PH-9 Multi Slice CT Phantom MHT

Instruction Manual

071116

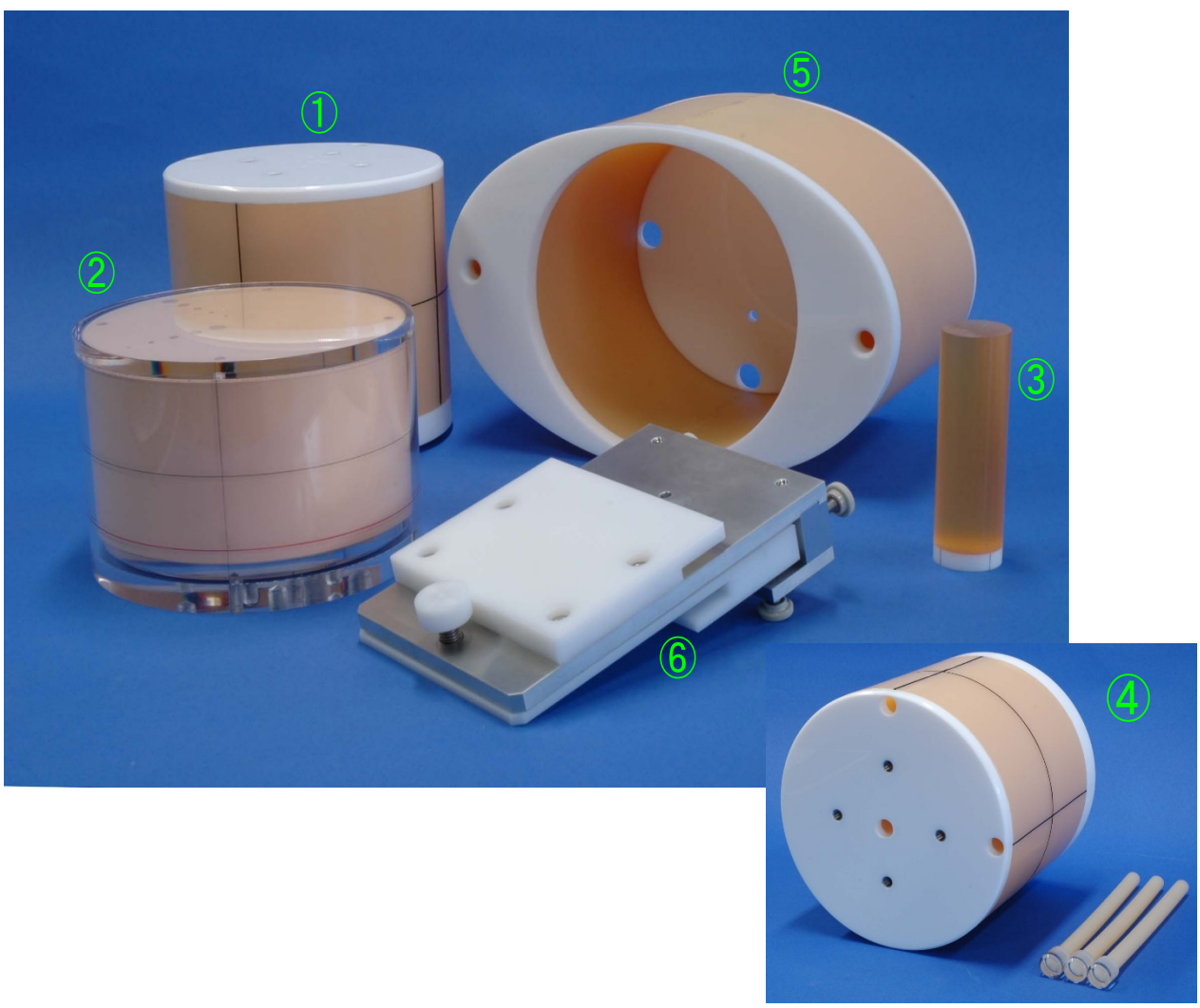
KYOTO KAGAKU CO.,LTD

PH-9 Multi Slice CT Phantoms

Set of the phantoms to assess the performance of Multi-detector CT.

1. Set Includes:
   ① Low Contrast Phantom
   The phantom features contrast targets in sphere in cylinder shape.
   Applicable both for axial and helical scanning.
   ② High Contrast Phantom
   The phantom features contrast targets in sphere in cylinder shape.
   Applicable both for axial and helical scanning.
   ③ Micro Disc Phantom
   For measurement of slice thickness in helical scanning.
   (The optional attachment is required to be used for assessment in axial scanning.)
   ④ Low Contrast and CTDI Phantom
   For simultaneous evaluation of effective energy and low contrast resolution..
   ⑤ Ellipse Absorber
   Representing human torso.
   ⑥ Holding fixture for the phantoms
   *Type may vary depending on your order.

Phantoms are to be scanned using standard setting and protocols of the relevant facility.



2. Low Contrast Phantom (Quality assurance for abdominal CT images)

1) Evaluation Items

a) Variation in the contrast resolution among different scanners.

b) Variation in the contrast resolution of the different x-ray beam widths and of the different delivery speeds of the beds.

c) Variation in the contrast resolution of the slice sensitivity profile (SSP) with the rectangular geometry collapse.

d) Numeric evaluation by the contrast noise ratio (CNR)

2) Features

Sphere and cylinder shape targets in each three different HU numbers and four different diameters are embedded in the soft tissue substitute phantom (50 HU).

