The Challenges of CT Accreditation: Introduction

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Outline

- Acknowledgements
- Resources
- Common Reasons for Failure
- ACR Accreditation: Table I
- GE Scanners
- Siemens Scanners
- Philips Scanners
- Toshiba Scanners
- Electronic Submission
- Panel Discussion

Disclaimer

- ACR CT Accreditation Physics Subcommittee
  - Charter member
  - Reviewer
- Alliance Medical Physics LLC
  - President
  - Medical Physics Consultant

Acknowledgements

- ACR CT Accreditation Physics Subcommittee
  - Dianna Cody, PhD Co-Chair
  - Doug Pfeiffer, MS Co-Chair
  - Cynthia McCollough, PhD
    - Former Chair
  - Michael McNitt-Gray, PhD
  - Thomas Payne, PhD
- ACR Staff
  - Theresa Branham
  - Dina Hernandez
  - Krista Bush

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  - Rich Mather, PhD
  - Kirsten L. Boedeker, PhD

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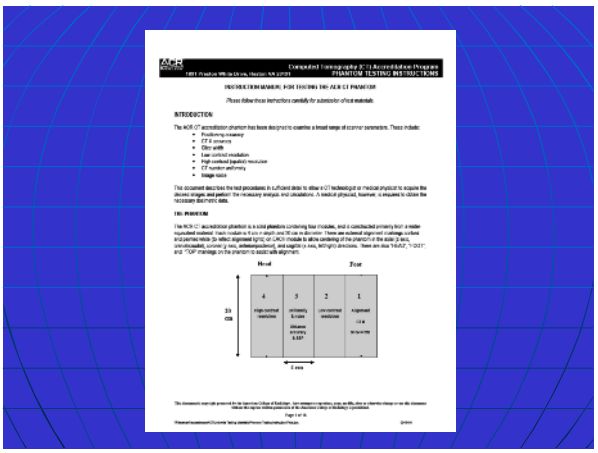
- Michael A. Tressler, MS, DABR
- Chad M. Dillon, MS

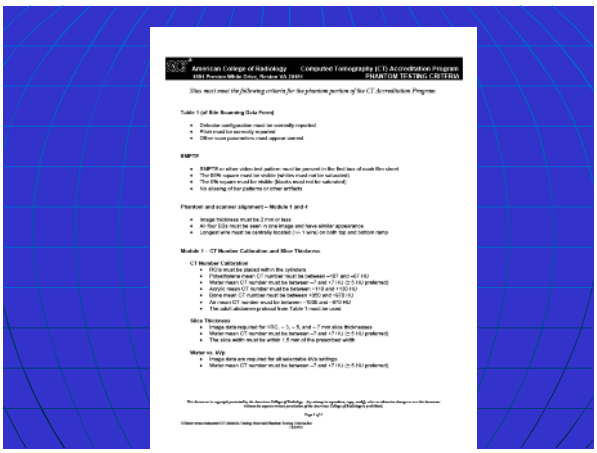
Resources

- ACR
  - 1-800-227-5463
    - Staff available to answer questions
    - Technical questions passed onto Physics subcommittee
  - www.acr.org/accreditation
- Medical Physicist
- Vendor
  - Service engineer
  - Applications Support
  - Operators Manual
  - Tips for Accreditation
- ImPACT
  - ImPACTscan.org

ACR

- Phantom Testing Instructions
- Phantom Testing Criteria
  - Take home test with the answers!
- Medical Physics 31(9) September 2004
  - Practical Tips, Artifact Examples, Pitfalls to Avoid
- FAQ's
  - Detector configurations (GE LS example)
  - Helical to axial conversion
  - Toshiba Dose
  - Toshiba FOV and CT numbers





Resource Personnel

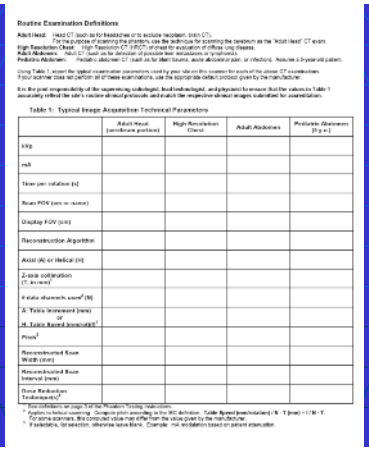
- Qualified Medical Physicist
  - Qualifications submitted to ACR with Entry Application
  - Experience with various scanners
- Service Engineer
  - Familiar with scanner operations and capabilities
  - Should be available to correct deficiencies
  - Service Mode access
- Applications Support
  - Familiar with scanner operations and capabilities

Scanner's Operators Manual

- Pro's
  - Detector configurations
  - Available slice reconstructions
  - Parameters are defined
- Con's
  - Not always easily accessible
    - Soft copies
  - May be difficult to find what is needed
- Tips for Accreditation
  - Supplied by some vendors upon request

Common Reasons for Failure

- Failure to follow instructions
- Phantom Alignment
  - Major Failure
- Improper scanning parameters used
  - Table I protocols do not match Protocols used
  - Helical to Axial conversions
  - mAs vs "effective mAs"
  - Medical Physicist vs Technologist
- Low Contrast Detectability
  - Cannot visualize at least all four 6 mm rods
- Dose
  - Incorrect parameters used
  - Dose Calculator Excel Spreadsheet *must* be used



Routine Examination Definitions

Adult Head: Head CT (such as for headaches or to exclude hemorrhage, brain CT).
For the purpose of scanning the phantom, use the technique for scanning the neurocranium as the "Adult Head" CT exam.
High Resolution Chest: High Resolution CT (HRCT) of chest for evaluation of diffuse lung disease.
Adult Abdomen: Adult CT (such as for detection of possible liver metastases or lymphoma).
Pediatric Abdomen: Pediatric abdomen CT (such as for infant trauma, acute abdominal pain, or infections). Assume a 5-year-old patient.

Using Table 1, report the typical examination parameters used by your site on this scanner for each of the above CT examinations.
If your scanner does not perform all of these examinations, use the appropriate default protocol given by the manufacturer.

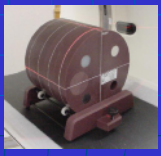
It is the joint responsibility of the supervising radiologist, lead technologist, and physicist to ensure that the values in Table 1 accurately reflect the site's routine clinical protocols and match the respective clinical images submitted for accreditation.

