Data Collection Diameter	(0018,0090)	1	(0018,9920), (0018,9325)	3\1	EQUAL	240

1260 **Table AAAA.2-3e First Reconstruction Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Reconstruction Protocol Element Sequence (yym8, m9x1)						

Protocol Element Name	(0018,9922)	1	(0018,9934)	1	EQUAL	"Transverse"
Requested Series Description	(0018,9937)	1	(0018,9934)	1	EQUAL	"Transverse without Contrast"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	1	EQUAL	3
Source Acquisition Beam Number	(0018,9939)	1	(0018,9934)	1	EQUAL	1
Convolution Kernel Group	(0018,9316)	1	(0018,9934)	1	EQUAL	"BRAIN"
Reconstruction Diameter	(0018,1100)	1	(0018,9934)	1	EQUAL	240
Rows	(0028,0010)	1	(0018,9934)	1	EQUAL	512
Columns	(0028,0011)	1	(0018,9934)	1	EQUAL	512
Slice Thickness	(0018,0050)	1	(0018,9934)	1	EQUAL	5
Spacing Between Slices	(0018,0088)	1	(0018,9934)	1	EQUAL	5
>Reconstruction Algorithm Sequence (0018,993D)						
Algorithm Name	(0066,0036)	1	(0018,9934) (0018,993D)	1/1	EQUAL	"Opti-Brain"
Algorithm Name Code Sequence	(0066,0030)	1	(0018,9934) (0018,993D)	1/1	EQUAL	(B506, 99ACME, "OptiBrain")
>Reconstruction Start Location Sequence (0018,993B)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993B)	1\1	EQUAL	"Bottom of Scan"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(128160, DCM, "Acquired Volume")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(128121, DCM, "Plane through Inferior Extent")
>Reconstruction End Location Sequence (0018,993C)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993C)	1\1	EQUAL	"Top of Scan"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(128160, DCM, "Acquired Volume")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")

1262 **Table AAAA.2-3f Second Reconstruction Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value

Reconstruction Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9934)	2	EQUAL	"Volume"
Protocol Element Purpose	(0018,9924)	1	(0018,9934)	2	EQUAL	"For volume processing"
Protocol Element Characteristics Summary	(0018,9923)	1	(0018,9934)	2	EQUAL	"Thin slices"
Requested Series Description	(0018,9937)	1	(0018,9934)	1	EQUAL	"Brain Volume"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	2	EQUAL	3
Source Acquisition Beam Number	(0018,9939)	1	(0018,9934)	2	EQUAL	1
Convolution Kernel Group	(0018,9316)	1	(0018,9934)	2	EQUAL	"BRAIN"
Reconstruction Diameter	(0018,1100)	1	(0018,9934)	2	EQUAL	240
Rows	(0028,0010)	1	(0018,9934)	2	EQUAL	512
Columns	(0028,0011)	1	(0018,9934)	2	EQUAL	512
Slice Thickness	(0018,0050)	1	(0018,9934)	2	EQUAL	0.5
Spacing Between Slices	(0018,0088)	1	(0018,9934)	2	EQUAL	0.25
>Reconstruction Algorithm Sequence (0018,993D)						
Algorithm Name	(0066,0036)	1	(0018,9934) (0018,993D)	2/1	EQUAL	"Opti-Brain"
Algorithm Name Code Sequence	(0066,0030)	1	(0018,9934) (0018,993D)	2/1	EQUAL	(B506, 99ACME, "OptiBrain")
>Reconstruction Start Location Sequence (0018,993B)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993B)	2\1	EQUAL	"Bottom of Scan"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993B)	2\1	EQUAL	(128160, DCM, "Acquired Volume")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993B)	2\1	EQUAL	(128121, DCM, "Plane through Inferior Extent")
>Reconstruction End Location Sequence (0018,993C)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993C)	2\1	EQUAL	"Top of Scan"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993C)	2\1	EQUAL	(128160, DCM, "Acquired Volume")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993C)	2\1	EQUAL	(128120, DCM, "Plane through Superior Extent")