<Size>

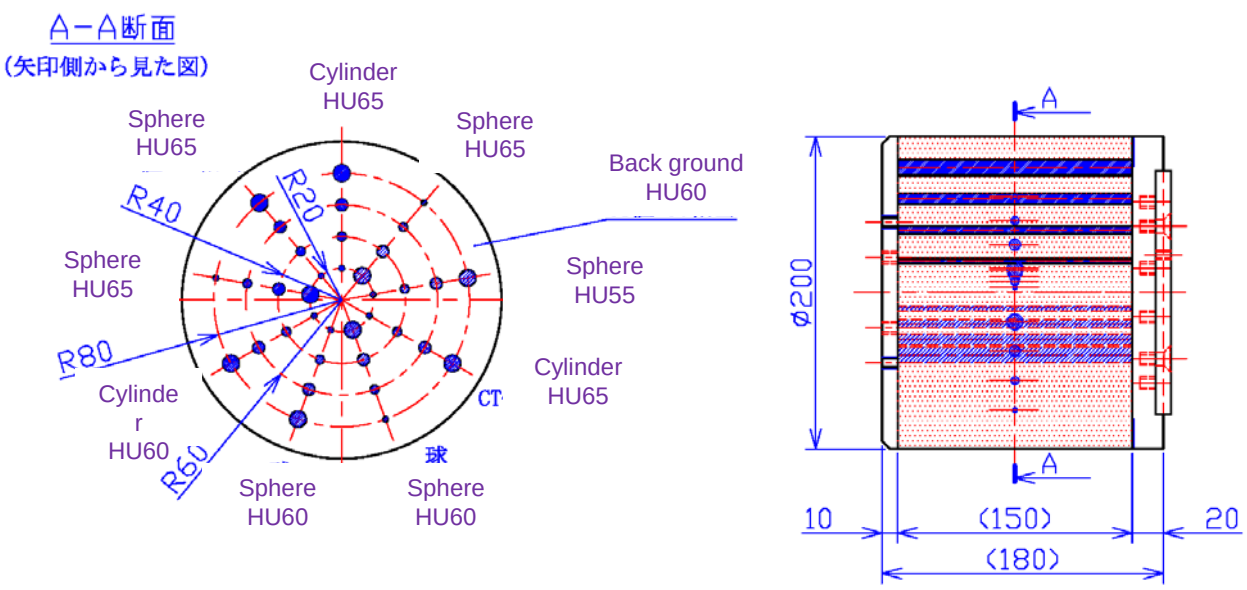
Diameter 200 mm, Length 180 mm

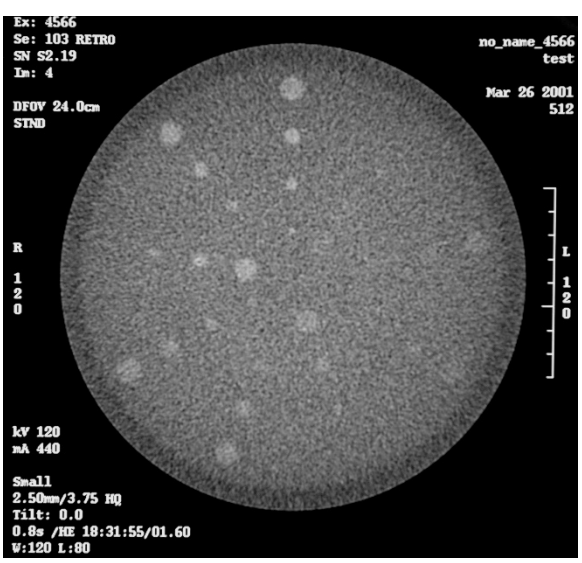
Embedded Sphere and Cylinder

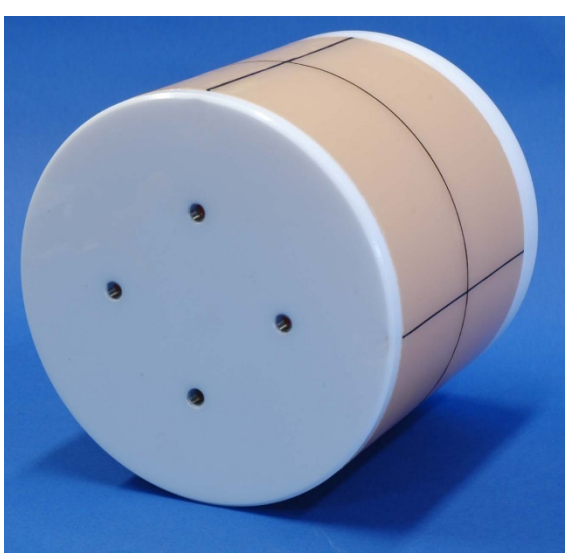
3, 5, 7, 10mm dia., 55, 60, 65HU

Spheres are arrayed on A-A cross section.

<Fig.1>







3) Set-up

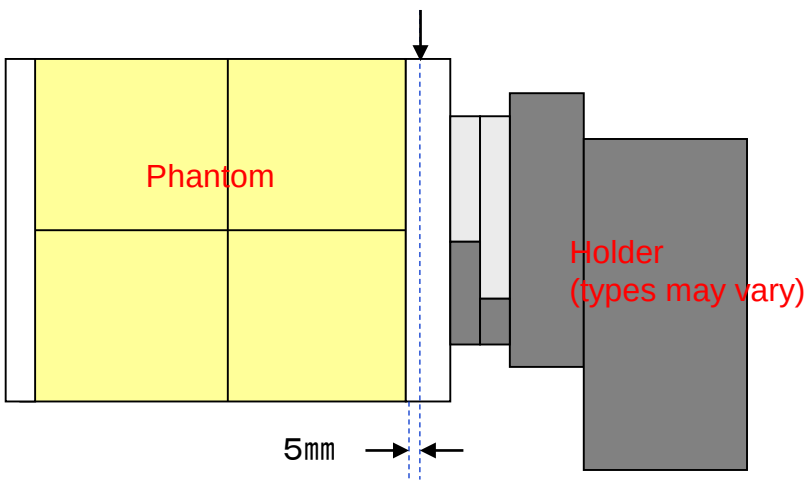
a) Set the phantom to the center of the gantry, using the adjusting holder.

b) Shoot for the positioning and align the phantom with the axis of the scanner.

c) Four metal lines are embedded at the base of the phantom as positioning guides (Fig 2). Scan this area with a thin single slice to confirm positioning. When all four metal lines fully appear in the image, positioning is done correctly (Fig 3).

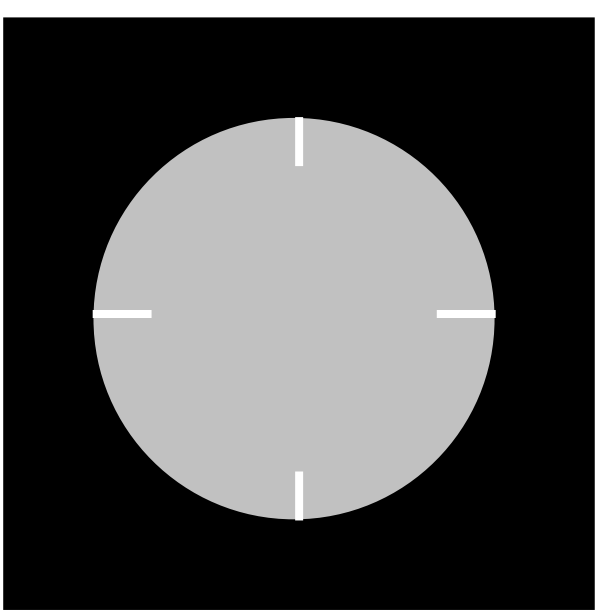
<Fig.2> Lateral View

Metal lines are embedded in this section.

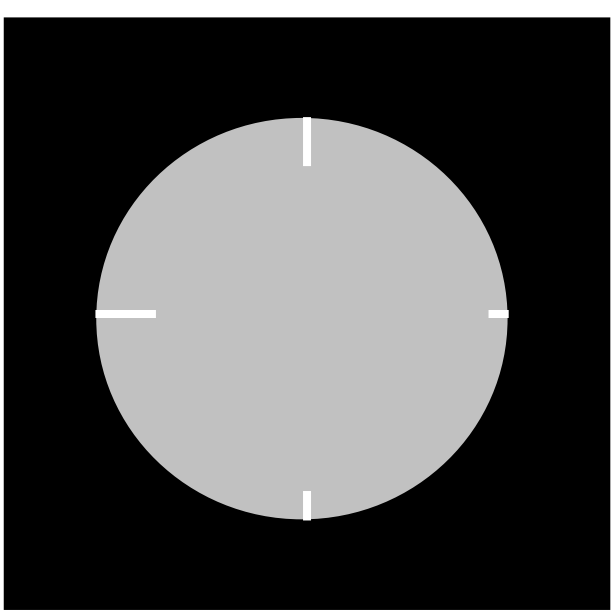


<Fig.3>

Correct Positioning
Four lines are the same length.



The phantom is tiled.
Length of the four lines is uneven.



4) Evaluation

Measure the size of smallest targets that can be visualized, adjusting the window width and the window level for the optimal visibility.

Visual evaluation is to be conducted by two or more people.

