

Gammex RMI CT Phantom, 438 (ACR CT Accreditation phantom, 464)

S. Edyvean, Jim Weston

Imaging Performance Assessment of CT Scanners

St. Georges Hospital, London

www.impactscan.org

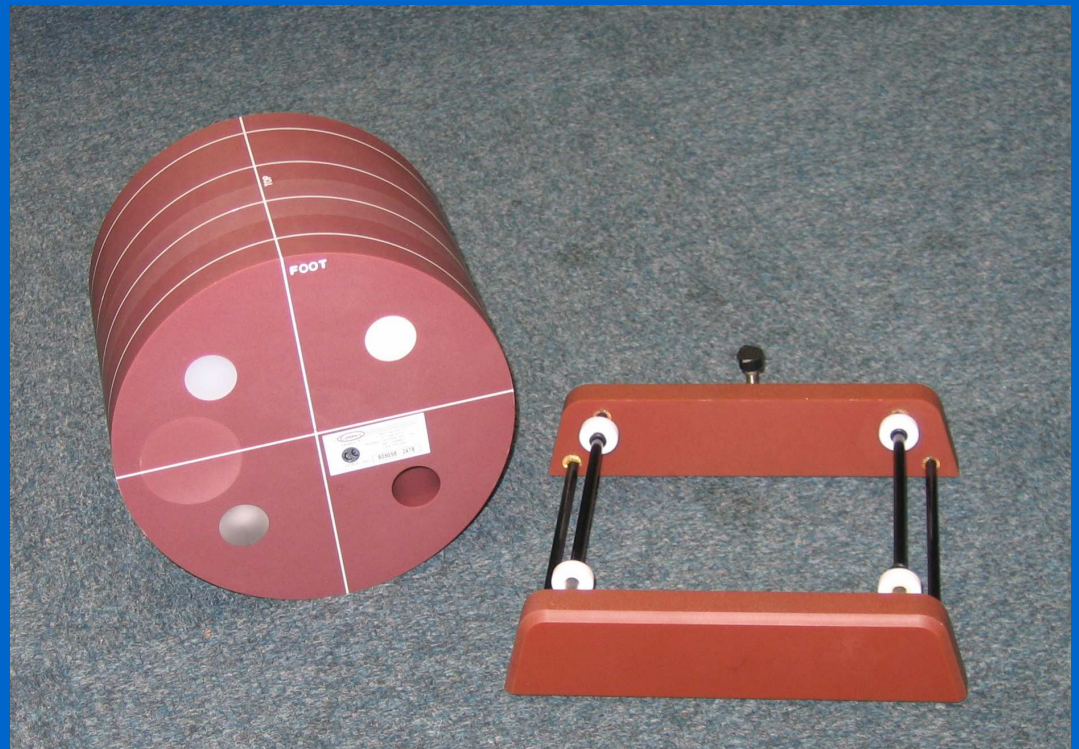
Some images courtesy of Cynthia McCullough

Mayo Clinic, Rochester, USA

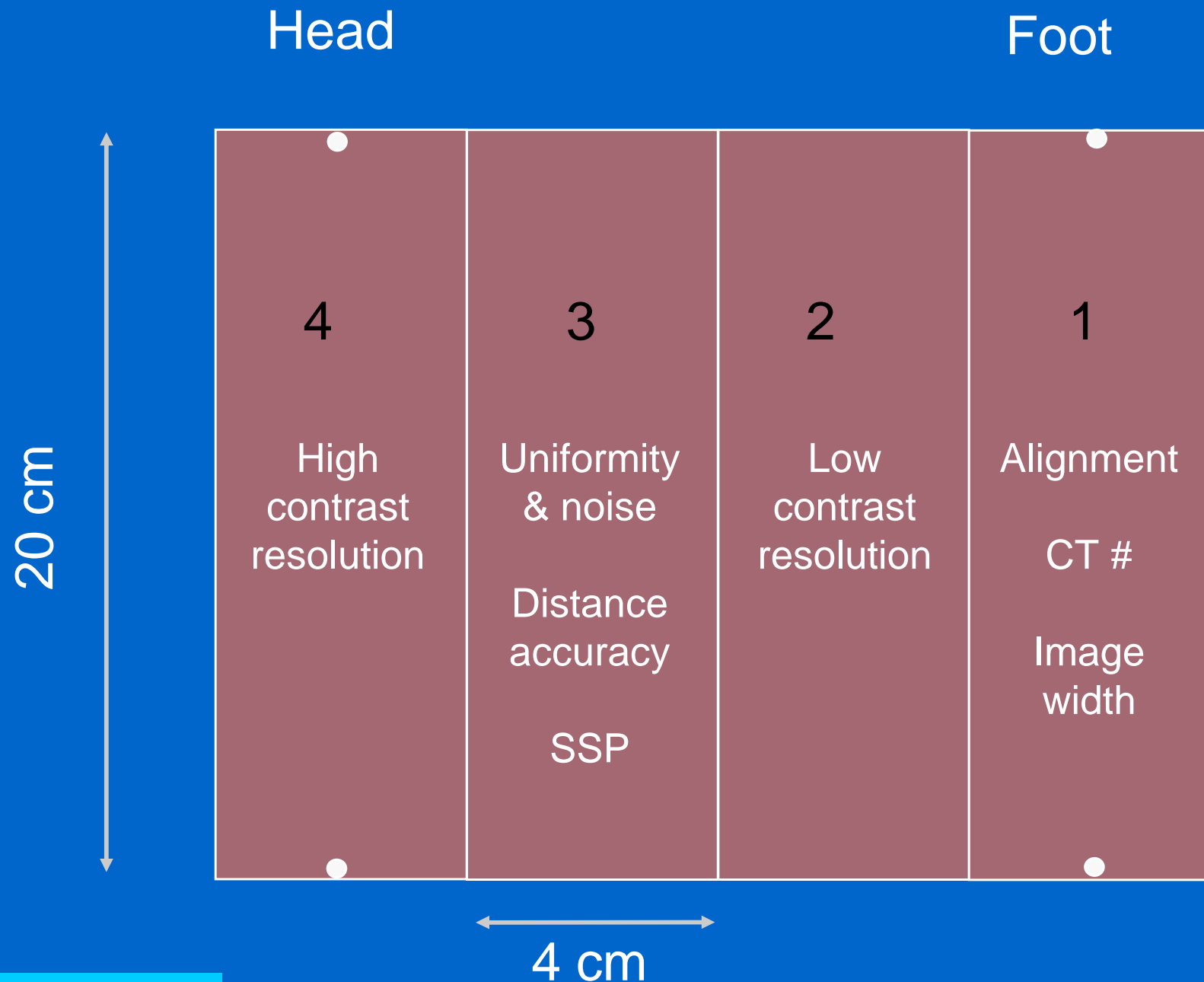


Gammex RMI CT Phantom, 438

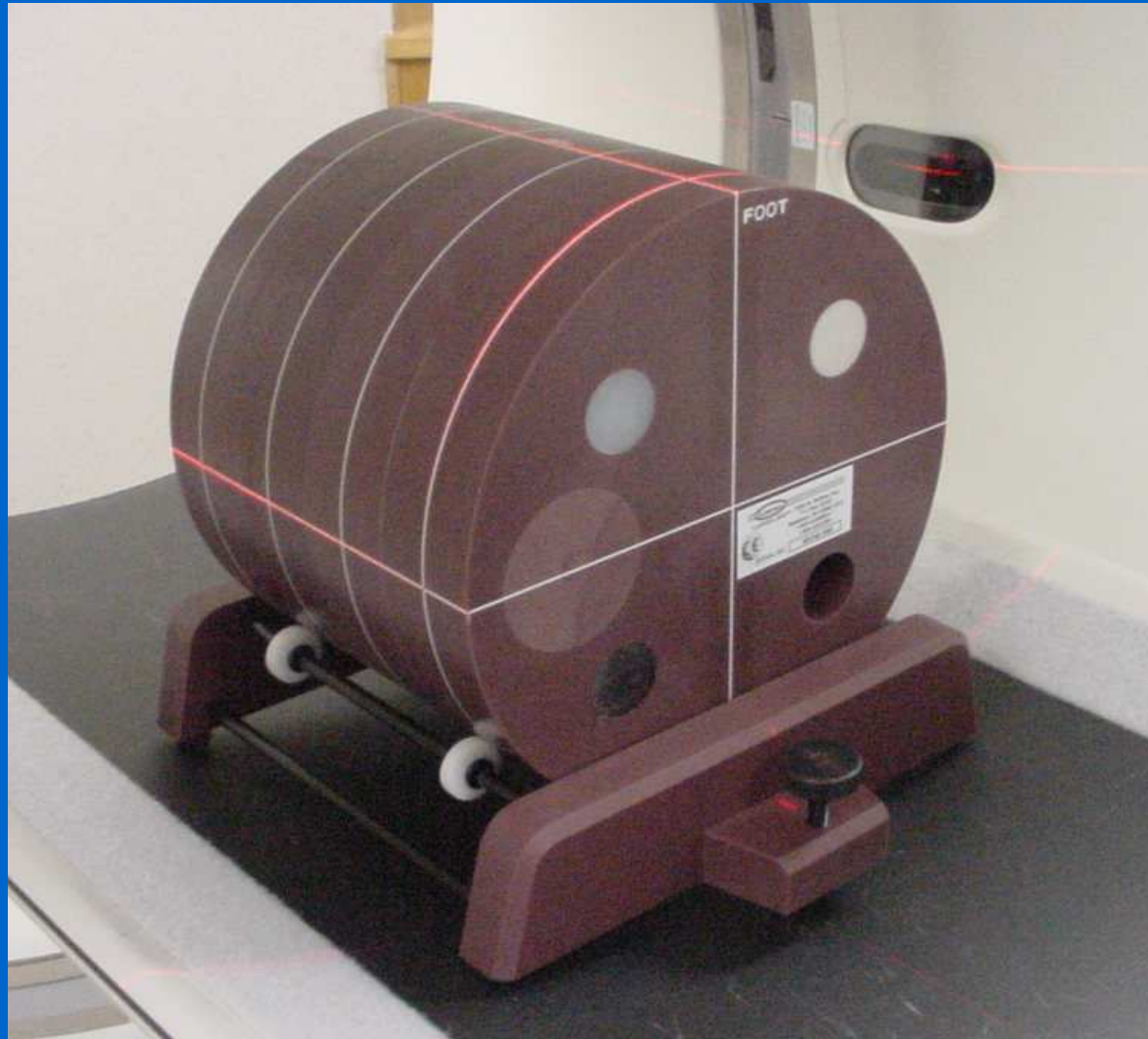
- David Aikman
 - Gammex RMI Ltd., Nottingham