1264 **Table AAAA.2-3g First Storage Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Storage Protocol Element Sequence (0018,9936)						
Protocol Element Name	(0018,9922)	1	(0018,9936)	1	EQUAL	"To PACS"
Protocol Element Purpose	(0018,9924)	1	(0018,9936)	1	EQUAL	"For reading"
Protocol Element Characteristics Summary	(0018,9923)	1	(0018,9936)	1	EQUAL	"Localizers, transverse and thin images"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9936)	1	EQUAL	1\2
Source Reconstruction Protocol Element Number	(0018,993A)	1	(0018,9936)	1	EQUAL	1\2
>Output Information Sequence (0040,4033)						
>>DICOM Retrieval Sequence (0040,4071)						
Destination AE	(2100,0140)	1	(0018,9936), (0040,4033), (0040,4071)	1\1\1	EQUAL	"MHPACS"

1266 **Table AAAA.2-3h Second Storage Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Storage Protocol Element Sequence (0018,9936)						
Protocol Element Name	(0018,9922)	1	(0018,9936)	2	EQUAL	"To 3D"
Protocol Element Purpose	(0018,9924)	1	(0018,9936)	2	EQUAL	"For 3D Processing"
Protocol Element Characteristics Summary	(0018,9923)	1	(0018,9936)	2	EQUAL	"Thin images"
Source Reconstruction Protocol Element Number	(0018,993A)	1	(0018,9936)	2	EQUAL	2
>Output Information Sequence (0040,4033)						
>>DICOM Retrieval Sequence (0040,4071)						

| DestinationAE | (2100,0140) | 1 | (0018,9936), (0040,4033), (0040,4071) | 2\1\1 | EQUAL | "3DWS" |

1268

Table AAAA.2-3i Third Storage Protocol Element Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Storage Protocol Element Sequence (0018,9936)						
Protocol Element Name	(0018,9922)	1	(0018,9936)	3	EQUAL	"Raw Data Archive"
Protocol Element Purpose	(0018,9924)	1	(0018,9936)	3	EQUAL	"For later recons"
Protocol Element Characteristics Summary	(0018,9923)	1	(0018,9936)	3	EQUAL	"Raw acq data"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9936)	3	EQUAL	3
>Output Information Sequence (0040,4033)						
>>DICOM Retrieval Sequence (0040,4071)						
DestinationAE	(2100,0140)	1	(0018,9936), (0040,4033), (0040,4071)	3\1\1	EQUAL	"RAWCACHE"

1270 **AAAA.3   CT PROTOCOL FOR TUMOR VOLUMETRIC MEASUREMENTS**

This section includes a Defined Protocol examples of a CT Protocol for Tumor Volumetric Measurements
1272 for a clinical trial. These examples are intended to illustrate the encoding mechanisms of the DICOM CT
Protocol Storage IODs, not to suggest particular values for clinical trials. Although the examples in this
1274 section were originally inspired by protocol documents previously published by ACRIN, some values here
were modified and are likely out of date.   Parties interested in the current ACRIN protocols are
1276 encouraged to visit https://www.acrin.org/

AAAA.3.1   Common Context

1278 Table AAAA-3-1 is basically the same for each model so it is shown here rather than duplicating it. The
second half is then shown below in Table AAAA.3-2.

1280 **Table AAAA.3-1 CT Tumor Volumetric Measurement - Context**

Attribute	Tag	Value
Clinical Trial Sponsor Name	(0012,0010)	Deckard Pharmaceuticals
Clinical Trial Protocol ID	(0012,0020)	6678
Clinical Trial Protocol Name	(0012,0021)	DP6678 Phase III

