

# QUALITY ASSURANCE(QA) FOR ELEKTA KILOVOLTAGE CONE BEAM COMPUTED TOMOGRAPHY (CBCT) IN UHC SPLIT

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# TESTS

- System safety tests
- Geometric test
- 2D imaging system tests
- 3D imaging system tests
- 2D geometric accuracy tests
- Table move assistant accuracy tests
- Determination of dose



# SYSTEM SAFETY TESTS

- Door open switch off
- Beam on/off
- Emergency off key
- Anti-collision system



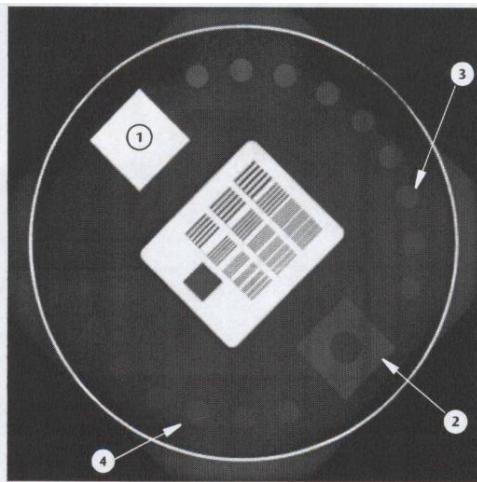
# GEOMETRIC ACCURACY TEST

- For daily checks the kV CBCT isocenter use the room lasers and Penta Guide phantom.



## 2D IMAGING SYSTEM TESTS

### ○ 2D Low contrast visibility with TOR 18FG



- 1-Brightness indicator
- 2-Contrast indicator
- 3,4-Low contrast disks

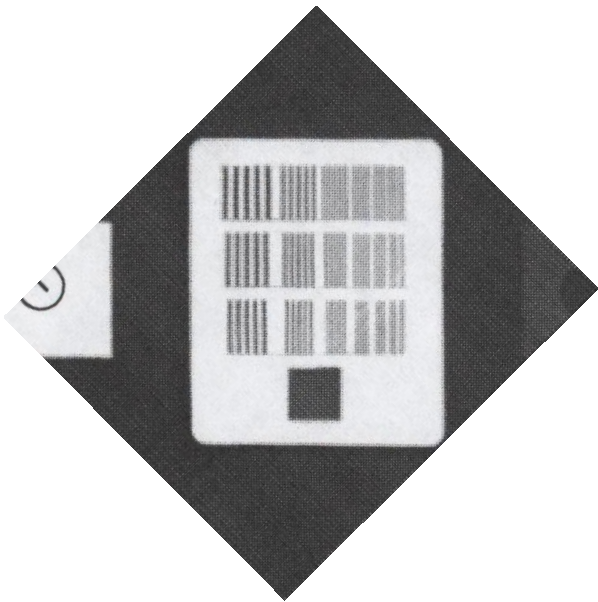
The more disks you can see, the better the low contrast visibility!

Comparison with initial (acceptance) test.



## 2D IMAGING SYSTEM TESTS

- 2D Spatial resolution in lp/mm (TOR 18FG)

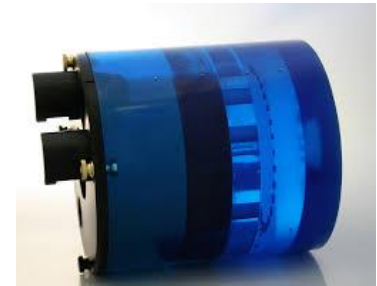


Count the groups from the top left down, then the group in other columns down.

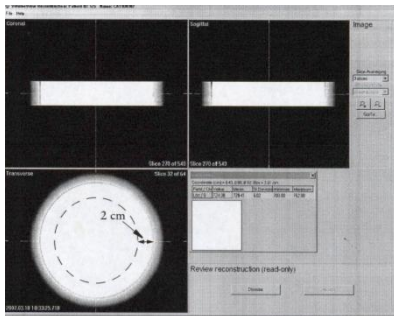
Comparison with initial (acceptance) test.