3. High Contrast Phantom （for imaging of lung field)

1) Evaluation Items

a) The variation in the contrast resolution among different scanners.

b) The variation in the contrast resolution of the different x-ray beam widths and of the different delivery speeds of the beds.

c) The variation in the contrast resolution of the slice sensitivity profile with the rectangular geometry collapse.

d) The variation in the shape of artifacts.

2) Features

Sphere and cylinder shape targets with five different diameters are embedded in the lung tissue substitute phantom..

<Size>

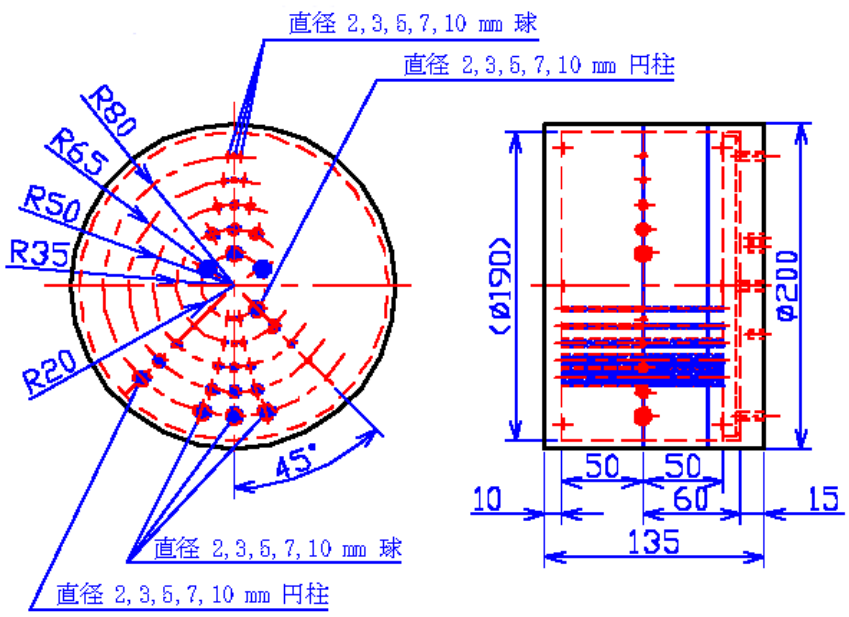
Diameter 200 mm, Length 125 mm

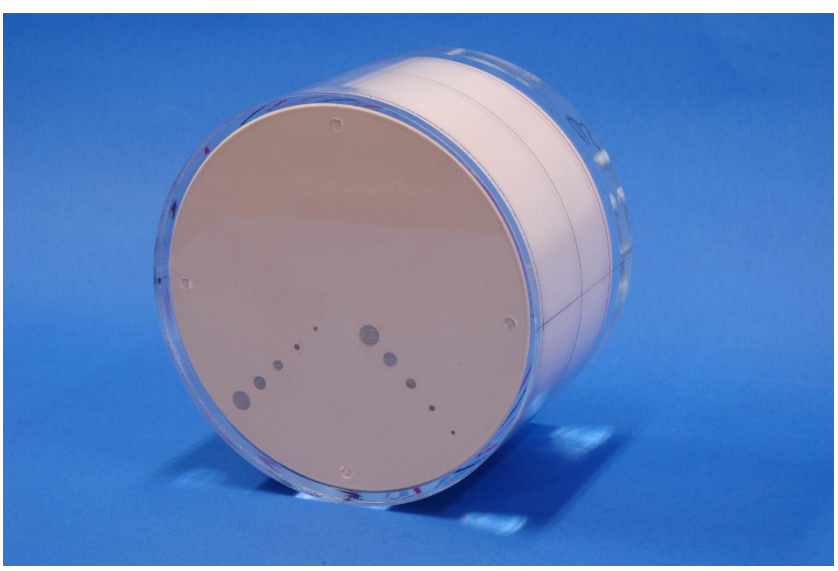
Embedded Sphere and Cylinder

2, 3, 5, 7, 10mm dia., 50 HU

Spheres are arrayed on the central section of the phantom.

Fig.4





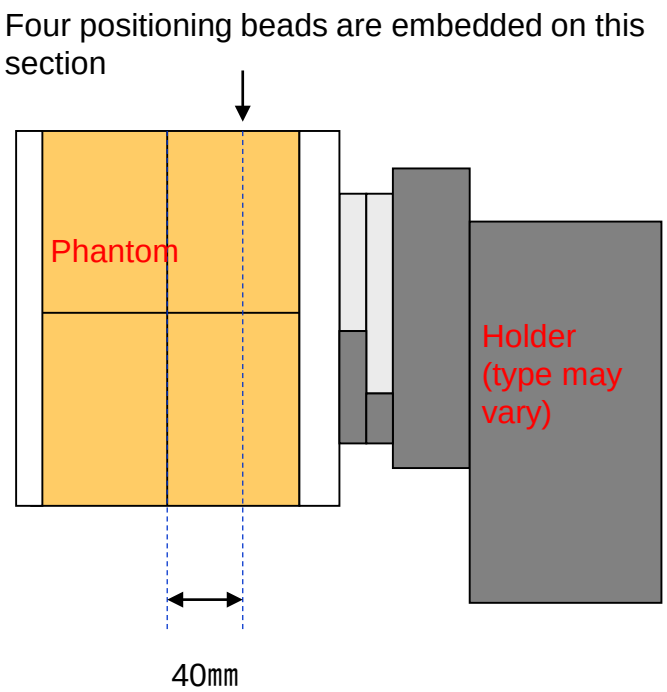
3) Set-up

a) Set the phantom to the center of the gantry, using the adjusting holder.

b) Shoot for the positioning and align the phantom with the axis of the scanner.

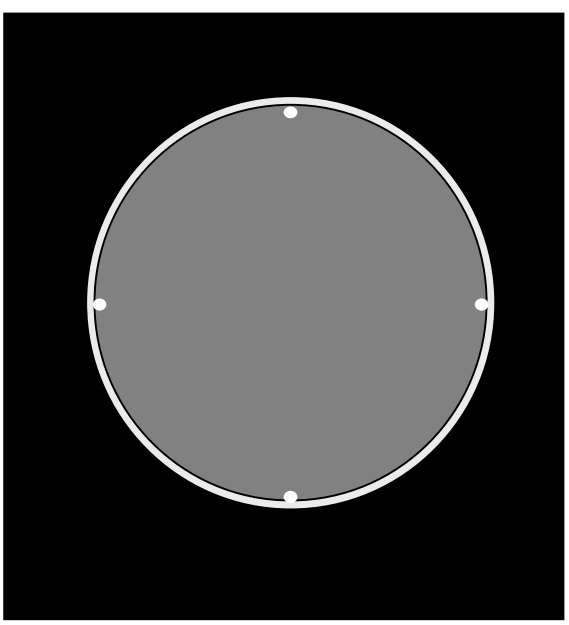
c) Four metal beads are embedded on the section at 40mm from the center as positioning guides (Fig 5). Scan this area with a thin single slice to confirm positioning. When all four metal beads fully appear in the image, positioning is done correctly (Fig 6).