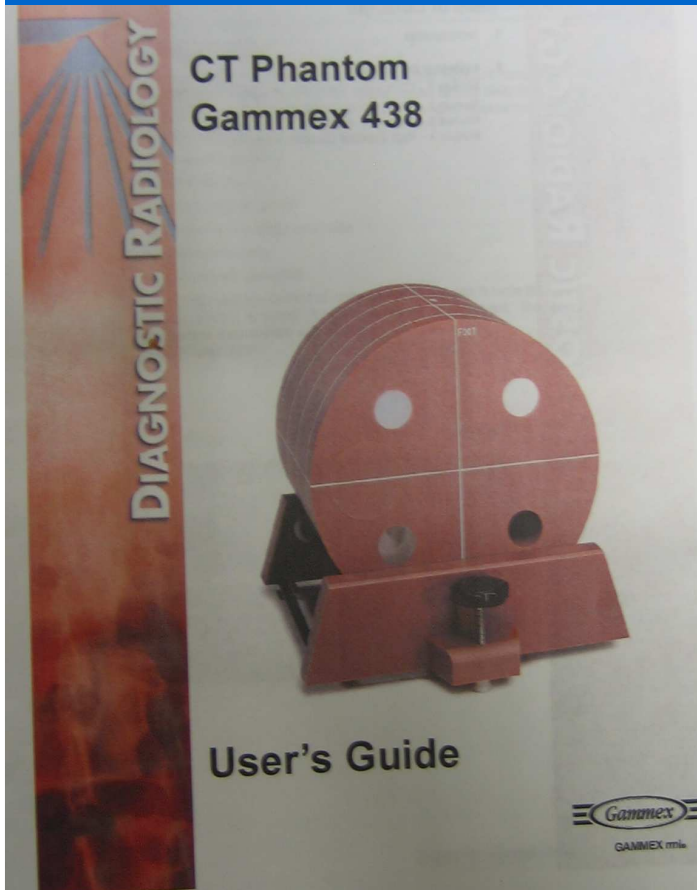
Gammex RMI CT Phantom



Gammex RMI CT Phantom



Documentation



ACR
RADIOLOGY
1891 Preston White Drive, Reston VA 20191

**Computed Tomography (CT) Accreditation Program
PHANTOM TESTING INSTRUCTIONS**

INSTRUCTION MANUAL FOR TESTING THE ACR CT PHANTOM

Please follow these instructions carefully for submission of test materials.

INTRODUCTION

The ACR CT accreditation phantom has been designed to examine a broad range of scanner parameters. These include:

- Positioning accuracy
- CT # accuracy
- Slice width
- Low contrast resolution
- High contrast (spatial) resolution
- CT number uniformity
- Image noise

This document describes the test procedures in sufficient detail to allow a CT technologist or medi desired images and perform the necessary analysis and calculations. A medical physicist, however necessary dosimetric data.

THE PHANTOM

The ACR CT accreditation phantom is a solid phantom containing four modules, and is constructed equivalent material. Each module is 4 cm in depth and 20 cm in diameter. There are external align and painted white (to reflect alignment lights) on EACH module to allow centering of the phantom i cranial/caudal), coronal (y-axis, anterior/posterior), and sagittal (x-axis, left/right) directions. There i and "TOP" markings on the phantom to assist with alignment.

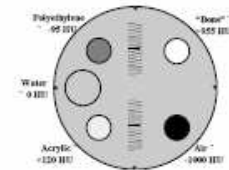
	Head	Foot		
20 cm	4	3	2	1
	High contrast resolution	Uniformity & noise Distance accuracy & BFP	Low contrast resolution	Alignment CT # Slice width
	4 cm			

This document is copyright protected by the American College of Radiology. Any attempt to reproduce, copy, modify, alter or otherwise use this document without the express written permission of the American College of Radiology is prohibited.

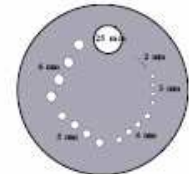
Page 1 of 16

\\naserver\acrradiology\CT\Integrity Testing Material\Phantom Testing Instruction Final.doc

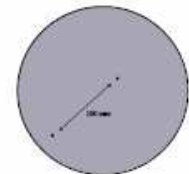
Module 1 is used to assess positioning and alignment, CT number accuracy, and slice thickness. The background material is water equivalent. For positioning, the module has 1-mm diameter steel BBs embedded at the longitudinal (z-axis) center of the module, with the outer surface of the BB at the phantom surface at 3, 6, 9, and 12 o'clock positions within the field of view (19.9cm center to center). To assess CT number accuracy, there are cylinders of different materials: bone-mimicking material ("Bone"), polyethylene, water equivalent material, acrylic, and air. Each cylinder, except the water cylinder, has a diameter of 25 mm and a depth of 4 cm. The water cylinder has a diameter of 50 mm and a depth of 4 cm. To assess slice thickness, two ramps are included which consist of a series of wires that are visible in 0.5-mm z-axis increments.



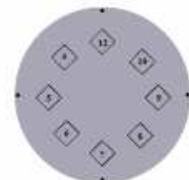
Module 2 is used to assess low contrast resolution. This module consists of a series of cylinders of different diameters, all at 0.6% (6 HU) difference from a background material having a mean CT number of approximately 90 HU. The cylinder-to-background contrast is energy-independent. There are four cylinders for each of the following diameters: 2 mm, 3 mm, 4 mm, 5 mm, and 6 mm. The space between each cylinder is equal to the diameter of the cylinder. A 25-mm cylinder is included to verify the cylinder-to-background contrast level.



Module 3 consists of a uniform, tissue-equivalent material to assess CT number uniformity. Two very small BBs (0.28 mm each) are included for optional use in assessing the accuracy of in-plane distance measurements. They may also be used to assess section sensitivity profiles.



Module 4 is used to assess high contrast (spatial) resolution. It contains eight bar resolution patterns: 4, 5, 6, 7, 8, 9, 10 and 12 lp/cm, each fitting into a 15-mm x 15-mm square region. The z-axis depth of each bar pattern is 3.8 cm, beginning at the Module 3 interface. The aluminum bar patterns provide very high object contrast relative to the background material. Module 4 also has four 1mm steel beads, as described for Module 1.



This document is copyright protected by the American College of Radiology. Any attempt to reproduce, copy, modify, alter or otherwise change or use this document without the express written permission of the American College of Radiology is prohibited.

Page 2 of 16

\\naserver\acrradiology\CT\Integrity Testing Material\Phantom Testing Instruction Final.doc

CA-16-04

Manual, also ACR (American College of Radiology) website

DIAGNOSTIC RADIOLOGY

ACR CT Accreditation Phantom Gammex 464



The optional phantom base (shown at left with the phantom) provides stability, makes alignment easier and features built-in leveling devices.

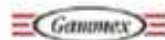
The Gammex 464 ACR CT Phantom is designed to be an integral part of the American College of Radiology (ACR) CT Accreditation Program. This voluntary program provides physicians with an opportunity for a comprehensive peer review of their CT facility, personnel qualifications, image quality and quality assurance programs. CT accreditation encourages patient's confidence and demonstrates your commitment to quality health care to payers, regulatory agencies and employers. The ACR CT Accreditation Phantom can be used for initial QA assessment and routine monthly QA testing to help ensure your patients are receiving the lowest possible CT dose.

Stainless Steel construction makes for a convenient, physically stable test device that provides reproducible results over time. The phantom consists of four modules designed to examine a broad range of scanner parameters. It features white scribed markings on the axial, coronal and sagittal axis, and HEAD, FOOT and TOP markings to ensure proper alignment.



Module layout of the Gammex ACR CT Accreditation Phantom

www.gammex.com



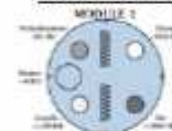
DIAGNOSTIC RADIOLOGY

ACR CT Accreditation Phantom Gammex 464

SPECIFICATIONS

Phantom Construction	
Modular material	Solid Water: D ±0.5 HU or equivalent
Length	100 mm (4.33 in.)
Diameter	100 mm (4.33 in.)
Weight	0.3 kg (1.175 lbs.)
Embedded Test Objects	
Water equivalent length by rod	Solid Water: D ±0.5 HU or equivalent
Steel equivalent length by rod	665 HU Steel (steel equivalent material)
Acrylic density rod	Clear acrylic
Polyethylene density rod	Low density polyethylene
Low contrast module marker	0.5 cm Gray: CB4 epoxy or equivalent
Low contrast rods	0.5 cm Gray: CB4 epoxy
	Density adjusted to yield ±0.5 HU difference or equivalent
Tungsten cathode beam	0.011" diameter grade 25 tungsten cathode leads
Lead pipe material	ED01 Aluminum and Solid Water: D ±0.5 HU or equivalent
Steel beam	1.00mm grade 25 chrome steel bolts
	Must provide homogeneity:
	The mean ROI values within any module, test objects included, may differ by no more than 2 HU.
	The average CT number of a module must meet the requirements of 0 ±5 HU.
Optional Phantom Stand Dimensions	
Length	228 mm (9 in.)
Width	203 mm (8 in.)
Height	47.63 cm (1.875 in.)
Weight	0.5 kg (1.1 lbs.)
Other Options	Form-fitted carrying case

PHANTOM MODULE SCHEMATICS



Positioning and alignment
CT number accuracy
and size contrast



Low contrast resolution
Receive a series of cylinders with different diameters, all at 0.5% difference from the background material



CT number uniformity assessment
rod pattern and steps for testing in-phantom dose measurement accuracy



High contrast spatial resolution
Covers eight high contrast resolution patterns of L, S, G, T, B, R, TQ, and T2 (one pattern per row)

Due to the complexity of calibration procedures, users should carefully follow instructions.

GAMMEX, INC.
PO Box 416021
Melrose, MA 02162-0211 USA
Tel: 978-281-0000 / 1-800-831-9391
1-800-828-7030
Fax: 1-800-828-7036
email: info@gammex.com



GAMMEX-RMI LTD
Barnsley House
17 Goswell Road
Huddersfield HD2 0NS, England
United Kingdom
Tel: +44 (0) 1482 5251-1800
Fax: +44 (0) 1482 5251-1800
email: info@rmi.gammex.com




GAMMEX-RMI GMBH
Glockenstraße 17
62102 Bad Nauheim, Germany
Tel: +49 6381 201-522
Fax: +49 6381 201-1800
e-mail: info@rmi.gammex.com



ISO 9001
CERTIFIED

ACR CT Accreditation Program

Address  http://www.acr.org/accreditation/computed/qc_forms.aspx 

Google  acr  

ACR
AMERICAN COLLEGE OF
RADIOLOGY

Site Map | Contact | Help

SEARCH SITE SEARCH INTERNET
[Powered by Google]

LOGIN RESIDENTS | ABOUT US | JOBS-CAREER DEV | PATIENT INFO | MEDIA ROOM | MY PROFILE | JOBS AT ACR |

Home | Accreditation | Computed Tomography | Forms

Testing and QC Forms

Facilities that have applied for the Computed Tomography (CT) Accreditation Program will submit the following documents with their image submission for review. These forms are provided to the facility in hard-copy form once their initial application has been processed at the ACR. For your convenience, additional copies may be printed by clicking on the links below. **Please note that these forms should not be submitted with an initial application for accreditation.**