Table 1: Typical Image Acquisition Technical Parameters

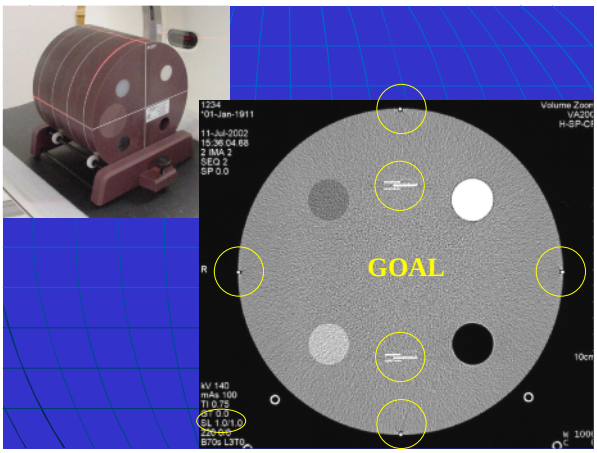
	Adult Head (axial/non-helical)	High Resolution Chest	Adult Abdomen	Pediatric Abdomen (5 y.o.)
kVp				
mA				
Time per rotation (s)				
Scan FOV (cm or name)				
Display FOV (cm)				
Reconstruction Algorithm				
Axial (A) or Helical (H)				
Z-axis collimation (T, in mm)[1]				
# data channels used[2] (N)				
Δ: Table increment (mm) or H: Table Speed (mm/rotation)[3]				
Pitch[2]				
Reconstructed Scan Width (mm)				
Reconstructed Scan Interval (mm)				
Dose Reduction Techniques[4]				

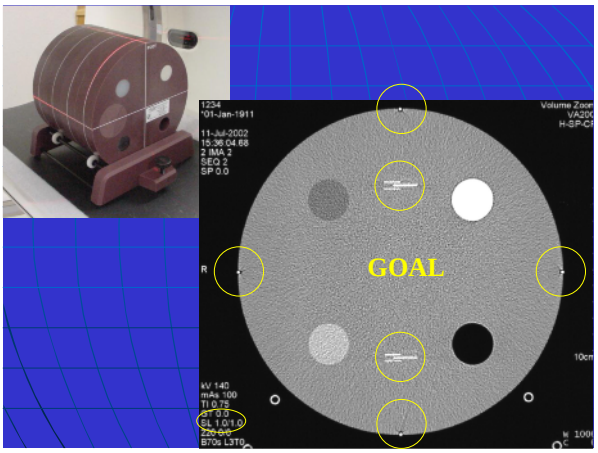
[1] See definitions on page 7 of the Phantom Testing Instructions
[2] Applies to helical scanning. Compute pitch according to the IRC definition. Table Speed (mm/rotation) / N · T (mm) = 1/ N · T.
[3] For some scanners, this computed value may differ from the value given by the manufacturer.
[4] If applicable, list selection, otherwise leave blank. Example: mA modulation based on patient exam.editor.

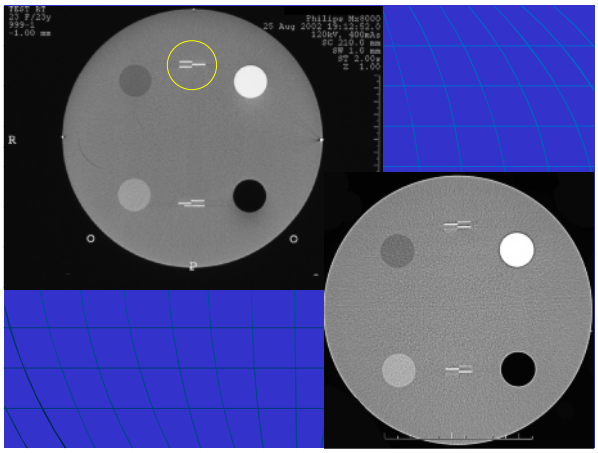
ACR Phantom Gammex 464

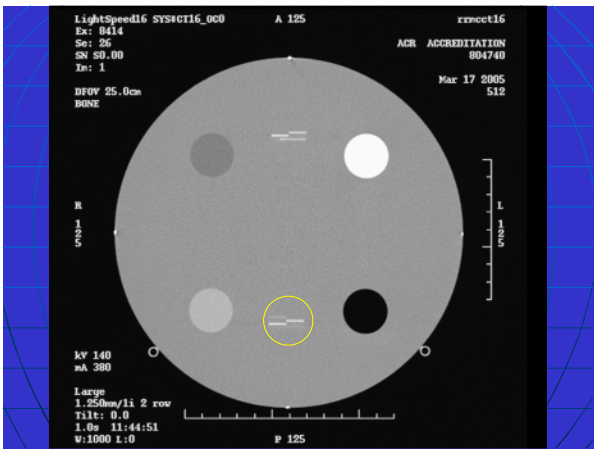


Phantom Alignment








LightSpeed16 SYS#CT16_OCO
A 125
rrnoct16
Ex: 8414
Se: 26
SN S0.00
In: 1
ACR ACCREDITATION
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Mar 17 2005
512
DFOV 25.0cm
BONE
R
L
kV 140
mA 380
Large
1.250mm/1i 2 rov
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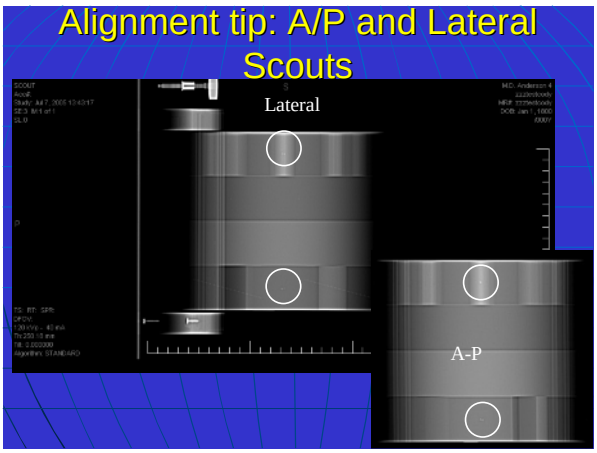
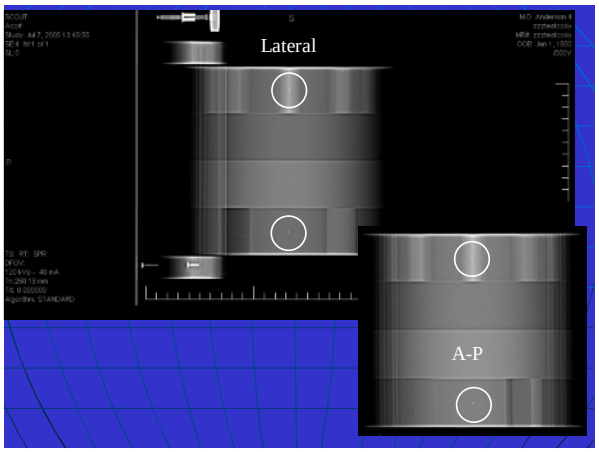
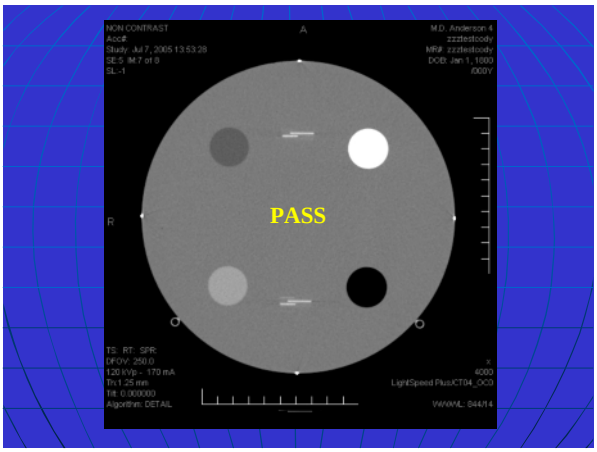
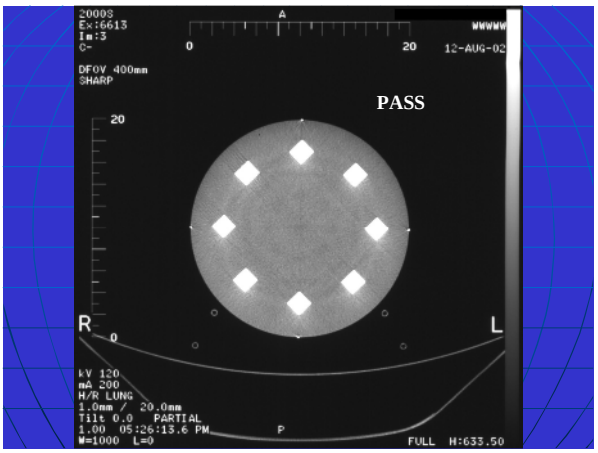
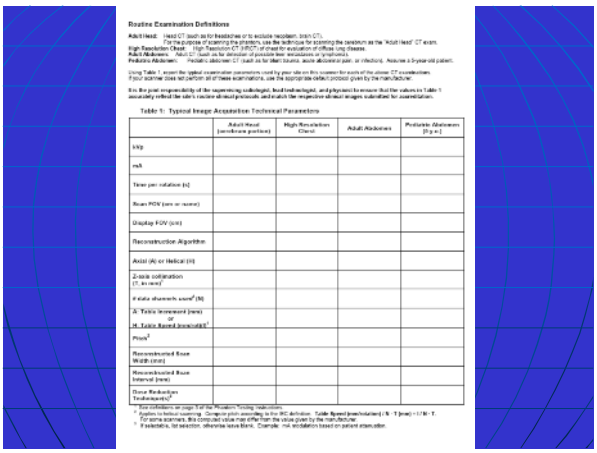
1.0s 11:44:51
W:1000 L:0
P 125