【Fig.5】 Lateral view

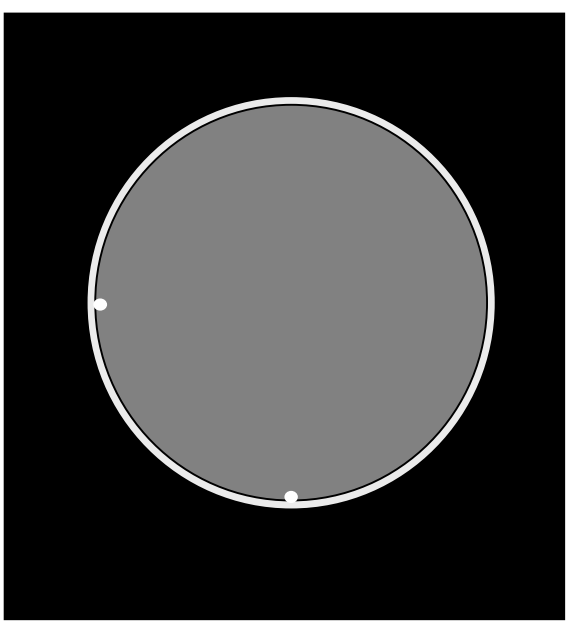


【Fig.6】

Correct positioning
All four beads are visualized



The phantom is tilted.
Four beads cannot be visualized on one section.

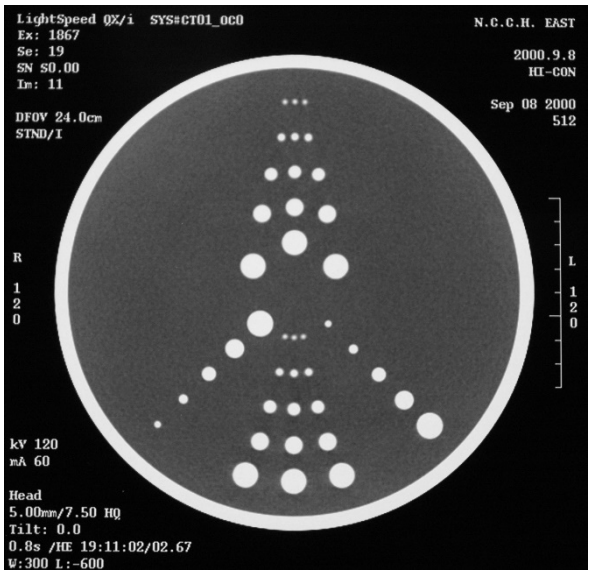


4) Evaluation

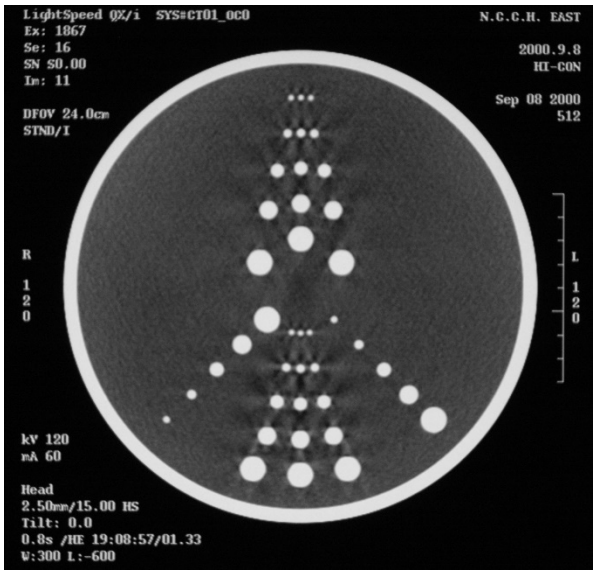
Measure the size of smallest targets that can be visualized, adjusting the window width and the window level for the optimal visibility.

Assess the variation of shape of artifacts with different X beam widths, different delivery speed of the bed as well as shape of targets.

Visual evaluation is to be conducted by two or more people.



GOOD



BAD

Artifacts caused by inappropriate combination of the slice widths and the delivery speed of the bed.

Micro Disc Phantom （for helical scanning）

1) Evaluation items

a) The variation in SSP shape between among different scanners.

b) The variation in SSP shape by the different x-ray beam widths and of the different delivery speeds of the bed.

c) Relation between SSP and effective slice width.

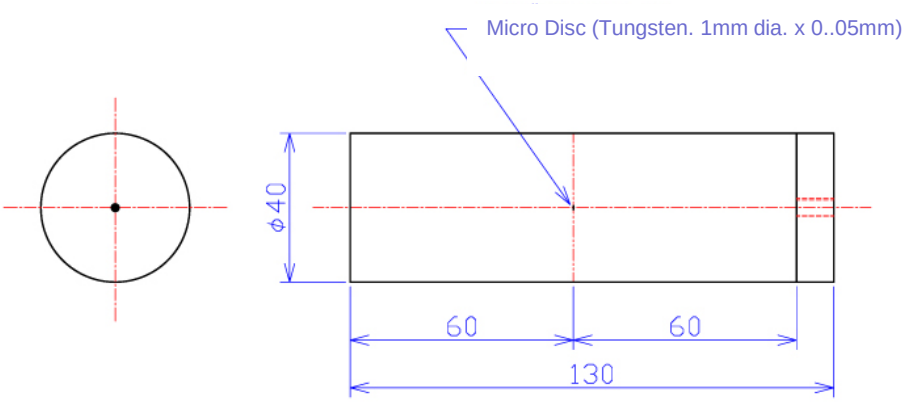
2) Features

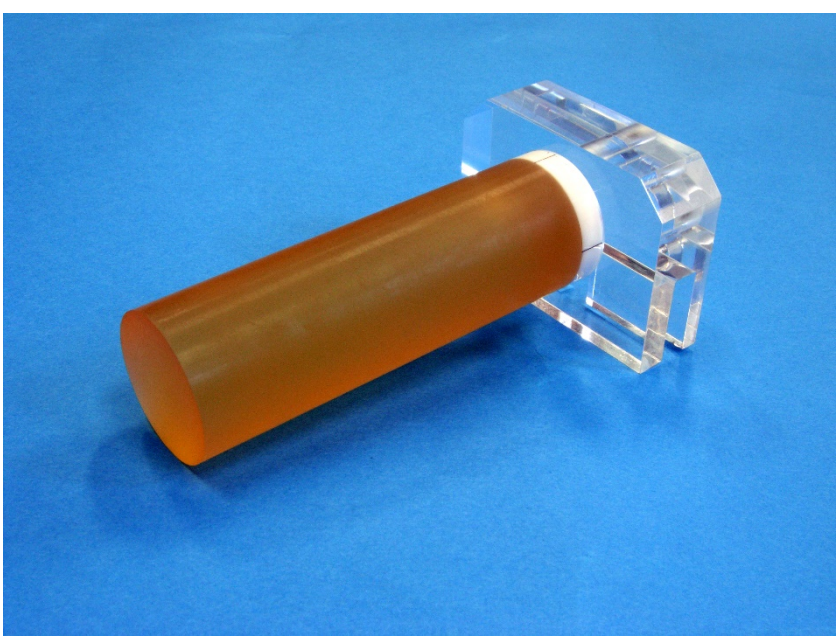
Tungsten micro disc is embedded in the tissue equivalent phantom.