Computed Tomography Testing and QC Forms

- Quality Assurance Questionnaire
- Electronic Submission Memorandum to Facilities
- Clinical Image Quality Guide
- Clinical Testing Instructions
- Clinical Test Image Data Form
- Phantom Order Form
- Phantom Testing Instructions
- Phantom Testing Criteria
- Phantom Site Scanning Data Form
- Phantom Dose Calculator Spreadsheet (Air Kerma)
- Phantom Dose Calculator Spreadsheet (Exposure)
- Detector Configuration Frequently Asked Questions Part I
- Detector Configuration Frequently
- Phantom Testing Criteria
- Phantom Site Scanning Data Form
- Phantom Dose Calculator Spreadsheet (Air Kerma)
- Phantom Dose Calculator Spreadsheet (Exposure)
- Detector Configuration Frequently Asked Questions Part I
- Detector Configuration Frequently Asked Questions Part II
- Checklist

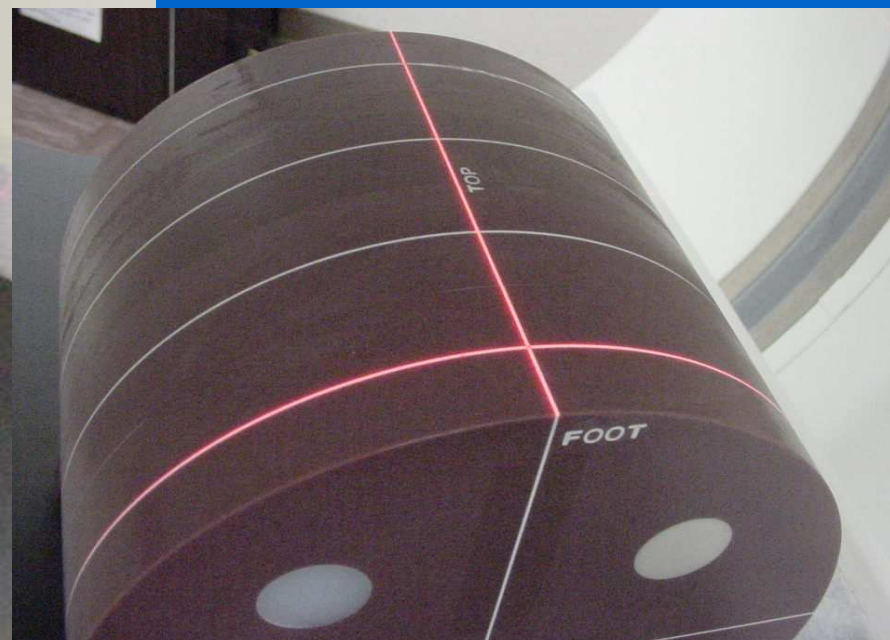
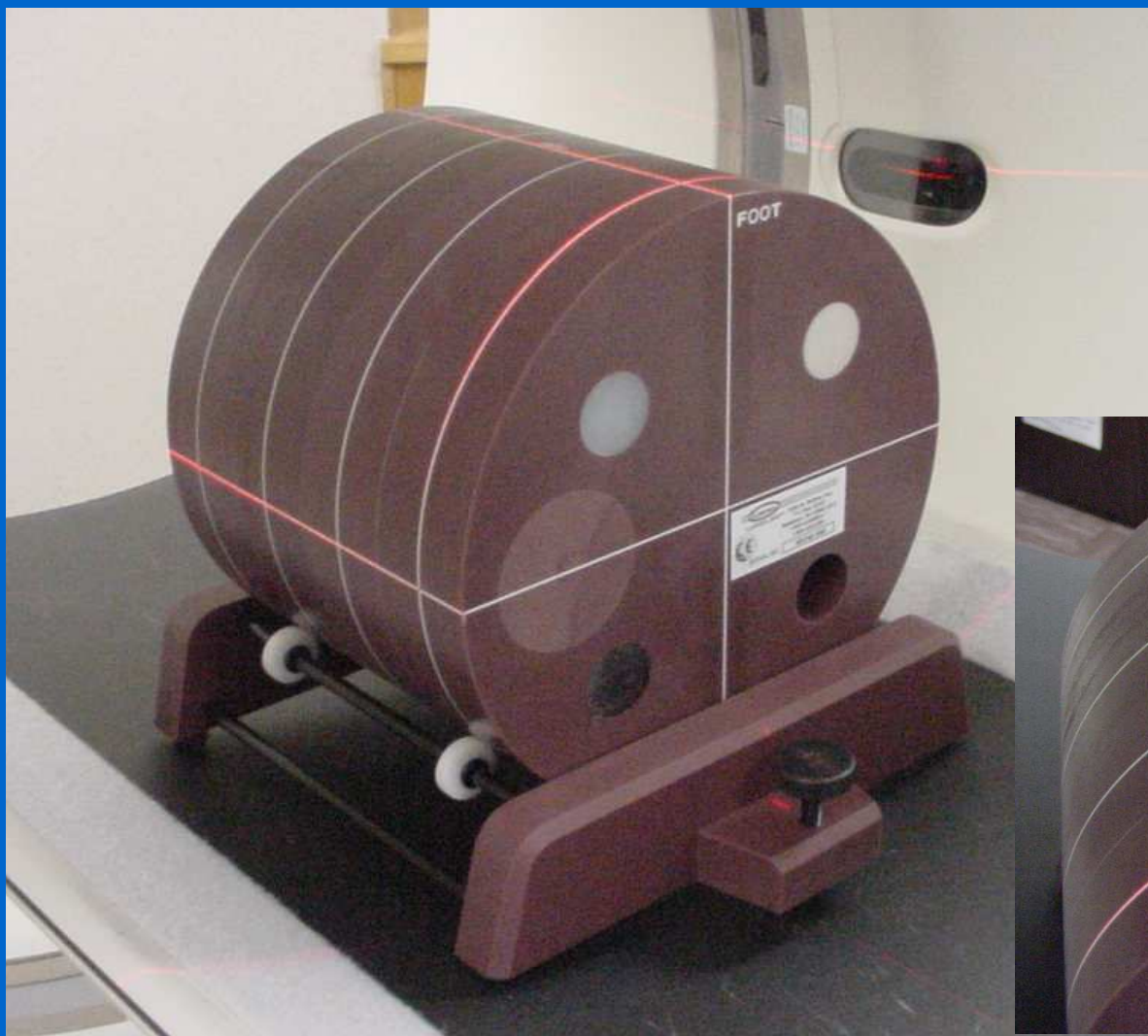
ACR Homepage
Quality Assurance Questionnaire
Electronic Submission Memorandum to Facilities
Clinical Image Quality Guide
Clinical Testing Instructions
Clinical Test Image Data Form
Phantom Order Form
Phantom Testing Instructions
Phantom Testing Criteria
Phantom Site Scanning Data Form
Phantom Dose Calculator Spreadsheet (Air Kerma)
Phantom Dose Calculator Spreadsheet (Exposure)
Detector Configuration Frequently Asked Questions Part I
Detector Configuration Frequently

ACR documentation

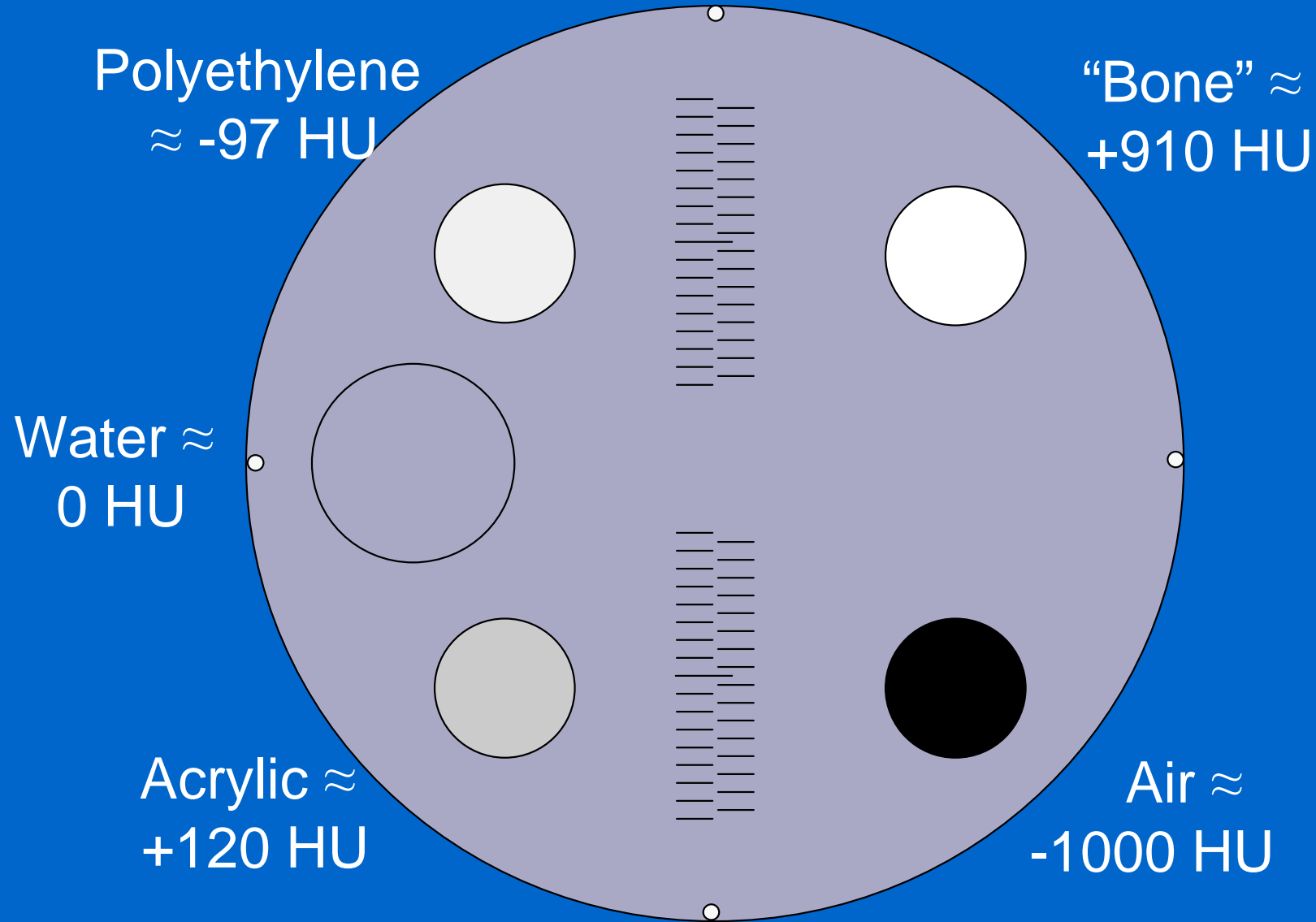
Table 1: Typical Image Acquisition Technical Parameters

	Adult Head (cerebellum portion)	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 <i>used</i> ¹ (N)				
A: Table Increment (mm) or H: Table Speed (mm/rot) (I) ¹				
Pitch ²				
Reconstructed Scan Width (mm)				
Reconstructed Scan Interval (mm)				
Dose Reduction Technique(s) ³				