Alignment tip: A/P and Lateral Scouts
Lateral
A-P


Lateral
A-P


PASS





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High Resolution Chest: High Resolution CT (HRCT) of chest for evaluation of diffuse lung disease.
Adult Abdomen: Adult CT (such as for detection of possible liver metastases or lymphoma).
Pediatric Abdomen: Pediatric abdomen CT (such as for Wilm's tumor, acute abdomen or pain, or infection). Assume a 5-year-old patient.

Using Table 1, report the typical examination parameters used by your site on this scanner for each of the above CT examinations. If your scanner does not perform all of these examinations, use the appropriate default protocol given by the manufacturer.

It is the joint responsibility of the supervising radiologist, lead radiologist, and physicist to ensure that the values in Table 1 accurately reflect the site's routine clinical protocols and match the respective clinical images submitted for accreditation.

Table 1: Typical Image Acquisition Technical Parameters

	Adult Head (cerebrum portion)	High Resolution Chest	Adult Abdomen	Pediatric Abdomen (5 y.o.)
kVp				
mA				
Time per rotation (s)				
Scan FOV (mm or none)				
Display FOV (cm)				
Reconstruction Algorithm				
Axial (A) or Helical (H)				
Z-axis collimation (T, in mm)				
# data channels used[2] (N)				
A: Table increment (mm) or H: Table Speed (mm/sec)[1]				
Pitch[2]				
Reconstructed Slice Width (mm)				
Reconstructed Slice Interval (mm)				
Dose Reduction Techniques[3]				

[1] See definitions on page 3 of the Phantom Testing Instructions.
[2] Applies to helical scanning. Compute pitch according to the IEC definition: Table Speed (mm/rotation) / (N · T) (mm) = I / N · T.
For some scanners, this computed value may differ from the value given by the manufacturer.
[3] If selectable, list selection, otherwise leave blank. Example: mA modulation based on patient attenuation.

Table I Parameters

- kVp
  - Must be tested if not disabled. Does not matter if they are used clinically or not.
  - For all scanners, a kVp may not be available for a given time and mA combination. Keep mAs the same and increase the rotation time or keep mA/mAs as close as possible to Table I.
  - Remember available kVp's are entered into page 1 of Site Scanning Data Sheet.

Table I Parameters

- mA
  - Typically mAs is displayed
    - mAs/time = mA
  - Effective mAs
    - Effective mAs = mAs/Pitch
  - mA modulation?
    - Determine average mA or mAs
      - Enter average value into Table I

mAs

- GE
  - mAs = mAs
- Philips
  - mAs/slice = effective mAs = mAs/Pitch
  - mAs = effective mAs * Pitch
- Siemens
  - Effective mAs = mAs/Pitch
  - mAs = effective mAs * Pitch
- Toshiba
  - mAs = mAs
  - Toshiba 32 and 64
    - Eff mAs

Table I Parameters

- Time per rotation(s) in sec
  - Partial scans
    - <0.4 sec/rotation
    - 270° rotation
    - Affects CTDI measurements
  - Overscans
    - 420° rotation
    - Affects CTDI measurements
  - Use Time per 360° rotation for dose measurements

Table I Parameters

- Scan Field of View (SFOV)
  - in cm or name
    - 25 cm, 50 cm, Large, Medium & Small Body, Head
    - Note: Head and Body use different Bowtie filters
    - Siemens 64 has 70 cm SFOV option
    - Toshiba has 18 cm, 24 cm, 32 cm,40 cm & 50 cm
      - Must use appropriate SFOV for phantom, even though the protocol may be different

Table I Parameters

- Display Field of View (DFOV)
  - 5 cm – 50 cm (70cm)
  - Select appropriate for phantom
  - ACR recommends closest to, but not <21 cm for ACR phantom (20 cm phantom)
    - 24 cm – 25 cm DFOV prevents displayed text obstruction
  - CTDI body
    - 32 cm diameter
      - 35 – 40 cm DFOV
  - CTDI head
    - 16 cm diameter
      - 20 cm – 35 cm DFOV

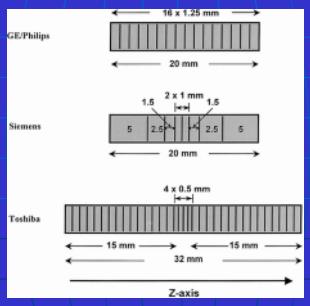
Table I Parameters

- Reconstruction Algorithm
  - Equipment manufacturer specific
  - High Resolution Chest algorithm is usually Lung, Detail or Bone (sharp or very sharp)
    - Must use for high resolution image at S120
- Axial (A) or Helical (H)
  - Indicate mode used for clinical protocol