Tissue equivalent phantom: 40mm dia. X 130mm

Tungsten micro disc: 1.00mm dia. X 0.05mm

【Fig.7】





3) Set-up

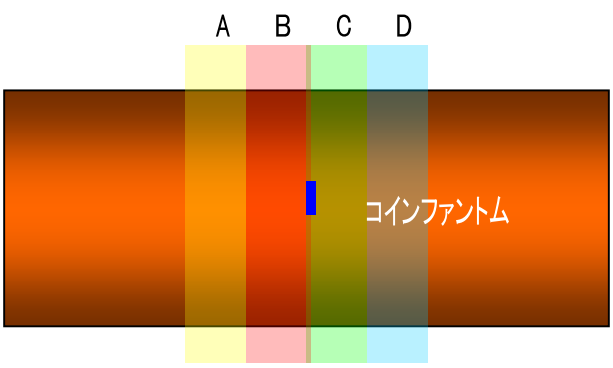
a) Set the phantom to the center of the gantry, using the adjusting holder.

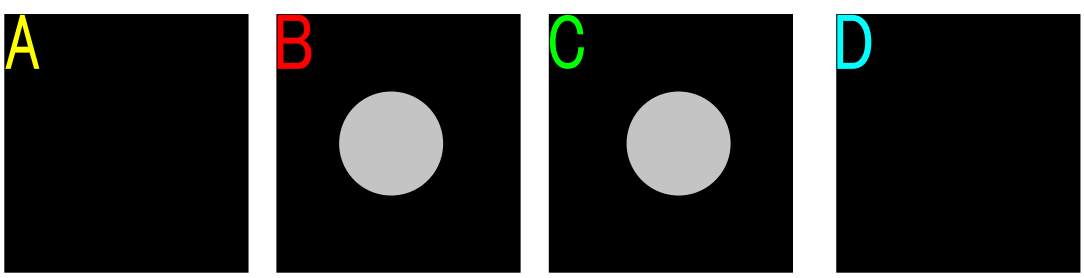
b) Using scout view align the phantom with the axis of the scanner.

c) Axial scan the central part of the phantom and verify that the micro disc is in the center. If the disc is not in the center, reposition the phantom.

d) Axial scan around the area of the micro disc with the thinnest slice and slowest speed of the delivery of the bed.

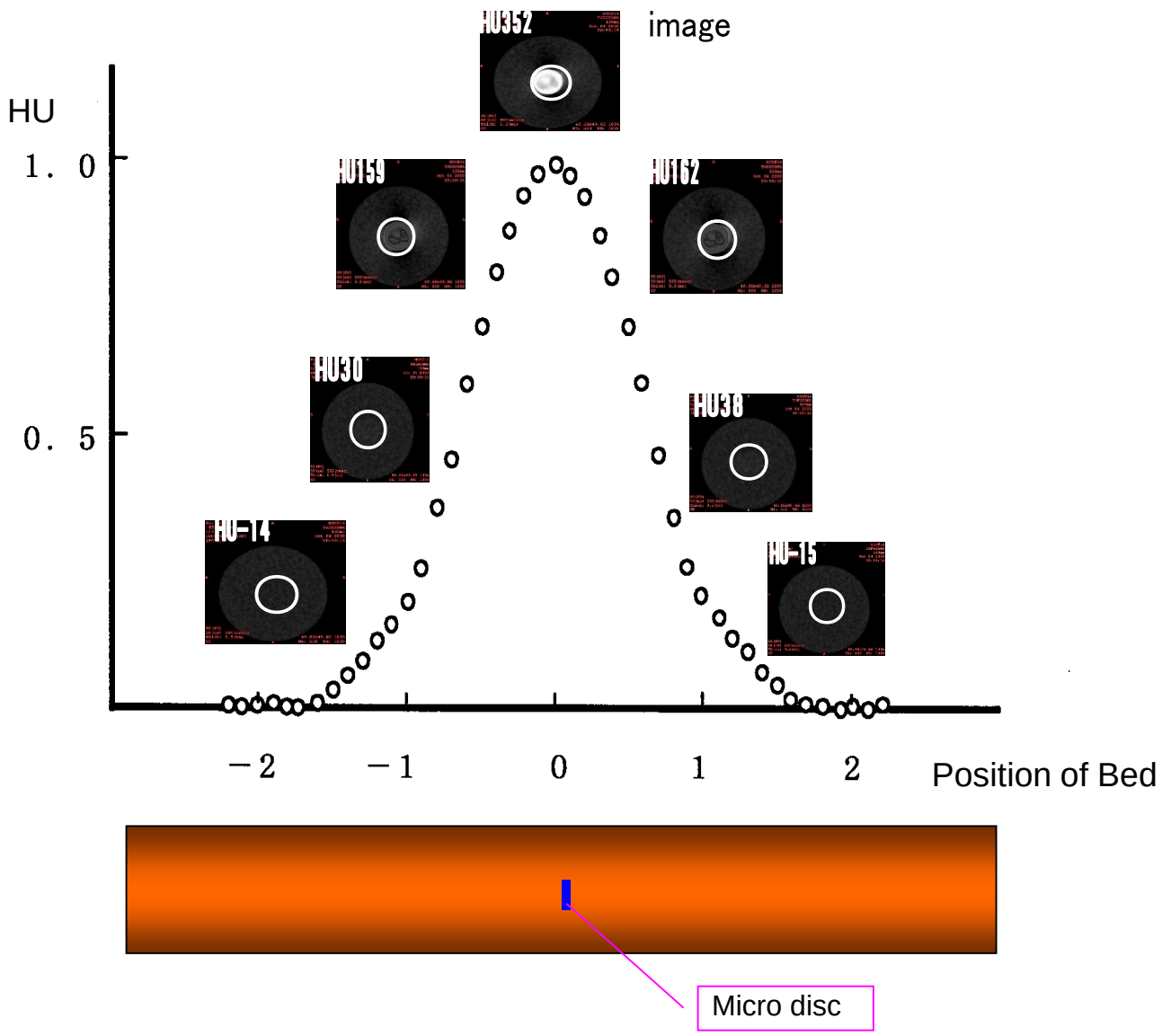
e) Define the position of the bed where the highest HU number of the disc is obtained, as reference position (zero position).





To position the phantom so that the disc is parallel to the beam is essential.
Verify that two central slices visualize the micro disc fully and that disc in the two images are of identical shape.
Align the phantom till such images are acquired.

【Fig.8】



4) Evaluation

Helical scan the phantom and measure SSPz.

Variation of HU of the micro disc is proportional to the variation of SSP when the disc moves through the thin sections.

SSP graph can be obtained by mapping measured HU value of the disc on each section according to the distance from zero position.

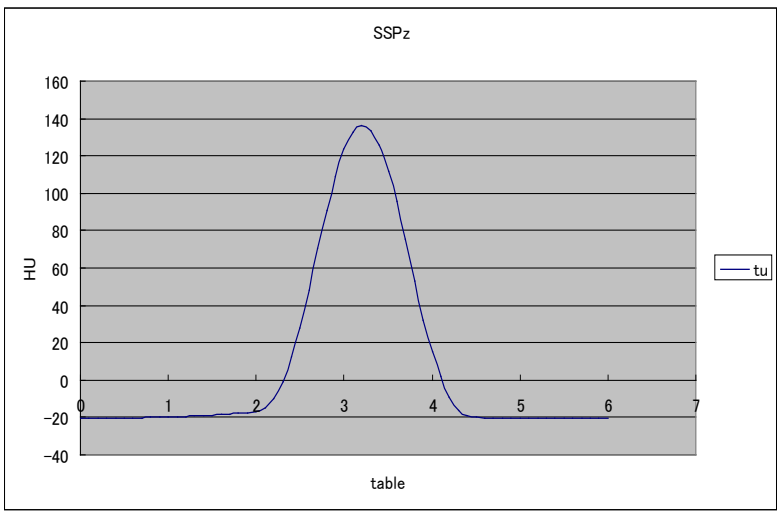
Make the graph as X=HU value of the disc and Y= position of the bed.