Setting up



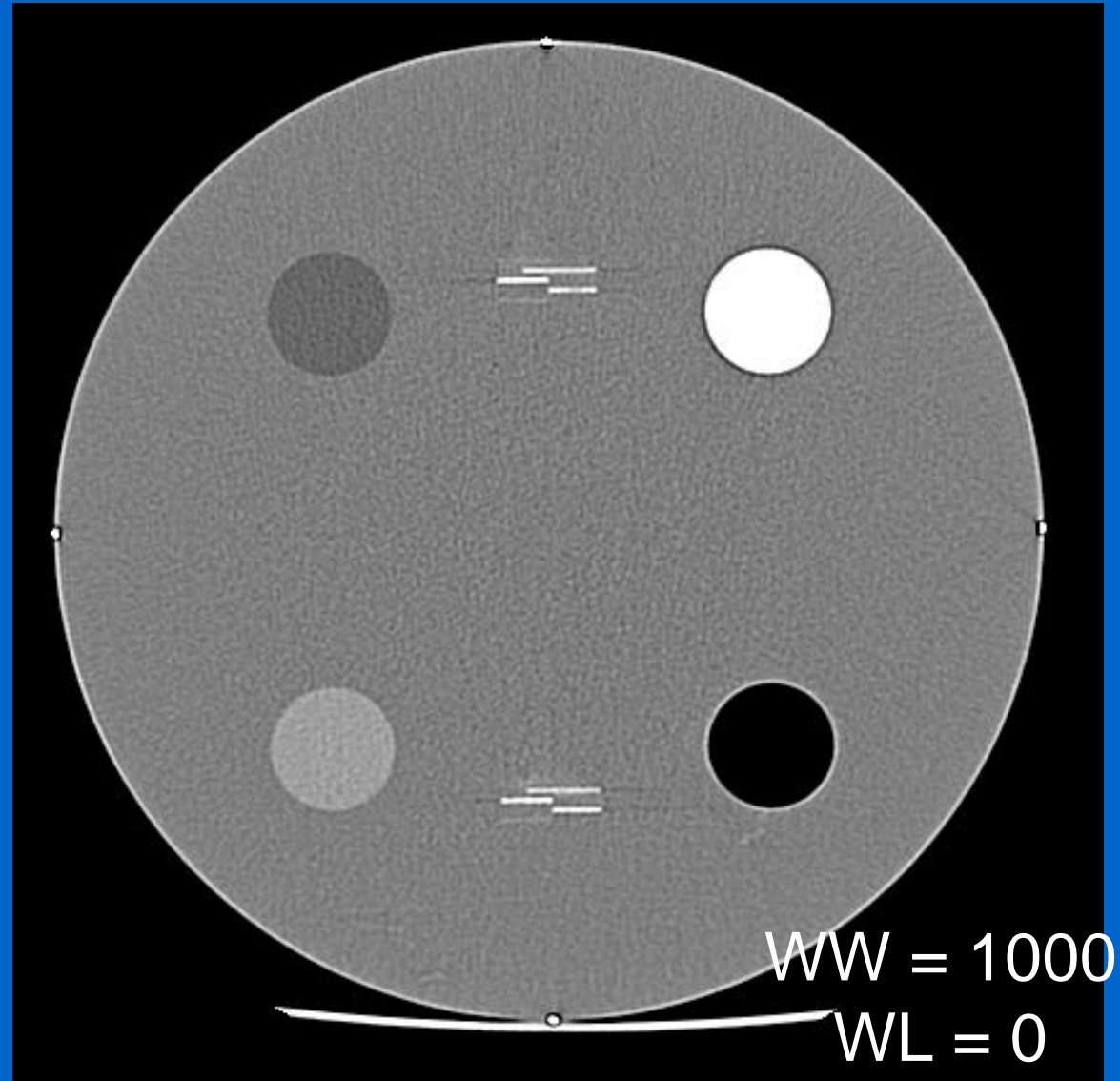
Module 1: alignment, image thickness, CT number



Module 1: alignment, image thickness, CT number

Must see all four BBs
(in Modules 1 & 4)

Longer wire must
have same number of
lines above and
below (± 1)



Browse

7 fps

Propagate

<no presentation state

Annotations:

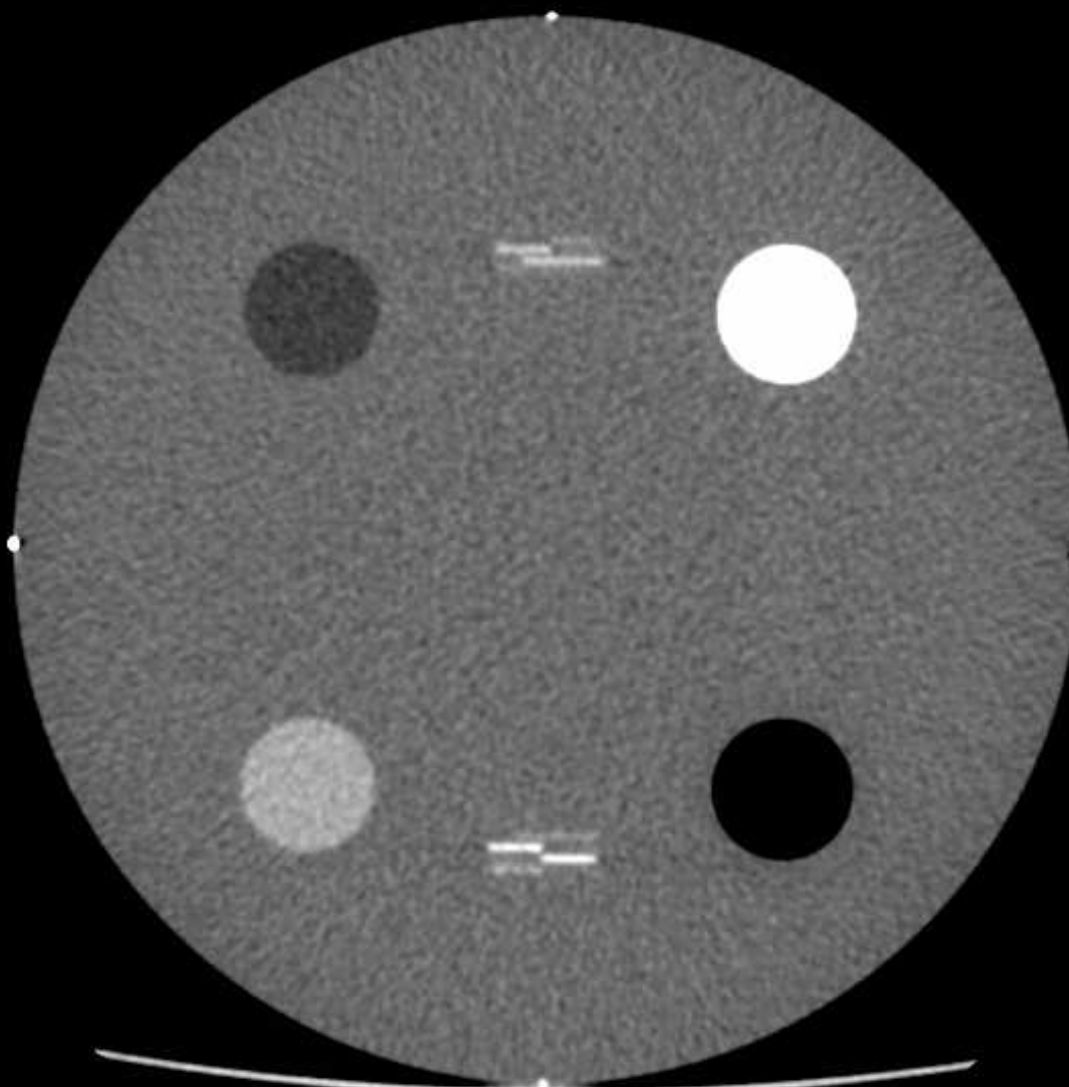
- 2
 - 1
 - 2
- TEST
 - 999
 - 2
 - 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 3
 - 1
 - 2
 - 4
 - 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9

TEST, ACR PHANTOM

[A]

TEST

4



[R]

[L]

SP: 0.3mm

ST: 1.3mm

C40

W500

Not for diagnostic use

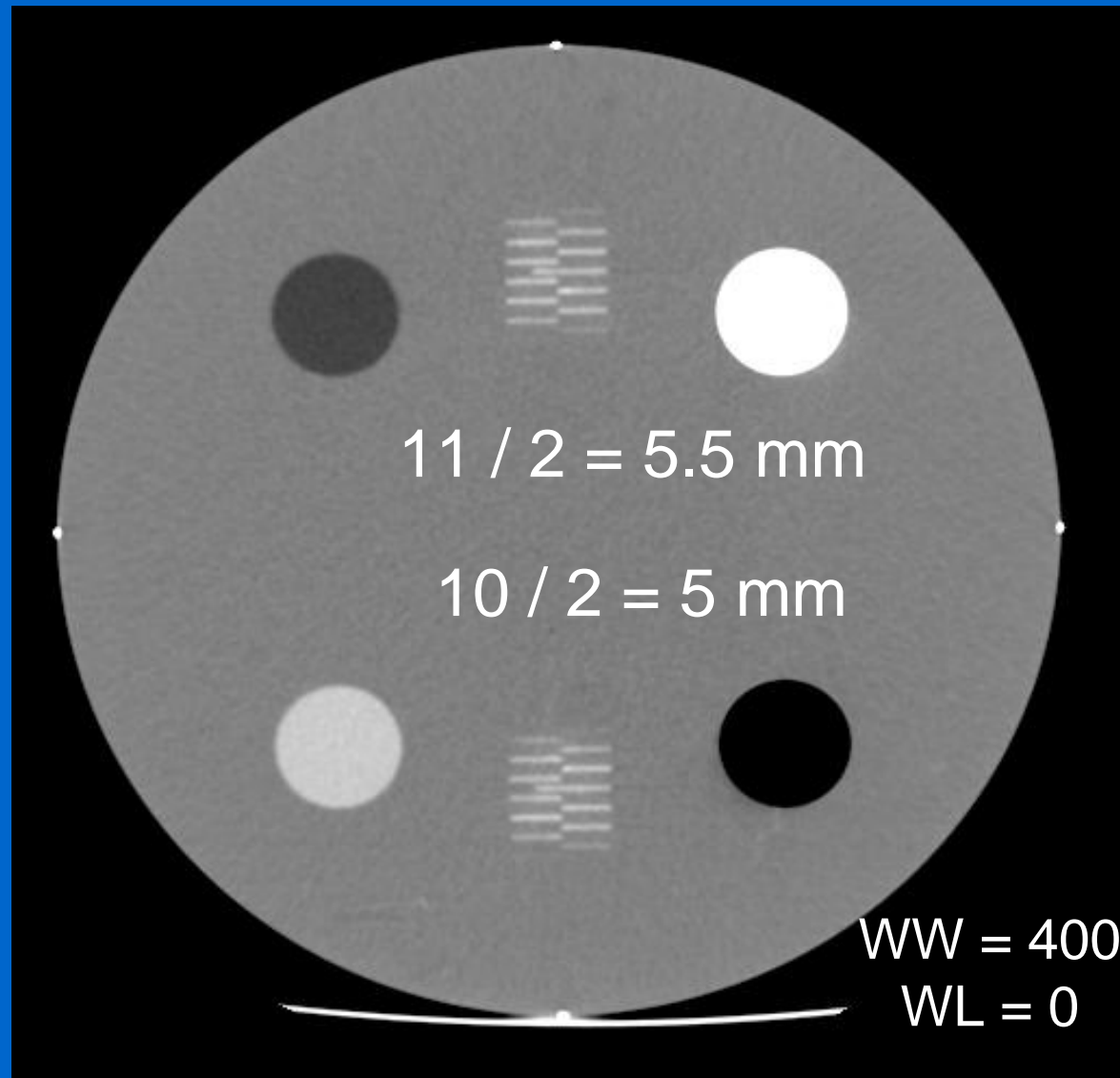
[P]