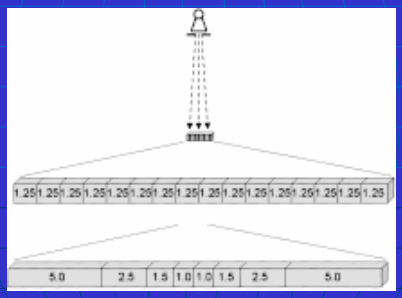
Table I Parameters Detector Configurations

- Z axis collimation (in mm)
  - Width of the tomographic section along the z axis imaged by one data channel
  - Note: In MDCT, several detector elements may be grouped together to form one data channel
- # Data Channels (N) in a single axial scan
- N x T = detector configuration = total effective x-ray beam width

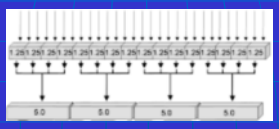
Detector Arrays



z = 20 mm, 16 vs 8 detectors

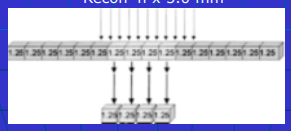


Equal Width Array



16 det x 1.25 mm

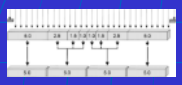
Recon 4i x 5.0 mm



4 det x 1.25 mm

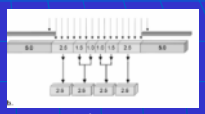
Recon 4i x 1.25 mm

Unequal Width Array



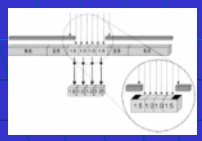
8 detectors

recon 4i x 5.0 mm

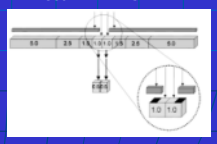


6 detectors

recon 4i x 2.5 mm



4 detectors recon 4i x 1.0 mm
Note: collimate outer 3rd of outer detectors



2 detectors recon 2i x 0.5 mm
Note: collimate outer half of detectors

Comparison of Early Detector Designs

Vendor	# of Detector elements	Type of Array	Detector Widths
GE	16	Equal	16 x 1.25
Marconi	8	Unequal	2 x 1.0, 2 x 1.5, 2 x 2.5, 2 x 5.0
Siemens	8	Unequal	2 x 1.0, 2 x 1.5, 2 x 2.5, 2 x 5.0
Toshiba	34	Unequal	4 x 0.5 30 x 1.0

Table I Parameters

- Pitch (IEC)
  - P = I / (N * T)
  - I = Table Speed in mm/rotation
  - N = # data channels
  - T = detector width in z axis
  - N * T = collimated x-ray beam width

Table I Parameters

- Example of Pitch
  - I = 15 mm / rotation
  - N = 4 data channels
  - T = 2.5 mm detector width
  - P = (15.0 mm/rotation)/(4 x 2.5 mm)
  - P = 15.0/10.0 = 1.5

Table I Parameters

- Pitch
  - Determines effective mAs
    - = mAs/Pitch
  - Determines CTDIvol
    - = CTDIw/Pitch
    - Used to also derive DLP and effective dose

Table Parameters

- Reconstruction Scan Width
  - Image thickness of reconstruction images
- Reconstruction Scan Interval
  - Interval between reconstructed images

Table I Parameters

- Dose Reduction Techniques
  - mA modulation
    - Auto mA/Smart mA
    - CAREDOSE
    - Doseright
    - Real EC
    - SureExposure3D
  - Clinical use recorded in Table I
    - Not used to obtain images

CT Dosimetry

- Must measure CTDI in Axial Mode
- Must use Technique in Table I for Adult Head, Adult Abdomen and Pediatric Abdomen (unless attested)
  - Use mAs vs effective mAs
- Adult Head in Head Holder
- Adult Abdomen and Pediatric Abdomen on Table
- Must fill all Phantom Holes
- Must use Dose Calculator Spreadsheet

CT Dosimetry

- Must use Clinical/Table I Techniques
- Must use Axial scan to measure CTDI
- When Clinical protocol is Helical
  - Convert to Axial
  - Use Axial scan with effective x-ray beam width closest to clinically used
  - Enter detector configuration used to obtain dose measurement
  - Adjust Table Speed to provide appropriate Pitch
- Use mAs not effective mAs
  - Effective mAs will yield CTDIvol instead of CTDIw

CT Dosimetry

- Must meet Dose Criteria
  - Pass/Fail
    - Adult Head: 80 mGy
    - Pediatric Abdomen: 25 mGy
    - Adult Abdomen: 30 mGy
  - Reference Values
    - Adult Head: 75 mGy
    - Pediatric Abdomen: 20 mGy
    - Adult Abdomen: 25 mGy

CT Dosimetry

- Compare CTDIvol with:
  - Displayed
  - Dose Calculator Programs
    - ImPACT
- Caveat:
  - Pediatric
    - Dependent on SFOV used
      - 16 cm vs 32 cm CTDI phantoms

Tips for success

- Follow instructions
- Know your scanner
  - Enlist technologist assistance
- Verify Scanner is calibrated and all previously identified deficiencies are corrected
- Use resources
  - Service engineer should be available
- Be your own reviewer!

The Challenges of CT Accreditation GE CT Scanners

Thomas G. Ruckdeschel, MS, DABR
Diagnostic Radiological Physicist
Medical Nuclear Physicist
Alliance Medical Physics LLC

GE Lightspeed (4 Detectors)

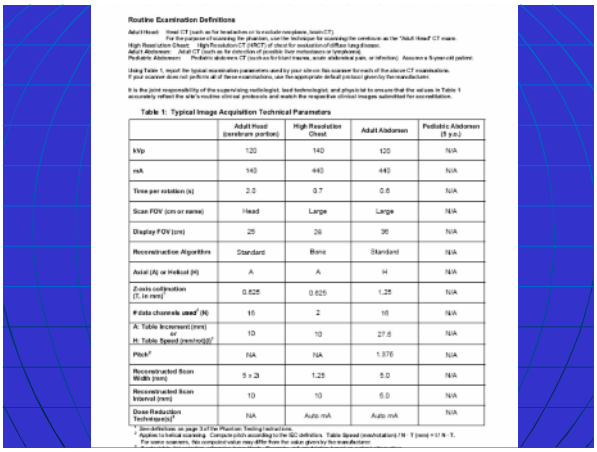
ACR FAQ
Provided with accreditation material

NOTE: The shaded cells in the table below are instances where the reconstructed slice thickness (Thick) is not the same as the channel thickness T.