(Excel will facilitate the task.)

Effective slice thickness is defined as FWHM of SSP.

【Example of SSPz graph】

table	HU	table	HU
0	−20.25	3	123.34
0.1	−20.27	3.1	132.87
0.2	−20.34	3.2	135.97
0.3	−20.34	3.3	133.44
0.4	−20.29	3.4	125.39
0.5	−20.19	3.5	112
0.6	−20.23	3.6	95.85
0.7	−20.14	3.7	75.22
0.8	−20.04	3.8	53.03
0.9	−19.98	3.9	31.84
1	−19.93	4	15.25
1.1	−19.77	4.1	1.72
1.2	−19.53	4.2	−9.27
1.3	−19.28	4.3	−16.07
1.4	−19.02	4.4	−18.8
1.5	−18.71	4.5	−19.86
1.6	−18.35	4.6	−20.26
1.7	−18.07	4.7	−20.48
1.8	−17.71	4.8	−20.61
1.9	−17.34	4.9	−20.71
2	−16.7	5	−20.71
2.1	−14.96	5.1	−20.71
2.2	−9.64	5.2	−20.71
2.3	−0.73	5.3	−20.71
2.4	12.69	5.4	−20.71
2.5	28.04	5.5	−20.71
2.6	48.32	5.6	−20.71
2.7	70.46	5.7	−20.71
2.8	90.55	5.8	−20.71
2.9	108.74	5.9	−20.71
3	123.34	6	−20.71



5. Low Contrast and CTDI Phantom and Ellipse Absorber

1) Evaluation items

a) Coinstantaneous evaluation in the contrast resolution and the effective energy.

b) Evaluation in Beam-hardening effect using ellipse absorber which simulates human body.

2) Features

A. Dose Measurement Phantom

Three dosimeter holes are located in the soft tissue substitute phantom (HU 50)

Spheres (8mm dia.) and cylinders (8mm dia. ,20mm long) targets with each 3 different HU value are embedded.

HU of the targets: 55, 60 and 65

Phantom size: 200mm dia. X 180mm

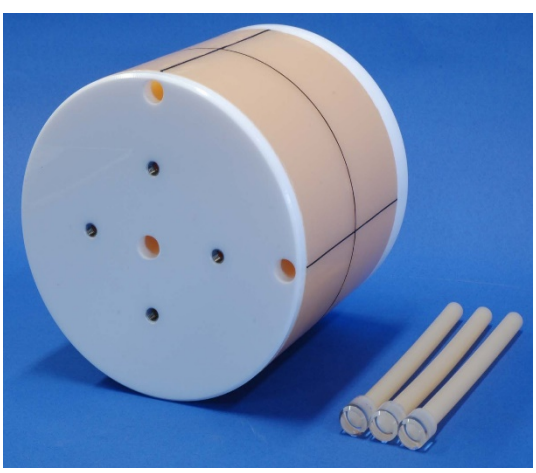
B. Ellipse Absorber

Two dosimeter holes located in the soft tissue substitute phantom.

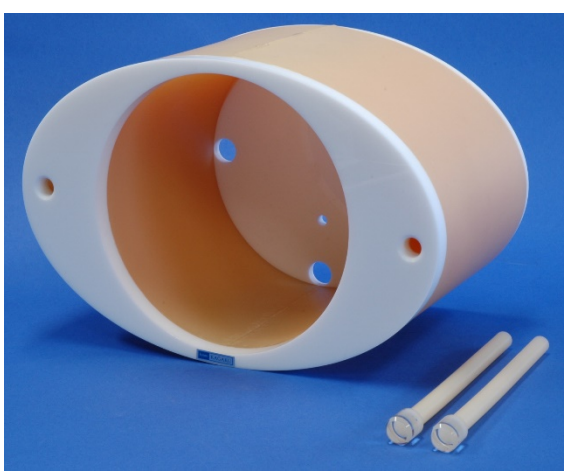
Phantom size: short axis 330mm / major axis 220mm X length 185mm

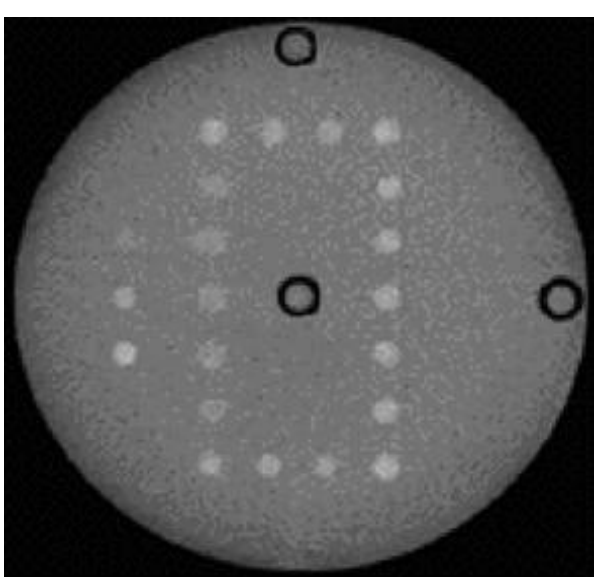
Ellipse Absorber can accommodate the low contrast and CTDI phantom.