GE MEDICAL SYSTEMS



Module 1: alignment, image thickness, CT number

Wires are 0.5 mm apart in z-direction

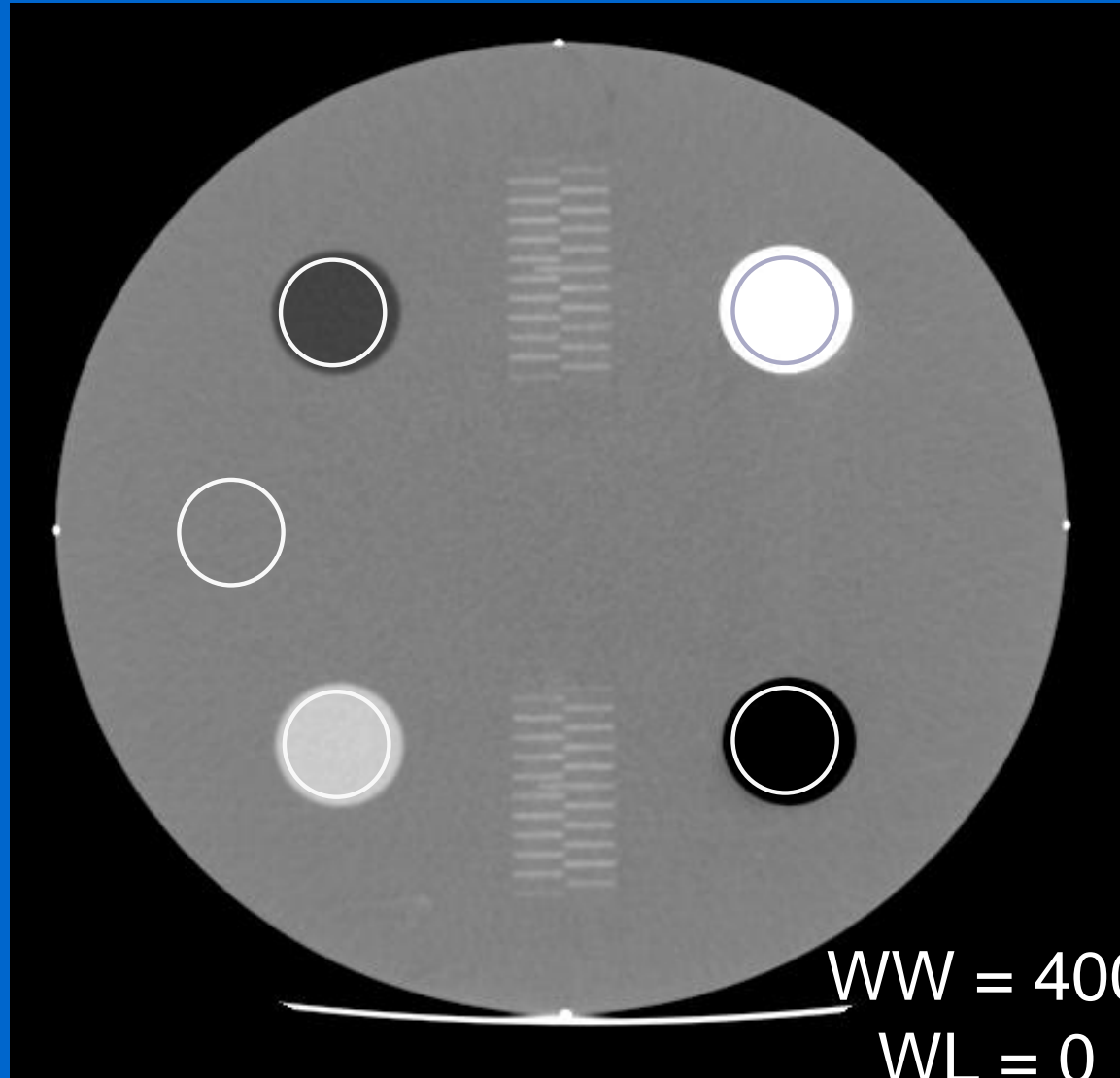


Module 1: alignment, image thickness, CT number

Polyethylene
 ≈ -97 HU

Water \approx
0 HU

Acrylic \approx
+120 HU



“Bone” \approx
+910 HU

Air \approx
-1000 HU

WW = 400
WL = 0

ACR documentation: module 1



Section 5 – Module 1: CT Number Calibration and Slice Thickness

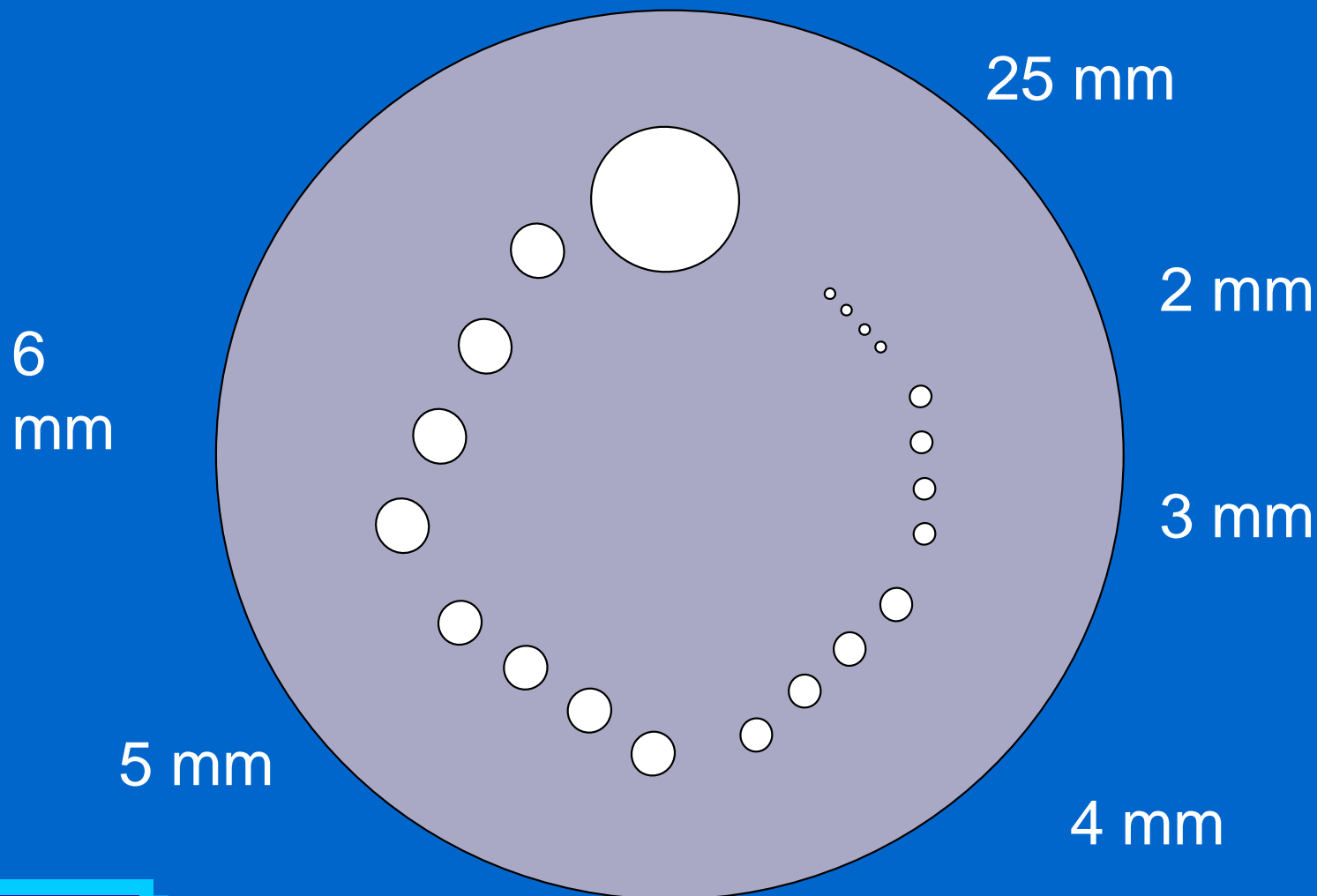
Adult Abdomen technique

Parameter	Measured			Film Page: Box
Location of center of Module 1	_____mm			
CT number calibration and scan width accuracy for adult abdomen slice width				
Polyethylene	Mean CT # = _____HU	Top	Bottom	1:4
Water	Mean CT # = _____HU	_____mm	_____mm	
Acrylic	Mean CT # = _____HU			
Bone	Mean CT # = _____HU			
Air	Mean CT # = _____HU			
Dependency of CT Number of water on scan width and kVp, and scan width accuracy				
	CT number of water	Top	Bottom	
Hi Res Chest = _____mm	Mean CT # = _____HU	_____mm	_____mm	1:5
≈ 3 mm = _____mm	Mean CT # = _____HU	_____mm	_____mm	1:6

Unknown Zone

Module 2: Low contrast detectability

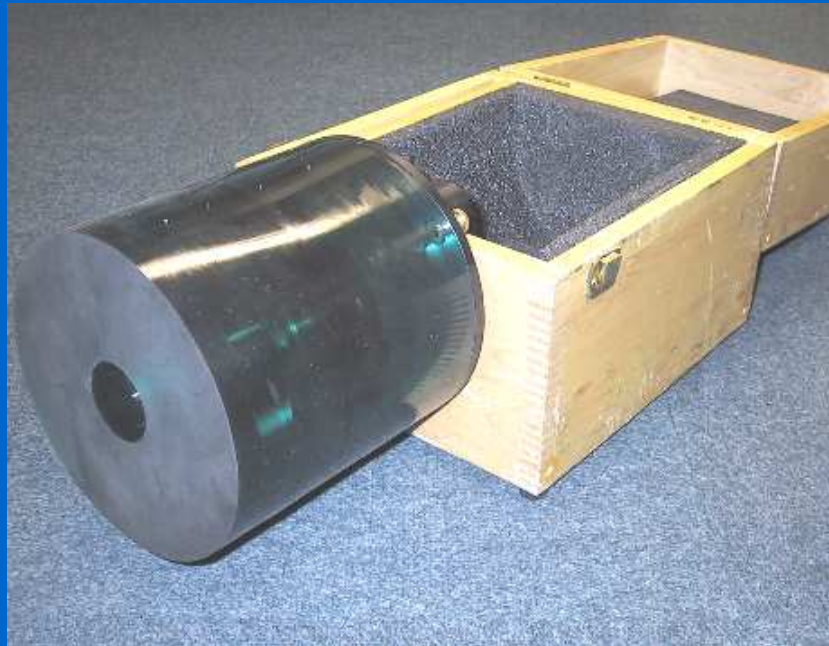
- Low contrast = $6 \text{ HU} \pm 0.5 \text{ HU}$
 - (cf Catphan 10, 5, 3 HU single object of each size)