If Helical Protocol is:			Then Measure in Axial Mode with: (for module 1 and CTDI)		Calculate CTDIvol with	
Thick (mm)	TableSpeed (mm/rot)	Pitch	N	T(in mm)	Table Speed(mm/rot)	Pitch(I definiti
1.25	3.75	HQ	4 (4i mode)	1.25 mm	3.75	0.75
1.25	7.5	HS	4	1.25	7.5	1.5
2.5	3.75	HQ	4	1.25	3.75	0.75
2.5	7.5	HQ	4	2.5	7.5	0.75
2.5	7.5	HS	4	1.25	7.5	1.5
2.5	15	HS	4	2.5	15	1.5
3.75	7.5	HQ	4	2.5	7.5	0.75
3.75	11.25	HQ	4	3.75	11.25	0.75
3.75	15	HS	4	2.5	15	1.5
5	7.5	HQ	4	2.5	7.5	0.75
5	11.25	HQ	4	3.75	11.25	0.75
5	15	HQ	4	5	15	0.75
5	15	HS	4	2.5	15	1.5
5	22.5	HS	4	3.75	22.5	1.5
5	30	HS	4	5	30	1.5
7.5	11.25	HQ	4	3.75	11.25	0.75
7.5	15	HQ	4	5	15	0.75
7.5	22.5	HS	4	3.75	22.5	1.5
7.5	30	HS	4	5	30	1.5
10	15	HQ	4	5	15	0.75
10	30	HS	4	5	30	1.5

GE Lightspeed 16

- Detector Configuration
  - 16 x 0.625 mm = 10.0 mm
  - 8 x 1.25 mm = 10.0 mm
  - Total effective length = 20.0 mm
  - Helical (# simultaneous slices/rotation time)
    - 2, 4, 8 & 16
- Simultaneous slices/rotation
  - 2 x 0.625 mm, 4 x 3.75 mm, 16 x 0.625 mm
  - 8 x 1.25 mm, 16 x 1.25 mm, 8 x 2.5 mm



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Adult Abdomen: Adult CT (such as for detection of possible liver metastases or lymphoma).
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Using Table 1, report the typical examination parameters used by your site on this scanner for each of the above CT examinations. If your scanner does not perform all of these examinations, use the appropriate default protocol given by the manufacturer.

It is the joint responsibility of the supervising radiologist, lead technologist, and physicist to ensure that the values in Table 1 accurately reflect the site's routine clinical protocols and match the respective clinical images submitted for accreditation.

Table 1: Typical Image Acquisition Technical Parameters

	Adult Head (cerebrum portion)	High Resolution Chest	Adult Abdomen	Pediatric Abdomen (5 y.o.)
kVp	120	140	120	N/A
mA	140	440	440	N/A
Time per rotation (s)	2.0	0.7	0.6	N/A
Scan FOV (cm or name)	Head	Large	Large	N/A
Display FOV (cm)	25	28	36	N/A
Reconstruction Algorithm	Standard	Bone	Standard	N/A
Axial (A) or Helical (H)	A	A	H	N/A
Z-axis collimation (T, in mm)	0.625	0.625	1.25	N/A
# data channels used[1] (N)	16	2	16	N/A
A: Table Increment (mm) or H: Table Speed (mm/rot)[2]	10	10	27.5	N/A
Pitch[2]	N/A	N/A	1.375	N/A
Reconstructed Scan Width (mm)	5 x 2	1.25	5.0	N/A
Reconstructed Scan Interval (mm)	10	10	5.0	N/A
Dose Reduction Technique(s)[3]	N/A	Auto mA	Auto mA	N/A

[1] See definitions on page 3 of the Phantom Testing Instructions.
[2] Applies to helical scanning. Compute pitch according to the IEC definition. Table Speed (mm/rotation) / N · T (mm) = H / N · T.
[3] For some scanners, this computed value may differ from the value given by the manufacturer.

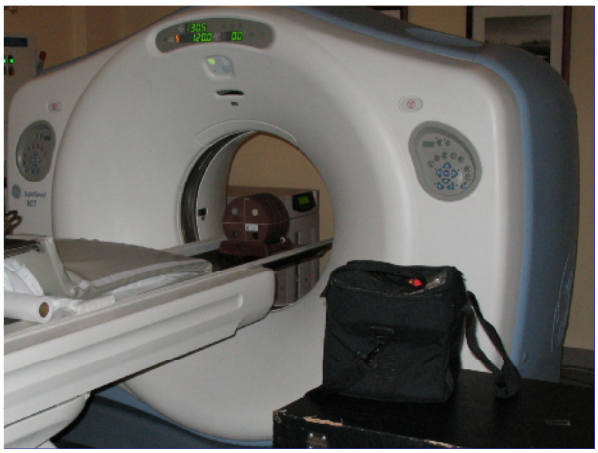
GE Lightspeed 32

- Detector Configuration
  - 32 x 0.625 mm = 20.0 mm
  - 16 x 1.25 mm = 20.0 mm
  - Total effective length = 40.0 mm
  - Helical (# simultaneous slices/rotation time)
    - 8 & 32
- Simultaneous slices/rotation
  - 8 x 0.625 mm, 32 x 0.625 mm, 32 x 1.25 mm

GE Lightspeed 64 (VCT)

- LS VCT (64)
  - 64 x 0.625 mm = 40.0 mm
  - Helical (# simultaneous slices/rotation time)
    - 8, 32 & 64
- Simultaneous slices/rotation
  - 8 x 0.625 mm, 32 x 0.625 mm, 32 x 1.25 mm
  - 64 X 0.625 mm

GE VCT 64 CT



Routine Examination Definitions

Adult Head: Head CT (such as for headaches or to exclude neoplasm, brain CT).
For the purpose of scanning the phantom, use the technique for scanning the cerebrum as the "Adult Head" CT exam.
High Resolution Chest: High-Resolution CT (HRCT) of chest for evaluation of diffuse lung disease.
Adult Abdomen: Adult CT (such as for detection of possible liver metastases or lymphoma).
Pediatric Abdomen: Pediatric abdomen CT (such as for blunt trauma, acute abdominal pain, or infection). Assume a 5-year-old patient.

Using Table 1, input the typical examination parameters and by your site on this scanner for each of the above CT examinations.
If your scanner does not perform all of these examinations, use the appropriate default protocol given by the manufacturer.

It is the joint responsibility of the supervising radiologist, lead technologist, and physicist to ensure that the values in Table 1 accurately reflect the site's routine clinical protocols and match the respective clinical images submitted for accreditation.