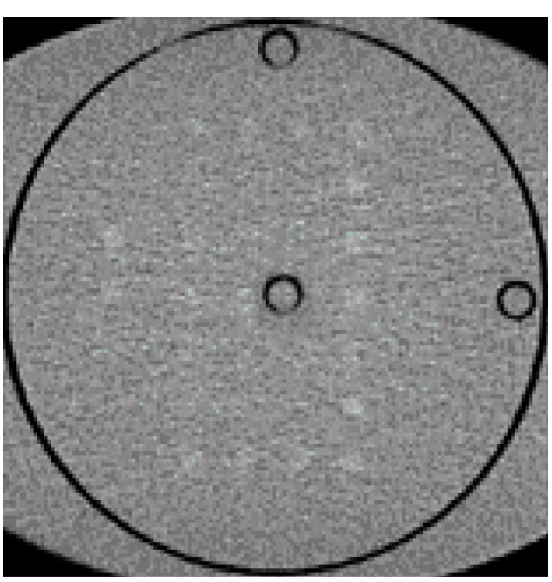
A. Low Contrast and CTDI Phantom



B. Ellipse Absorber

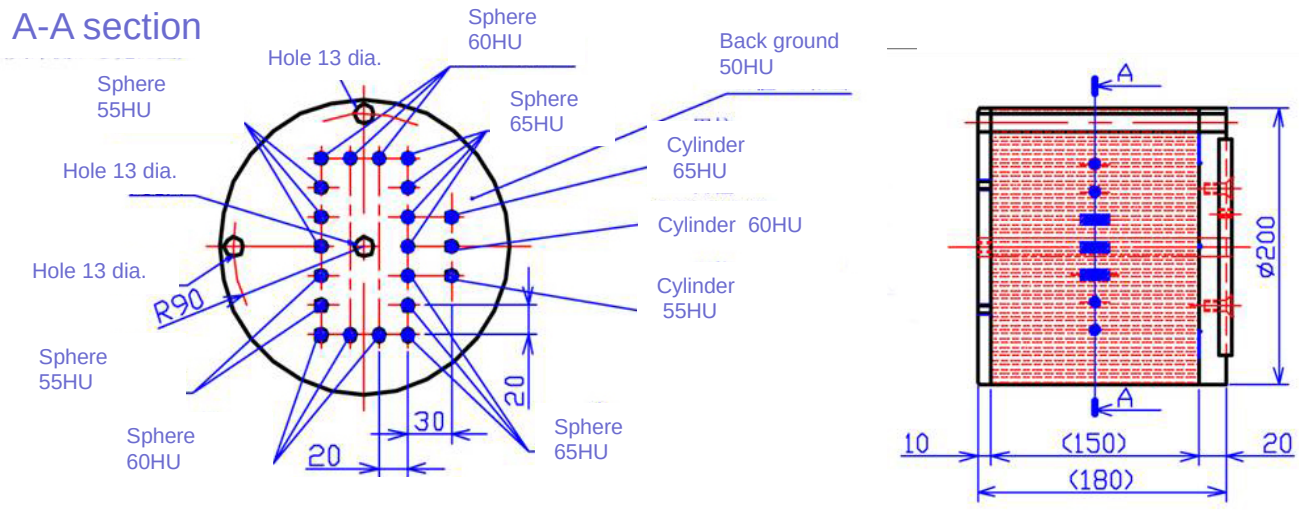




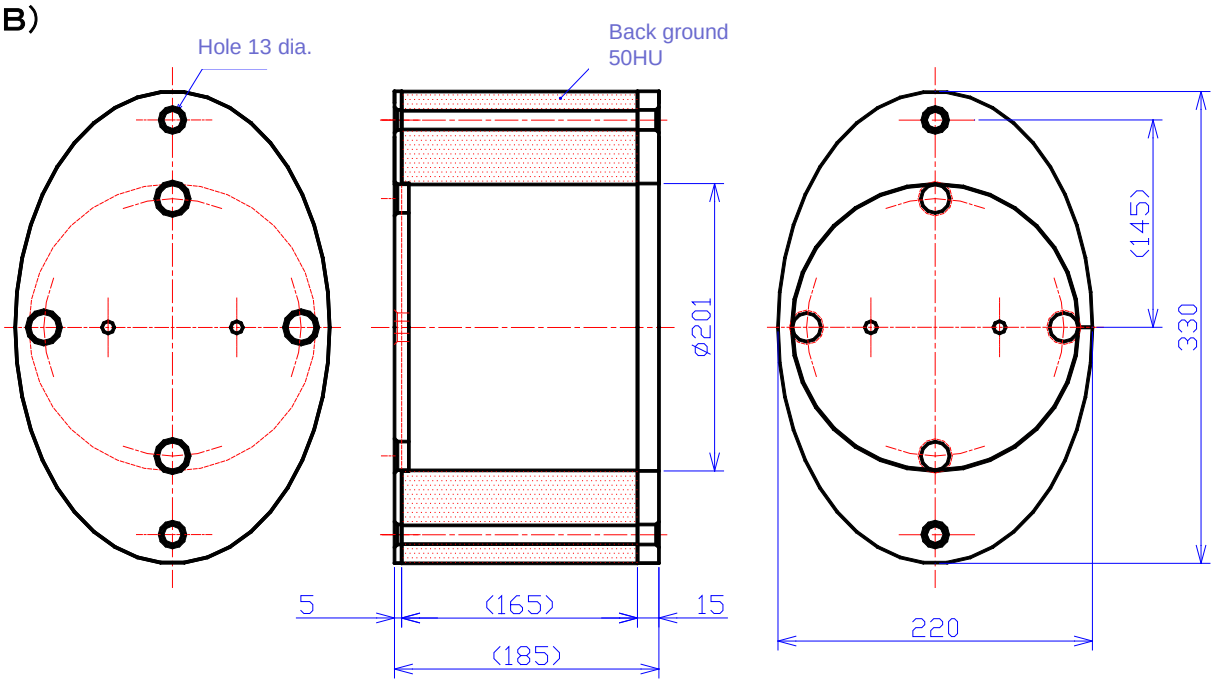


<Fig.10>

A)


A-A section
Sphere
60HU
Hole 13 dia.
Back ground
50HU
Sphere
55HU
Sphere
65HU
Cylinder
65HU
Hole 13 dia.
Cylinder 60HU
Hole 13 dia.
R90
Cylinder
55HU
Sphere
55HU
20
30
Sphere
65HU
Sphere
60HU
20
A
A
ø200
10
(150)
20
(180)

B)


Hole 13 dia.
Back ground
50HU
ø201
(145)
330
5
(165)
15
(185)
220

3) Set-up

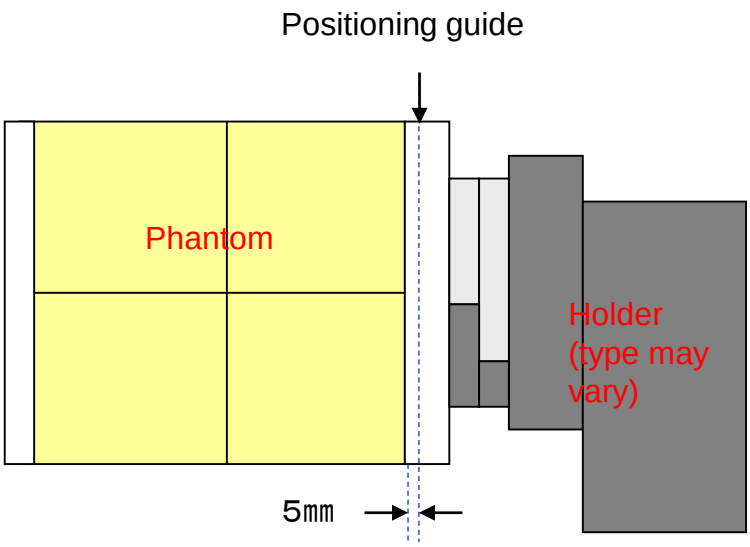
a) Set the phantom to the center of the gantry, using the adjusting holder.

b) Shoot for the positioning and align the phantom with the axis of the scanner.

c) Four metal lines are embedded at the base of the phantom as positioning guides (Fig 11). Scan this area with a thin single slice to confirm positioning. When all four metal line fully appear in the image, positioning is done correctly (Fig 6).

d) Plug the empty dosimeter holes with enclosed cylinders.