Phantoms for low contrast detectability (LCD)

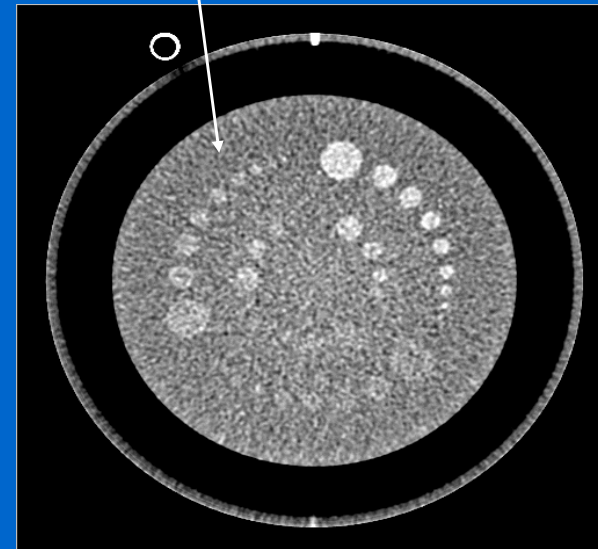
- Catphan 500

2-15 mm diameter



10 HU contrast

5 HU
contrast

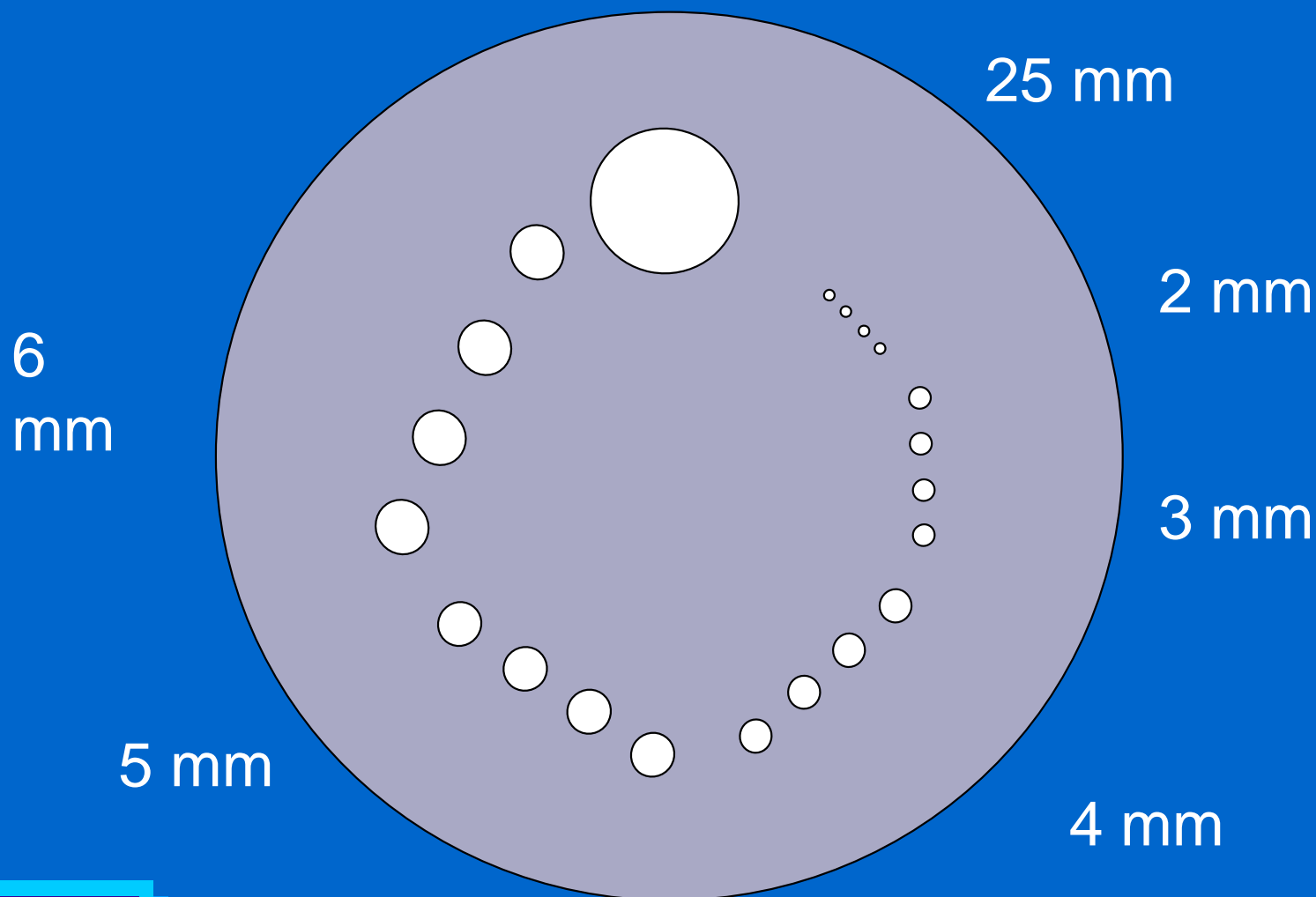


3 HU
contrast

- Catphan is closest to a 'standard' phantom

Module 2: Low contrast detectability

- Low contrast = $6 \text{ HU} \pm 0.5 \text{ HU}$
 - (cf Catphan 10, 5, 3 HU single object of each size)



Browse

7 fps

Propagate

<no presentation state

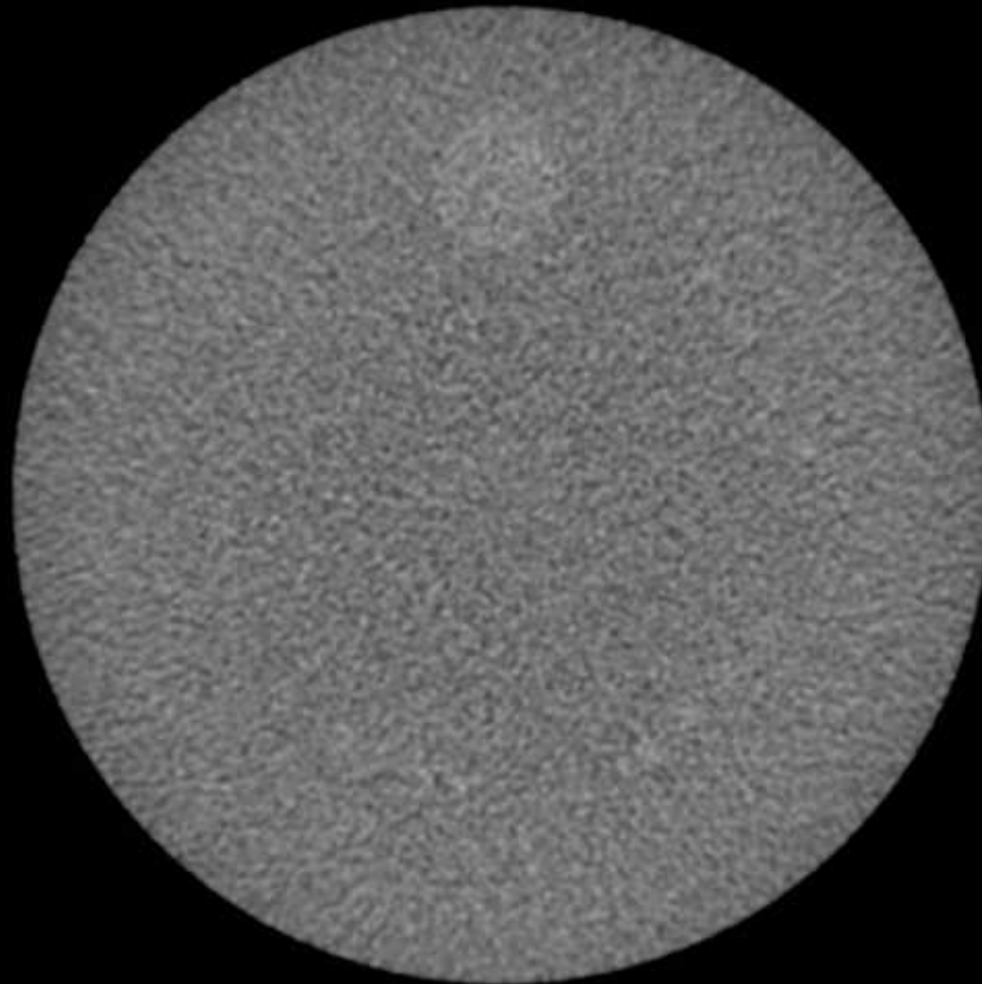
Annotations: ?

- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 17
 - 1
 - 2
- 2
 - 1
 - 2

TEST, ACR PHANTOM
19

[A]

TEST



[R]

[L]

SP: 135.0mm
ST: 5.0mm
C101
W102

Not for diagnostic use

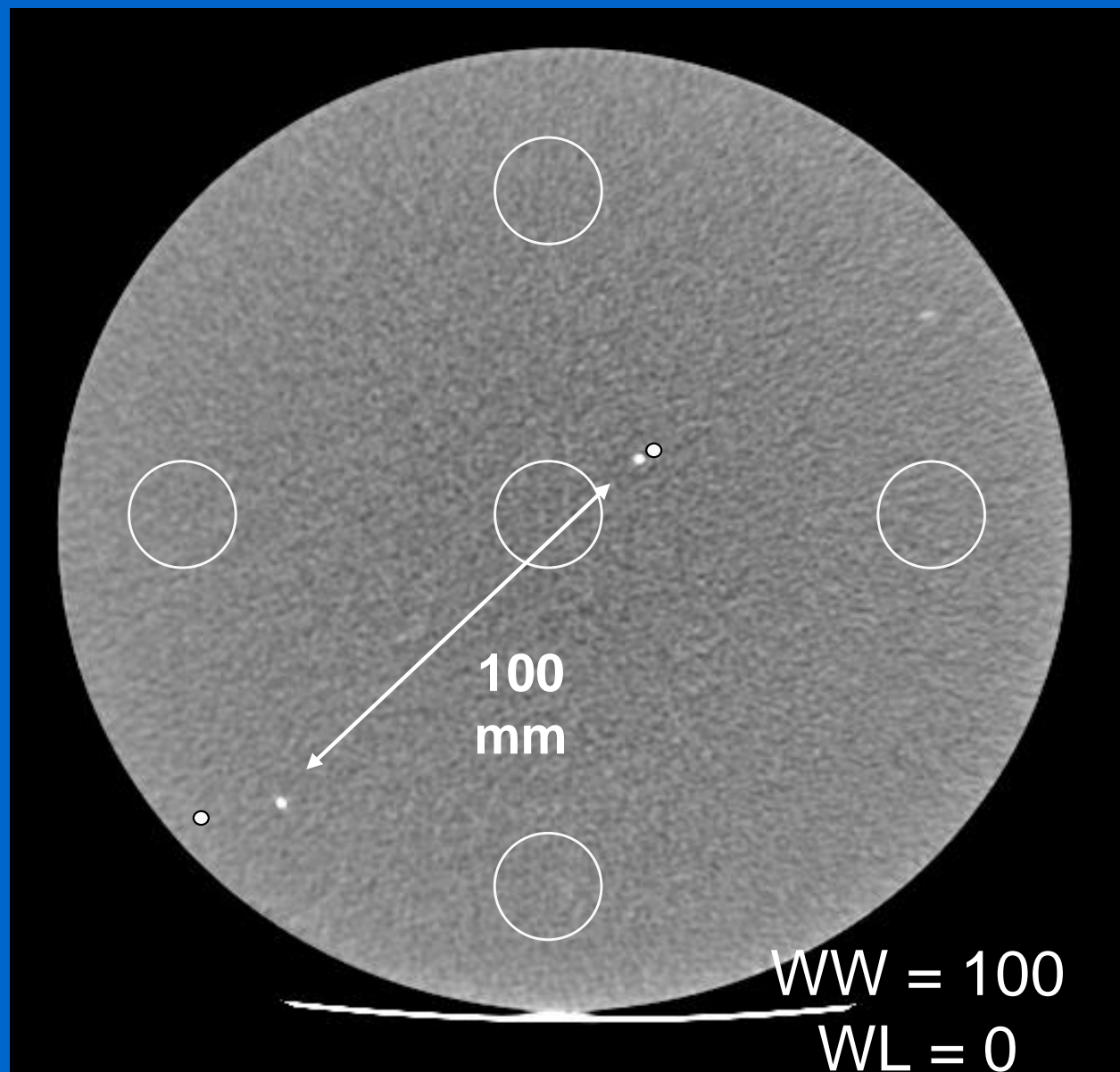
[P]

GE MEDICAL SYSTEMS



Module 3: uniformity, noise, distance, mtf & ssp

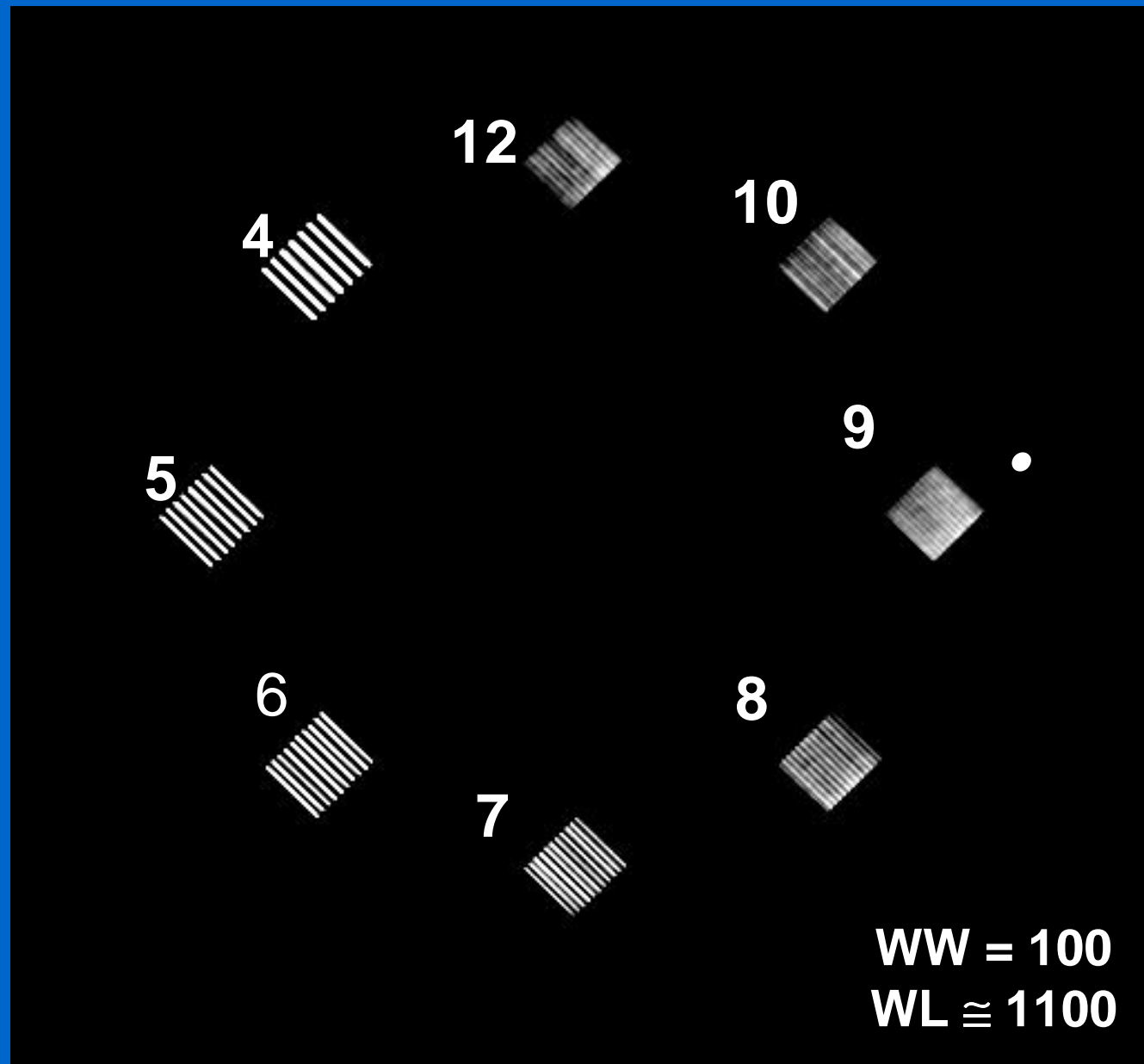
0.3 mm
tungsten
carbide beads



Module 4: high contrast spatial resolution

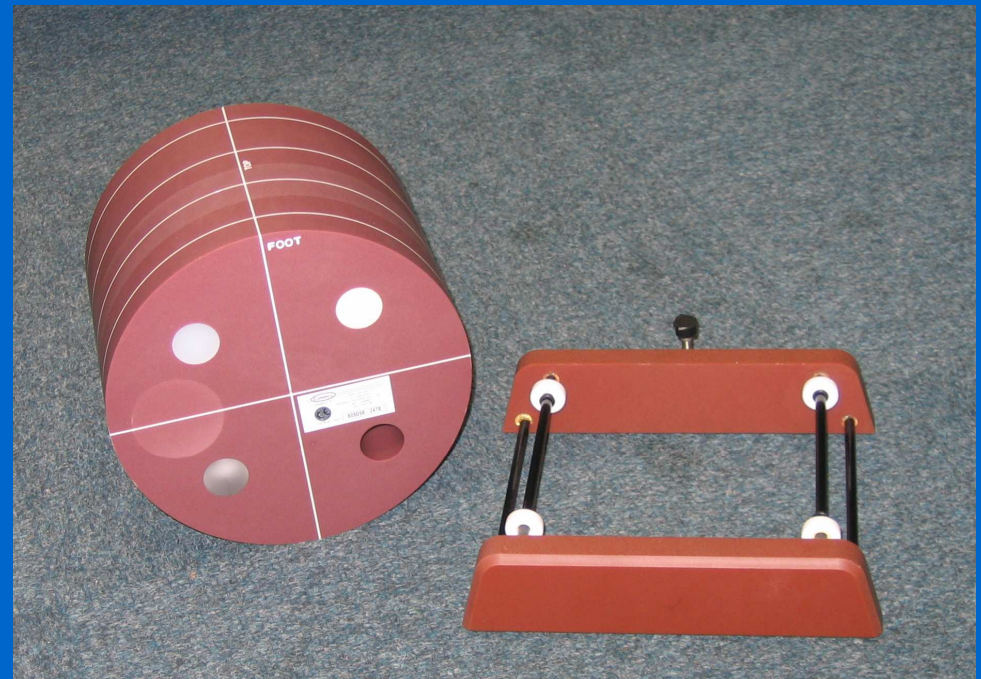
Bar patterns:
lp/cm

Aluminium in
solid water



Gammex RMI CT Phantom

- Nicely designed phantom
- Excellent phantom stand
- Good additional documentation from ACR
- Slightly limited for axial MSCT? (40 mm modules)
- Bar pattern doesn't go to maximum resolution
- LCD of 6HU different from manufacturers spec. (use 3HU from Catphan)



Gammex
GAMMEX rmi[®]

...since 1969
setting the pace...

Top » Catalog » Diagnostic Radiology » Phantoms » 464

My Account | Cart Contents | Checkout

Categories
Diagnostic Radiology »
Laser Alignmt/Scanner »
Mammography »
Radiation Oncology »
Ultrasound »

Manufacturers
Please Select

What's New?
5 Arm CT Sim

Quick Find
Use keywords to find the product you are looking for.
Advanced Search

ACR CT Accreditation Phantom

464

The Gammex 464 ACR CT Phantom is designed to be an integral part of the American College of Radiology (ACR) CT Accreditation Program. This voluntary program provides physicians with an opportunity for a comprehensive peer review of their CT facility, personnel qualifications, image quality and quality assurance programs. CT accreditation encourages patient's confidence and demonstrates your commitment to quality health care to payers, regulatory agencies and employers. The ACR CT Accreditation Phantom can be used for initial QA assessment and routine monthly QA testing to help ensure your patients are receiving the lowest possible CT dose.

Available Options:
Option 2: None
Option 1: None

This product was added to our catalog on Monday 30 June, 2003.

[Reviews](#) [View Datasheet](#)

Shopping Cart
0 items

Manufacturer Info
GAMMEX rmi[®]
- Gammex Inc. Homepage
- Other products

Notifications
Notify me of updates to ACR CT Accreditation Phantom

Tell A Friend
Tell someone you know about this product.

Reviews
Write a review on

Gammex
GAMMEX rmi[®]

...since 1969
setting the pace...

Top » Catalog » Diagnostic Radiology » Phantoms » 438

My Account | Cart Contents | Checkout

Categories
Diagnostic Radiology »
Laser Alignmt/Scanner »
Mammography »
Radiation Oncology »
Ultrasound »

Manufacturers
Please Select

What's New?
Radiation Beam Analyzer

Quick Find
Use keywords to find the product you are looking for.