Clinical Trial Site ID	(0012,0030)	""
Clinical Trial Site Name	(0012,0031)	""
Clinical Trial Coordinating Center Name	(0012,0060)	Tyrell Core Labs
Responsible Group Code Sequence	(0008,0220)	""
Equipment Modality	(0008,0221)	CT
Protocol Name	(0018,1030)	CT Tumor Volumetric Measurement
Potential Scheduled Protocol Code Sequence	(0018,9906)	(6678-1, 99DP, "DP6678 Phase III CT Protocol")
Potential Requested Procedure Code Sequence	(0018,9907)	(72253-8, LN, "CT CAP WO contrast")
Potential Reasons for Procedure	(0018,9908)	Metastatic non-small cell lung cancer\tumor volumetric measurements
Contraindications Code Sequence	(0018,990B)	(F-84000, SRT, "Patient currently pregnant")
Content Creator's Name	(0070,0084)	Jane Investigator
Protocol Design Rationale	(0018,9910)	See DP6678 Phase III Protocol documents: http://ctrialdocs.tyrell.co.ca/DP6678_protocol.aspx. In particular, see discussion in Section 3 (CT Acquisition Parameters and Image Data Analysis) of the Protocol Document: The Spacing Between Slices may be increased as long as the overlap between slices is maintained between 0% and 20% overlap. The Slice Thickness may be increased up to 1.5mm as long as the Spacing Between Slices is correspondingly increased to maintain between 0% and 20% overlap.
Protocol Planning Information	(0018,990F)	Use of intravenous contrast media, presence of motion artifacts or violation of slice width, slice interval or voxel size constraints will disqualify the CT scan series.
Instance Creation Date	(0008,0012)	20150607
Instance Creation Time	(0008,0013)	115623
Patient Specification Sequence	(0018,9911)	
Instruction Sequence	(0018,9914)	
>Instruction Index	(0018,9915)	1
>Instruction Text	(0018,9916)	"Scan the chest in full inspiration"
>Instruction Index	(0018,9915)	2
>Instruction Text	(0018,9916)	"Set reconstruction diameter to span from outer rib to outer rib"
Patient Positioning Instruction	(0018,991B)	

Sequence		
>Instruction Index	(0018,9915)	1
>Instruction Text	(0018,9916)	"Position arms above the head."
Anatomic Region Sequence	(0008,2218)	(T-D3000, SRT, "Chest")
Primary Anatomic Structure Sequence	(0008,2228)	(T-D03C3, SRT, "Lung and Mediastinum")

1282

AAAA.3.2   Acme

1284 The first part of this example is shown above in Table AAAA.3-1.

The anatomical extent is defined in the reconstruction to represent the dataset of interest to the clinical
1286 trial.   The extent was not defined in the localizer or acquisition.   Sites are welcome to reflect their local
practice in the localizer and acquisition extent as long as they permit production of the reconstruction as
1288 specified here.

Table AAAA.3-2 CT Tumor Volumetric Measurement – Details - Acme

1290

Attribute	Tag	Value
Model Specification Sequence	(0018,9912)	
>Manufacturer	(0008,0070)	ACME
>Manufacturer's Related Model Group	(0008,0222)	Ultimate
>Software Versions	(0018,1020)	V3.1
Acquisition Protocol Element Specification Sequence	(0018,991F)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>*See Table AAAA.3-2a First Acquisition Protocol Element Specification*		
>Protocol Element Number	(0018,9921)	2
>Parameters Specification Sequence	(0018,9913)	
>>*See Table AAAA.3-2b Second Acquisition Protocol Element Specification*		
Reconstruction Protocol Element Specification Sequence	(0018,9933)	
>Protocol Element Number	(0018,9921)	1
>Parameters Specification Sequence	(0018,9913)	
>>*See Table AAAA.3-2c First Reconstruction Protocol Element Specification*		

1292 The following tables reflect the semantic contents of constraint sequences but not the actual structure of
the IOD.   The centered rows in italics clarify the context of the constrained attributes that follow by
1294 indicating which sequence in the performed module contains the constrained attribute (as specified in the
Selector Sequence Pointer).