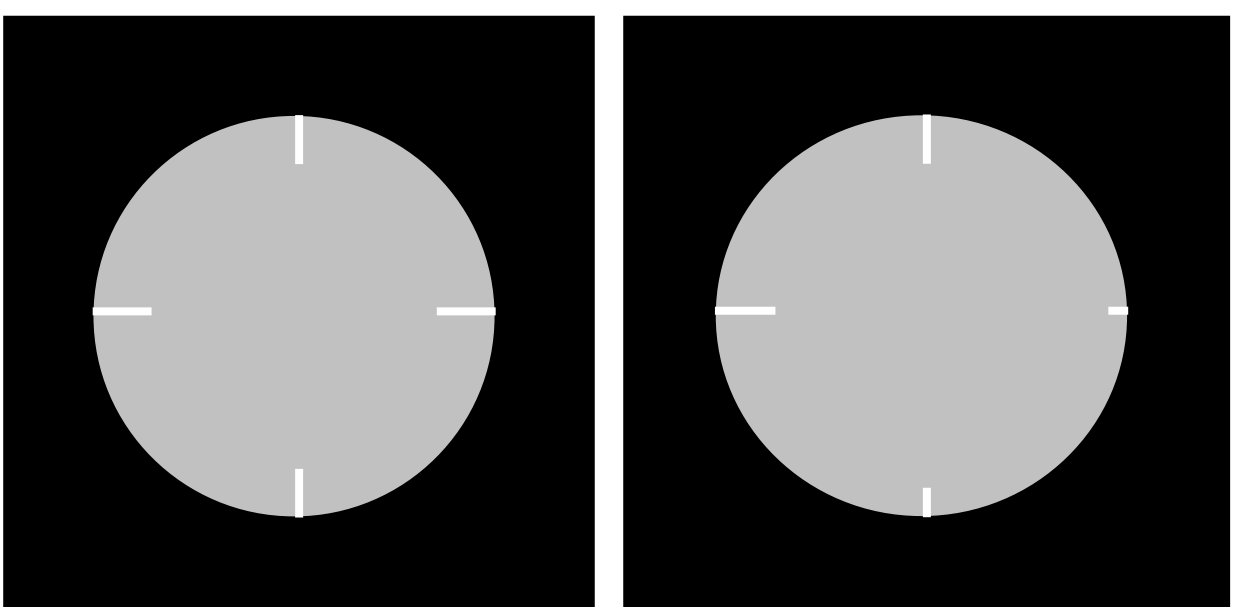
【Fig.11】 Lateral View



【Fig.12】

Correct Positioning
Four lines are the same length.

The phantom is tilted.
The length of four lines is uneven.



4. Evaluation

Coinstantaneous evaluation of radiation dose and the contrast resolution.

When 8mm dia. targets visualized as:

▌: up to 0.15% contrast ratio is differentiated (difference: 15HU)

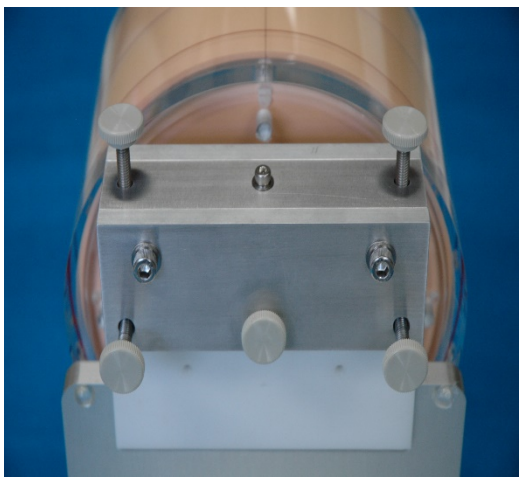
▐: up to 0.10% contrast ratio is differentiated (difference:10HU)

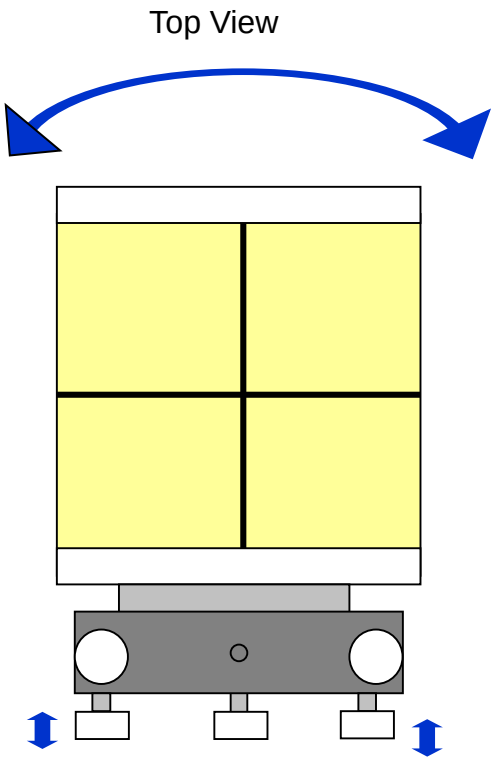
▯: up to 0.05% contrast ratio is differentiated (difference: 5HU)

Employ the ellipse absorber as needed.

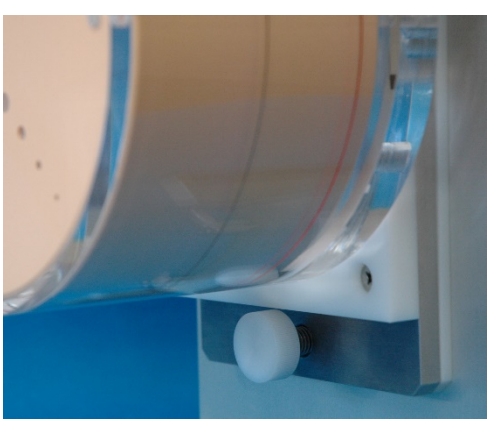
Angle adjustment holder (type may vary)

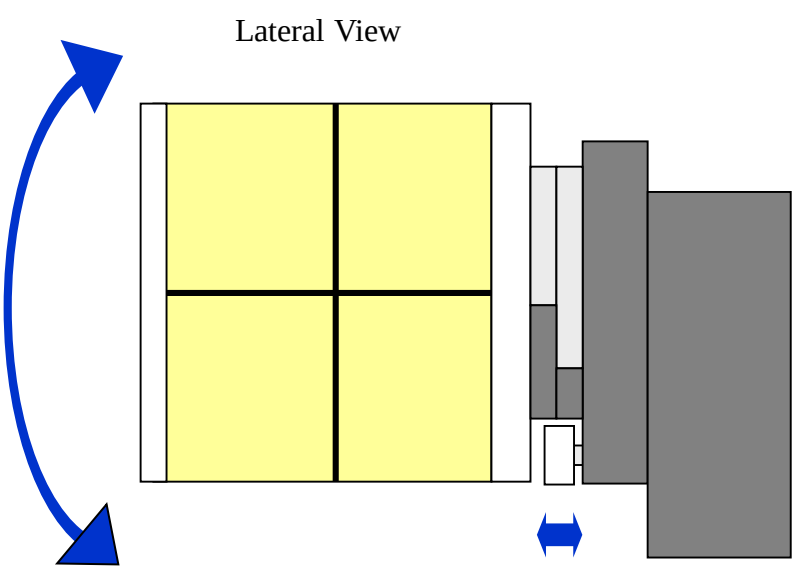
If your phantom have the holder shown below, angle of the phantom can be adjusted using two screws





The screw below the phantom is to adjust vertical angle.





Disclaimer

Phantom may contain small amount of air babbles. This is due to the characteristics of the material and is not regarded as product defect.

Bonding Plane

Lines of bonding plane may be recognized in the scanning image of Low Contrast Phantom and also Low Contrast and CTDI Phantom.
This is because the phantom material is cured in several steps in order to embed the targets in place. The lines are seen at 10mm distance from the section of the sphere targets, and also between this line and each sphere target.

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