Table 1: Typical Image Acquisition Technical Parameters

	Adult Head (cerebrum portion)	High Resolution Chest	Adult Abdomen	Pediatric Abdomen (5 y.o.)
kVp	120	120	120	120
mA	265	375	500	100
Time per rotation (s)	1	0.5	0.5	0.4
Scan FOV (cm or name)	Head	Large Body	Large Body	Medium Body
Display FOV (cm)	25	36	36	25
Reconstruction Algorithm	Standard	Bone +	Standard	Standard
Axial (A) or Helical (H)	A	A	H	H
Z-axis collimation (T, in mm)[1]	0.625	1.25	0.625	0.625
# data channels used[2] (N)	32	1	64	32
A: Table Increment (mm) or H: Table Speed (mm/rot)[3]	20	10	55	27.5
Pitch[3]	NA	NA	1.375	1.375
Reconstructed Scan Width (mm)	5	1.25	5	5
Reconstructed Scan Interval (mm)	5	10	5	5
Dose Reduction Technique(s)[4]	Smart mA	Smart mA	Smart mA	Smart mA

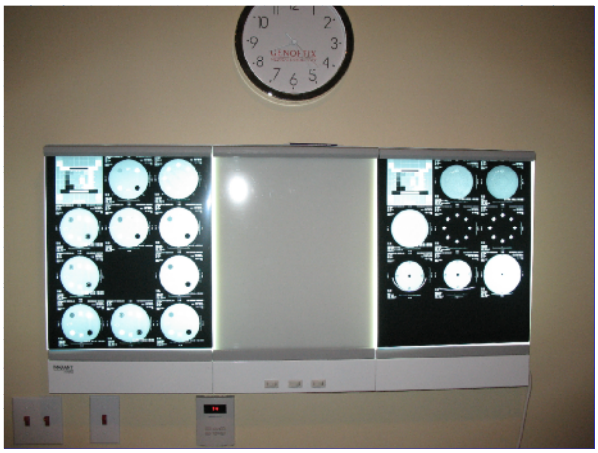
[1] See definitions on page 3 of the Phantom Testing instructions.
[2] Applies to helical scanning. Compute pitch according to the IEC definition. Table Speed (mm/rotation) / N · T (mm) = H / N · T.
For some scanners, this computed value may differ from the value given by the manufacturer.
[3] If selectable, for selection, otherwise leave blank. Example: mA modulation based on patient attenuation.

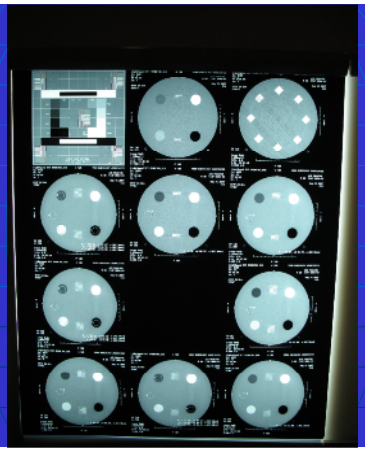
SMPTE Pattern

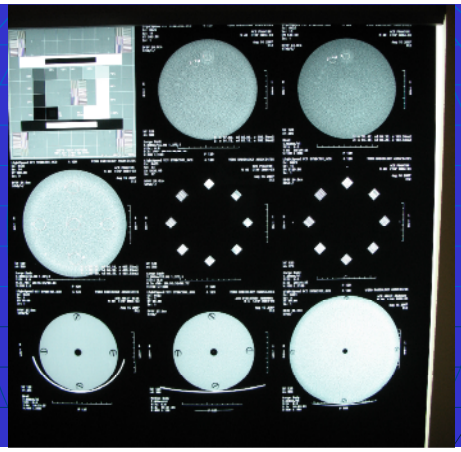
- Usually loaded and stored in Browser
- If not, Use Service Browser
  - Image Quality
  - Install SMPTE

Slice Thickness

- All requested slice thicknesses available
- GE VCT (64)
  - CT # vs Slice Thickness
    - > 5.0 mm slice thickness unavailable







Low Contrast

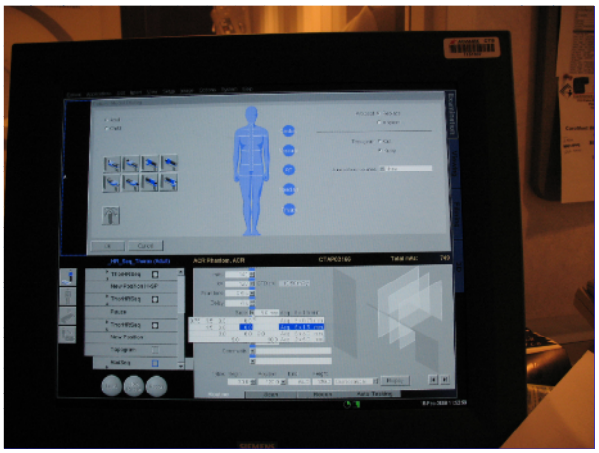
- Verify that low contrast criteria pass with Clinically used Technique
  - Must visualize all four 6.0 mm rods
  - If not, optimize technique, consult with site and adjust protocol
    - Table I

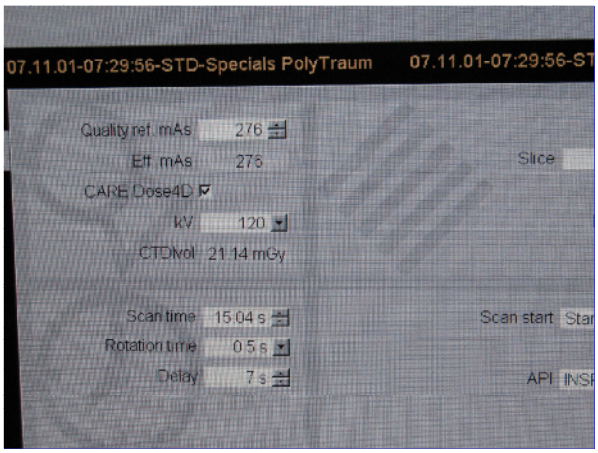
CT Dosimetry

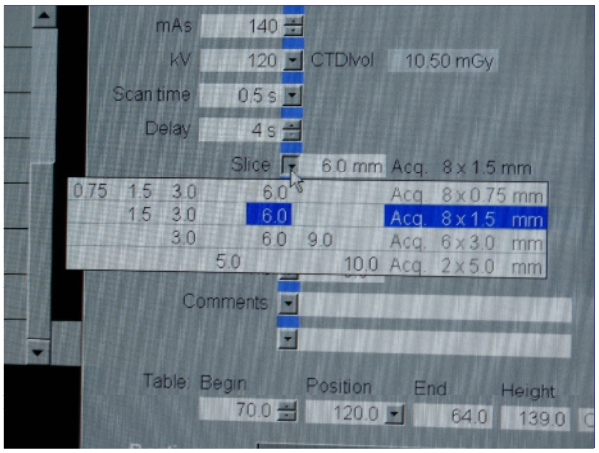
- Convert Helical Technique to Axial Technique
  - 4 slice
    Helical = 4 x 3.75 mm = 15 mm , I = 10 mm/rot
    Pitch = 1.5
    Axial = 4 x 3.75 mm = 15 mm, Table Feed = 0 mm
  - 64 slice
    Helical = 64 x 0.625 mm = 40 mm, I = 55 mm/rot
    Pitch = 1.375
    Axial = 64 x 0.625 mm = 40 mm, Table Feed = 0 mm