1296 **Table AAAA.3-2a First Acquisition Protocol Element Specification**

Attribute	Selector Attribute	Select or Value	Selector Sequence Pointer	Selecto r Sequen	Constrai nt Type	Constraint Value

Attribute	Selector Attribute	Numbe r	Selector Sequence Pointer	ce Pointer Items	Constraint Type	Constraint Value
Acquisition Protocol Element Sequence (0018,9920)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	1	EQUAL	Localizer: Lateral
Acquisition Type	(0018,9302)	1	(0018,9920)	1	EQUAL	CONSTANT_ANGLE
Tube Angle	(0018,9303)	1	(0018,9920)	1	EQUAL	90
Acquisition Motion	(0018,9930)	1	(0018,9920)	1	EQUAL	FORWARD
>CT X-Ray Details Sequence (0018,9325) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	1\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	1\1	EQUAL	120
X-ray Tube Current in mA	(0018,9330)	1	(0018,9920), (0018,9325)	1\1	EQUAL	50

1298 **Table AAAA.3-2b Second Acquisition Protocol Element Specification**

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Acquisition Protocol Element Sequence (0018,9920)						
Protocol Element Name	(0018,9922)	1	(0018,9920)	2	EQUAL	Helical
Acquisition Type	(0018,9302)	1	(0018,9920)	2	EQUAL	SPIRAL
Revolution Time	(0018,9305)	1	(0018,9920)	2	EQUAL	0.5
Single Collimation Width	(0018,9306)	1	(0018,9920)	2	EQUAL	0.75
Total Collimation Width	(0018,9307)	1	(0018,9920)	2	EQUAL	48
Table Speed	(0018,9309)	1	(0018,9920)	2	EQUAL	27
>CT X-Ray Details Sequence (0018,9325) – First Beam						
Beam Number	(300A,00C0)	1	(0018,9920), (0018,9325)	2\1	EQUAL	1
KVP	(0018,0060)	1	(0018,9920), (0018,9325)	2\1	EQUAL	120
Exposure in mAs	(0018,9332)	1	(0018,9920), (0018,9325)	2\1	RANGE_IN CL	100, 260
Respiratory Motion Compensation Technique	(0018,9170)	1	(0018,9920), (0018,9325)	2\1	EQUAL	BREATH_HOLD

1300

Table AAAA.3-2c First Reconstruction Protocol Element Specification

Attribute	Selector Attribute	Selector Value Number	Selector Sequence Pointer	Selector Sequence Pointer Items	Constraint Type	Constraint Value
Reconstruction Protocol Element Sequence (yym8, m9x1)						
Protocol Element Name	(0018,9922)	1	(0018,9934)	1	EQUAL	"Transverse"
Source Acquisition Protocol Element Number	(0018,9938)	1	(0018,9934)	1	EQUAL	2
Source Acquisition Beam Number	(0018,9939)	1	(0018,9934)	1	EQUAL	1
Reconstruction Algorithm	(0018,9315)	1	(0018,9934)	1	EQUAL	FILTER_BACK_PROJ
Convolution Kernel	(0018,1210)	1	(0018,9934)	1	EQUAL	"B1"
Convolution Kernel Group	(0018,9316)	1	(0018,9934)	1	EQUAL	"LUNG"
Reconstruction Pixel Spacing	(0018,9322)	1	(0018,9934)	1	RANGE_INCL	0.55, 0.75
Slice Thickness	(0018,0050)	1	(0018,9934)	1	EQUAL	1.0
Spacing Between Slices	(0018,0088)	1	(0018,9934)	1	EQUAL	1.0
>Reconstruction Start Location Sequence (0018,993B)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993B)	1\1	EQUAL	"Top of Shoulders"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(T-D2220, SRT, "Shoulder region structure")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993B)	1\1	EQUAL	(128120, DCM, "Plane through Superior Extent")
>Reconstruction End Location Sequence (0018,993C)						
Reference Location Label	(0018,9900)	1	(0018,9934), (0018,993C)	1\1	EQUAL	"Mid-liver"
Reference Basis Code Sequence	(0018,9902)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(T-62000, SRT, "Liver")
Reference Geometry Code Sequence	(0018,9903)	1	(0018,9934), (0018,993C)	1\1	EQUAL	(128130, DCM, "Plane through Center")

1302