CT Phantom

438

Solid Water[®] construction makes for a convenient, physically stable test device that provides reproducible results over time. The phantom features white scribed markings on the axial, coronal and sagittal axis, and HEAD, FOOT and TOP markings to ensure proper alignment. The CT Phantom consists of four modules designed to examine a broad range of scan parameters. Module 1 is designed to be used for Positioning and alignment and to provide CT number and information on slice thickness. Module 2 is used to detecting Low contrast resolution. It features a series of cylinders with different diameters, all at 0.6% (6 HU) difference from the background material. Module 3 is used for assessing CT number uniformity. It includes 2 small targets for testing in-plane distance measurement accuracy. Module 4 is used to monitor High contrast (spatial) resolution. It contains 8 high contrast resolution patterns of 4, 5, 6, 7, 8, 9, 10 and 12 lines per cm.

This product was added to our catalog on Monday 27 October, 2003.

[Reviews](#)

Shopping Cart
0 items

Manufacturer Info
GAMMEX rmi[®]
- Gammex Inc. Homepage
- Other products

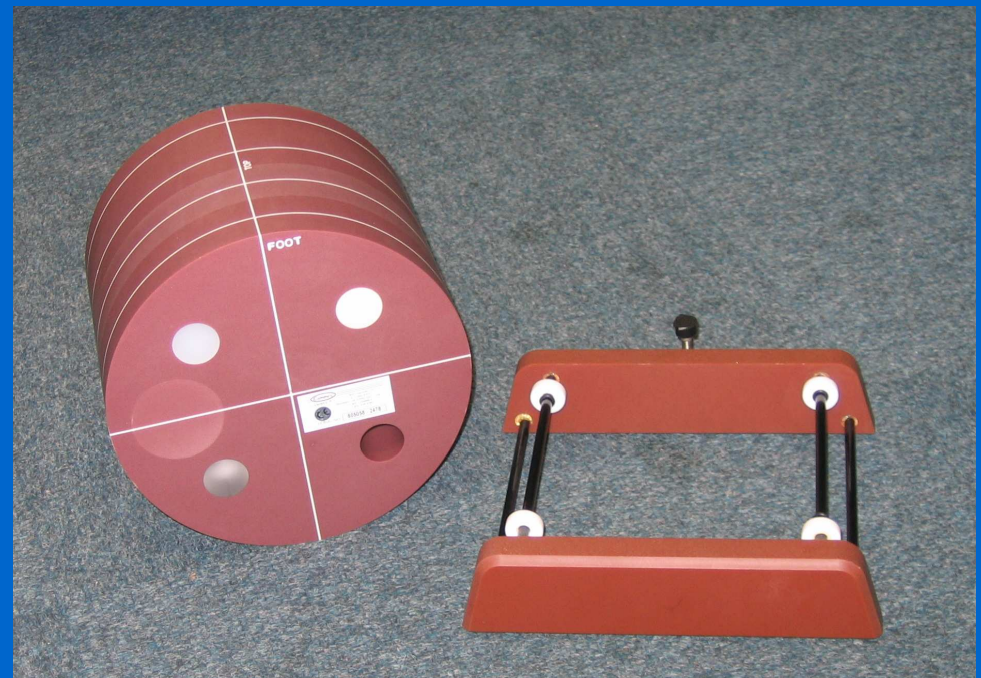
Notifications
Notify me of updates to CT Phantom

Tell A Friend
Tell someone you know about this product.

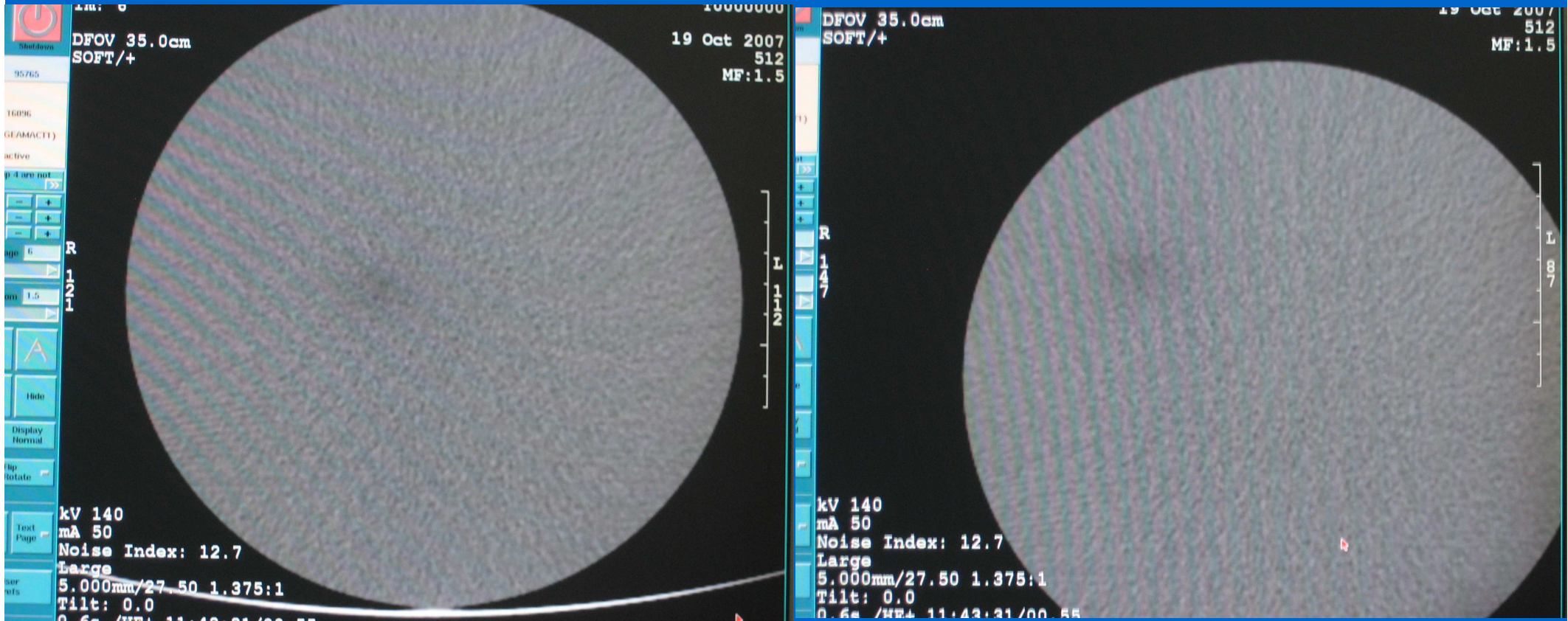
Reviews
Write a review on

Gammex RMI CT Phantom

- David Aikman
 - Gammex RMI Ltd., Nottingham
 - 01159850808, daa@gammex.com
- Cost
 - List price £5589 (not including stand),
 - Discount for early sales ~10%



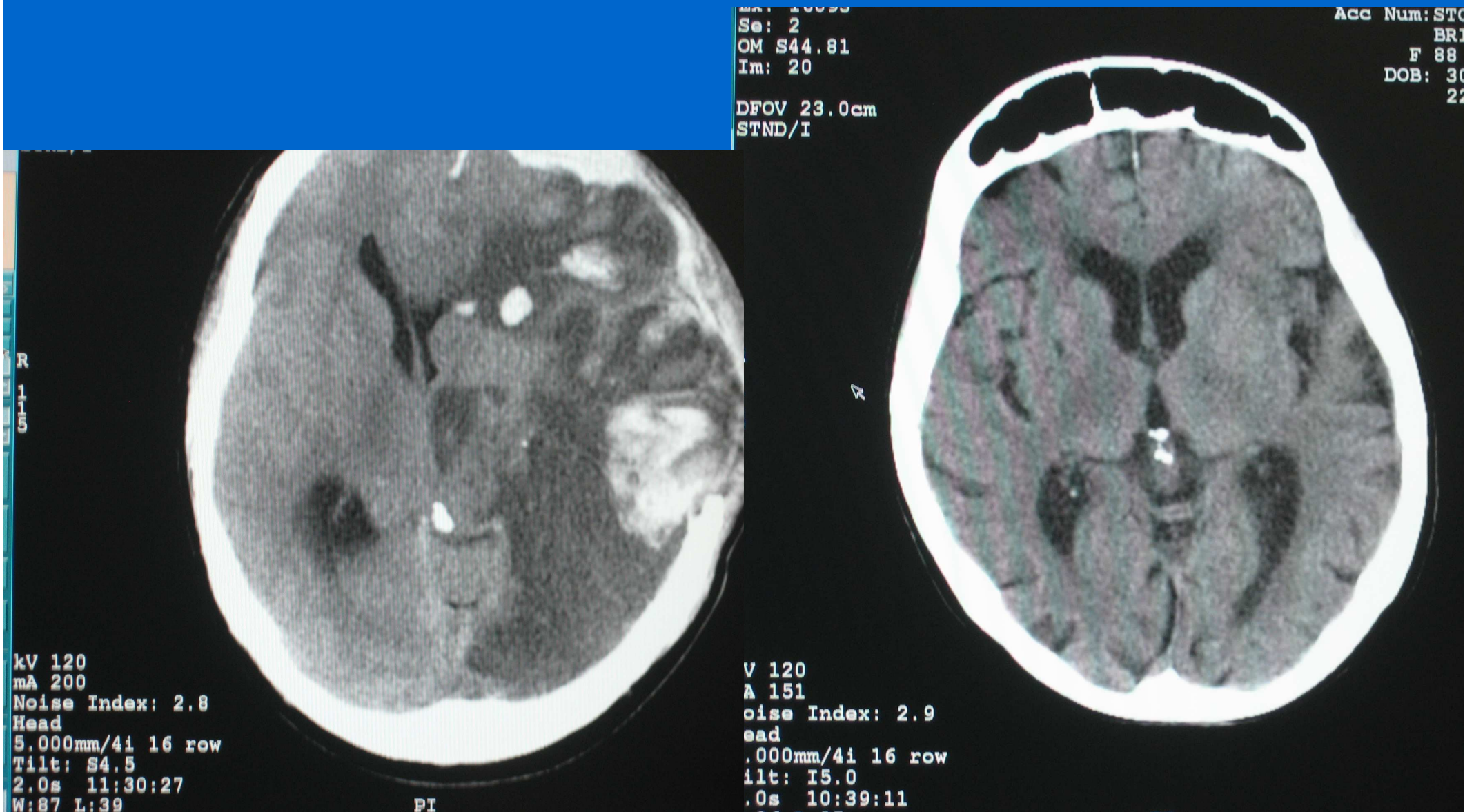
Incidental Findings



Incidental Findings



Incidental Findings



Gammex RMI CT Phantom, 438 (ACR CT Accreditation phantom, 464)

S. Edyvean, Jim Weston

Imaging Performance Assessment of CT Scanners

St. Georges Hospital, London

www.impactscan.org

Some images courtesy of Cynthia McCullough

Mayo Clinic, Rochester, USA