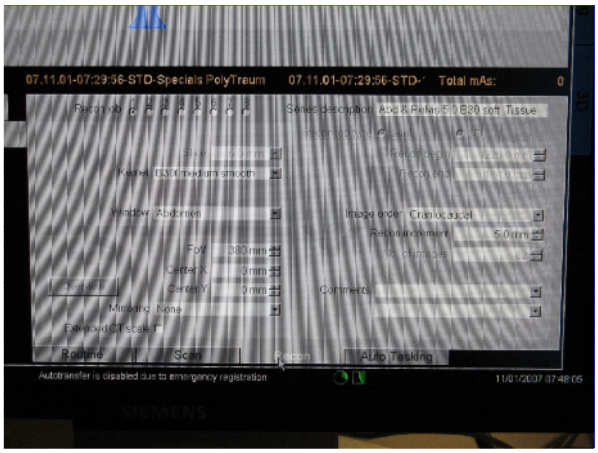
The Challenges of CT Accreditation

Siemens Scanners




07.11.01-07:29:56-STD-Specials PolyTraum
07.11.01-07:29:56-ST
Quality ref. mAs 276
Eff. mAs 276
Slice
CARE Dose4D
kV 120
CTDIvol 21.14 mGy
Scan time 15.04 s
Scan start
Rotation time 0.5 s
Delay 7 s
API


mAs 140
kV 120
CTDIvol 10.50 mGy
Scan time 0.5 s
Delay 4 s
Slice 6.0 mm Acq. 8 x 1.5 mm
0.75 1.5 3.0 6.0 Acq. 8 x 0.75 mm
1.5 3.0 6.0 Acq. 8 x 1.5 mm
3.0 6.0 9.0 Acq. 6 x 3.0 mm
5.0 10.0 Acq. 2 x 5.0 mm
Comments
Table Begin Position End Height
70.0 120.0 64.0 139.0


07.11.01-07:29:56-STD-Specials PolyTraum
Total mAs:
Comments
Routine
Scan
Recon
Auto Tasking
Autotransfer is disabled due to emergency registration
SIEMENS

Siemens Sensation 10

- Detector Elements
  - 16 x 0.75 mm and 8 x 1.5 mm for a total "maximum" effective length of 24 mm @ isocenter

Siemens Sensation 10

- **Nominal slice widths (Axial)**
  - 0.6 mm, 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm, 4.5 mm, 5.0 mm, 6.0 mm, 9.0 mm & 10.0 mm
- **Nominal slice widths and simultaneous slices (Axial)**
  - 10 x 0.75 mm, 10 x 1.5 m, 2 x 0.6 mm, 2 x 1.0 mm, 6 x 3.0 mm and 2 x 12.0 mm

Siemens Sensation 10

- Important Notes:
  - The 0.6 mm detector is available on Head Work & extremities
  - 0.75 mm and 1.5 mm are available in all modes
  - 1.5 mm Helical can be reconstructed as 2.0 mm, 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm, 7.0 mm, 8.0 mm & 10.0 mm

Siemens Sensation 10

- **Head (Axial):**
  - 0.75 mm can be reconstructed as 0.75 mm, 1.5 mm, 3.0 mm & 6.0 mm
  - 1.5 mm can be reconstructed as 1.5 mm 3.0 mm & 6.0 mm
  - 0.6 mm can be reconstructed as 0.6 mm, 0.75, 1.0, 1.5

Siemens Sensation 10

- **Head (Helical):**
  - 10 x 0.75 mm can be reconstructed as 0.75 mm,1.5 mm, 2.0 mm, 3.0 mm, 4.5 mm, 6.0 mm, 7.0 mm, 8.0 mm & 10.0 mm
  - 10 x 1.5 mm can be reconstructed as 1.5 mm, 2.0 mm, 3.0 mm, 4.5 mm, 6.0 mm, 7.0 mm, 8.0 mm & 10.0 mm

Siemens Sensation 10

- **Detailed Head Work**:
  - 0.6 mm 2 x 0.6 mm can be reconstructed as 0.6 mm
  - 6 x 0.75 mm can be reconstructed as 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm, 4.0 mm, 5.0 mm & 6.0 mm
  - 6 x 3.0 mm can be reconstructed as 4.0 mm, 5.0 mm, 6.0 mm, 7.0 mm, 8.0 mm & 10.0 mm

Siemens Sensation 10

- **Abdomen (Axial):**
  - 8 x 0.75 mm can be reconstructed as 0.75 mm, 1.5 mm, 3.0 mm & 6.0 mm
  - 8 x 1.5 mm can be reconstructed as 1.5 mm, 3.0 mm & 6.0 mm
  - 6 x 3.0 cam be reconstructed as 3.0 mm, 6.0 mm & 9.0 mm
  - 2 x 5.0 mm can be reconstructed as 5.0 mm & 10.0 mm

Siemens Sensation 10

- **Abdomen (Helical):**
  - 10 x 0.75 mm can be reconstructed as 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm, 4.0 mm, 5.0 mm & 6.0 mm
  - 10 x 1.5 mm can be reconstructed as 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm, 4.0 mm, 5.0 mm & 6.0 mm
  - 6 x 3.0 mm can be reconstructed as 3.0 mm & 6.0 mm

Siemens Sensation 10

- Reconstructed slice widths available in Axial Mode:
  - 0.6 mm, 0.75 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm, 4.5 mm, 5.0 mm, 6.0 mm, 7.0 mm, 8.0 mm, 9.0 mm & 10.0 mm

Helical to Axial Slice Thickness

- Sensation 10
  - Abdomen Helical:
    - 10 x 1.5 mm
      - 5.0 mm slice recon
  - Abdomen Axial:
    - 8 x 1.5 mm
      - 3.0 mm or 6.0 mm slice recon
    - 2 x 5.0 mm
      - 5.0 mm

Siemens Sensation 16

Mode	Maximum # Detectors/rot	Detector Configurations	Reconstructed image thickness
Axial	12	12 x 1.5 mm 12 x 0.75 mm 6 x 3.0 mm 2 x 0.6 mm 2 x 5.0 mm	4i x 4.5 mm 3i x 3.0 mm 6i x 3.0 mm; 2i x 9.0 mm 2i x 0.6 mm; 1i x 1.25 mm 2i x 5.0 mm
Helical	16	16 x 1.5 mm 16 x 0.75 mm	5.0 mm 4.0 mm

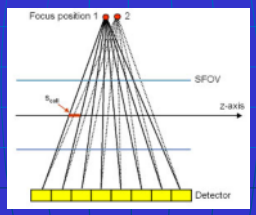
Siemens Sensation 64 Detector Configurations

- 64 x 0.6 mm, 20 x 0.6mm, 12 x 0.6 mm
- 24 x 1.2 mm, 3 x 1.2 mm
- 6 x 3.0 mm, 3 x 6.0 mm, 2 x 9.0 mm
- 12 x 2.4 mm, 6 x 4.8 mm, 4 x 7.2 mm
- 3 x 9.6, 2 x 14.4 mm
- 1 x 5.0 mm, 1 x 10.0 mm
- 6 x 0.6 mm, 3 x 1.2 mm
- 2 x 1.8 mm, 1 x 3.6 mm
- Note:
  - effective length of each element @ isocenter
    - 32 x 0.6 mm = 19.2 mm
      - "flying" focal spot doubles # images
        - 64 x 0.3 mm = 19.2 mm
    - 8 x 1.2 mm = 9.6 mm
    - Total effective length= 28.8 mm

Siemens Sensation 64 CT

- Dose Measurements
  - Technique may use 64 detector elements
  - Axial Techniques permit 32 detector elements only
  - Important Note: “Flying focal spot” uses 32 detector elements

Flying Focal Spot



The ACR instructions state that the CT dosimetry spreadsheet should use the techniques provided in Table I which should also be the techniques that are used clinically. If the technique is 120kVp, 276 effective mAs, 0.5 seconds per rotation, N = 64 and T = 0.6 mm, Pitch = 0.75 then the Table I should be completed as follows:

Siemens Sensation 64

- kVp: 120
- mA: 414
  - If effective mAs = 276 mAs, Pitch = 0.75, and mAs = effective mAs x Pitch then,
    mAs = 276 x 0.75 = 207 mAs
  - If mAs = mA x time in sec then,
    mA = mAs/time
    mA = 207 mAs/ 0.5 sec = 414 mA
- Time per rotation: 0.5 sec

Siemens Sensation 64

- Scanner Technique
  - T = 0.6 mm and N = 64 ??
  - Flying Focal Spot
    - T = 0.6 mm and N = 32
- Pitch: 0.75
- What is the *Table Speed?:
  - Pitch = Table Speed/ N x T
  - Table Speed = Pitch x N x T
  - Table Speed = 0.75 x 32 x 0.6 = 14.4 mm/rot

* The table speed is not displayed but is determined from the IEC definition of Pitch; P = Table speed (mm/rot)/ N x T

Routine Examination Definitions

Adult Head: Head CT (such as for headaches or to exclude neoplasm, brain CT).
For the purpose of scanning the phantom, use the technique for scanning the cerebrum as the "Adult Head" CT exam.
High Resolution Chest: High Resolution CT (HRCT) of chest for evaluation of interstitial lung disease.
Adult Abdomen: Adult CT of the abdomen (such as for kidney stones, appendicitis, cholecystitis).
Pediatric Abdomen: Pediatric abdomen CT (such as for blunt trauma, acute abdominal pain, or infection). Assume a 5-year-old patient.

Using Table 1, report the typical examination parameters used by your site on this scanner for each of the above CT examinations. If your scanner does not perform all of these examinations, use the appropriate default protocol given by the manufacturer.

It is the joint responsibility of the supervising radiologist, lead technologist, and physicist to ensure that the values in Table 1 accurately reflect the site's routine clinical protocols and match the respective clinical images submitted for accreditation.

Table 1: Typical Image Acquisition Technical Parameters

	Adult Head (cerebrum portion)	High Resolution Chest	Adult Abdomen	Pediatric Abdomen (5 y.o.)
kVp	120	120	120	120
mA	390	390	414	218
Time per rotation (s)	1	0.5	0.5	0.5
Scan FOV (cm or name)	20	30	32.5	19
Display FOV (cm)	20	30	32.5	19
Reconstruction Algorithm	H40s Medicure	B60s Sharp	B30f Med Smooth	B30f Med Smooth
Axial (A) or Helical (H)	A	A	H	H
Z-axis collimation (T, in mm)	0.5	1.0	0.5	1.2
# data channels used[2] (N)	32	2	32	24
A: Table Increment (mm) or H: Table Speed (mm/sec)[3]	10	10	14.4	34.56
Pitch[4]	NA	NA	0.75	1.2
Reconstructed Scan Width (mm)	3	1	5	3
Reconstructed Scan Interval (mm)	3	10	5	3
Dose Reducing Technique(s)[5]	None	Care Dose 4D	Care Dose 4D	Care Dose 4D

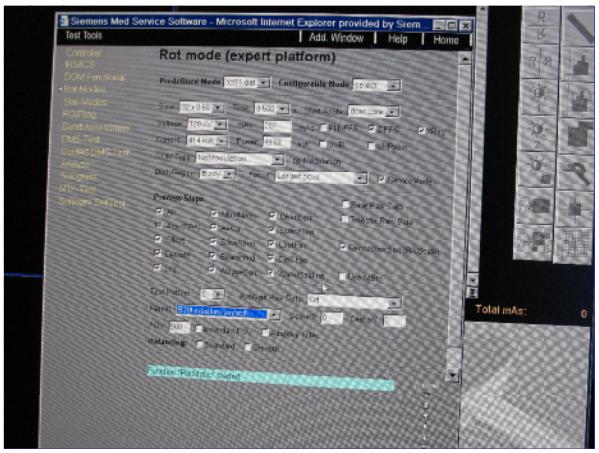
[1] See definitions on page 3 of the Phantom Testing instructions.
[2] Applies to helical scanning. Compute pitch according to the IEC definition. Table Speed (mm/rotation) (N · T (mm) ÷1) N · T.
For some scanners, this computed value may differ from the value given by the manufacturer.
[3] If calculable, list selection, otherwise leave blank. Example: mA modulation based on patient attenuation.

Service Engineer

- Service Mode
  - Permits all technique combinations for all modes
  - (Rotate) Rot Mode
    - Imaging
  - (Stationary) Stat Mode
    - Generator tests
      - kVp
      - HVL

Service Mode

- Problems
  - Need service engineer
  - Difficulty filming from service mode
- QC or Physics Mode?



Anticipated Options for ACR Accreditation

- Potential Change of phantom alignment criteria from Major to Minor deficiency?
- Allow Helical scan with appropriate SFOV for CT # accuracy
  - Acrylic (+110 to +135)
- Use Adult Head protocol for CT# water and slice thickness
- When Abdomen Protocol kVp is 140 kVp, use 120 kVp for CT# accuracy
- Remove conversion of helical protocol to axial except for Dose
- Add to instructions method to determine mAs for mA modulated techniques

Anticipated Options for ACR Accreditation

- New definitions and calculations to instructions:
  - Add mAs & effective mAs to Table I
  - Instructions to include N & T on e submissions
  - T = the width of the tomographic section along the z-axis imaged by one data channel. In multi-detector-row CT, several detector elements may be grouped together to form one data channel. In single-detector-row CT, the value of T is equal to the nominal scan width.

    N = the number of tomographic sections imaged in a single axial scan (one rotation of the x-ray source). This is equal to the number of data channels used in a particular scan. The value of N may be less than or equal to the maximum number of data channels available on the system.

Thank you!