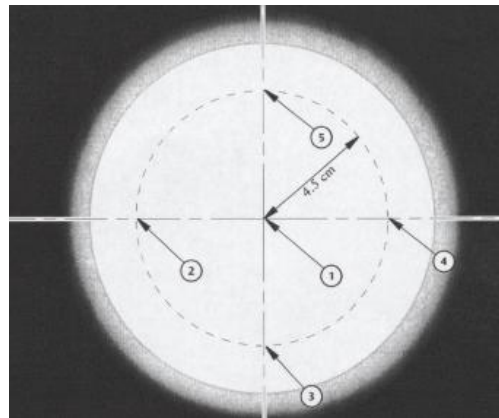
# 3D IMAGING SYSTEM TESTS



- 3D uniformity with Catphan CTP 600  
Scans in uniformity module and image analysis



Analysis area:



Results:

| Actual Coordinates (cm) |   |       | Mean pixel value |
|-------------------------|---|-------|------------------|
| X                       | Y | Z     |                  |
| -0.01                   | 0 | -0.01 | 766.9            |
| -4.50                   | 0 | 0.01  | 761.38           |
| -0.01                   | 0 | 4.50  | 760.14           |
| +4.50                   | 0 | -0.01 | 761.05           |
| -0.01                   | 0 | 4.50  | 761.52           |

| Measurement position | Coordinate position (cm) |   |      |
|----------------------|--------------------------|---|------|
|                      | X                        | Y | Z    |
| Position 1 - center  | 0                        | 0 | 0    |
| Position 2           | -4.5                     | 0 | 0    |
| Position 3           | 0                        | 0 | -4.5 |
| Position 4           | +4.5                     | 0 | 0    |
| Position 5           | 0                        | 0 | +4.5 |



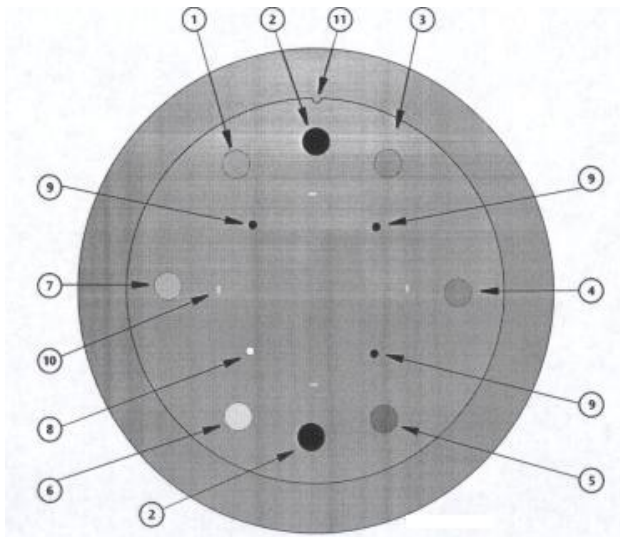
# 3D IMAGING SYSTEM TESTS

## 3D low contrast visibility

Scans in contrast resolution module and image analysis



Analysis area for mean pixel value and st.dev.:



- (1) Acrylic
- (2) Air insert
- (3) Polystyrene insert
- (4) LDPE insert
- (5) PMP insert
- (6) Teflon insert
- (7) Delrin
- (8) Teflon rod
- (9) Air rods
- (10) White alignment markers
- (11) Keyway

Results:

| Insert      | Mean pixel value (Mean) | Standard Deviation (SD) | Hounsfield Unit (CT # est) |
|-------------|-------------------------|-------------------------|----------------------------|
| Polystyrene | 744.74                  | 6.36                    | -35                        |
| LDPE        | 702.20                  | 6.52                    | -100                       |

Percentage of low contrast visibility 0.98%





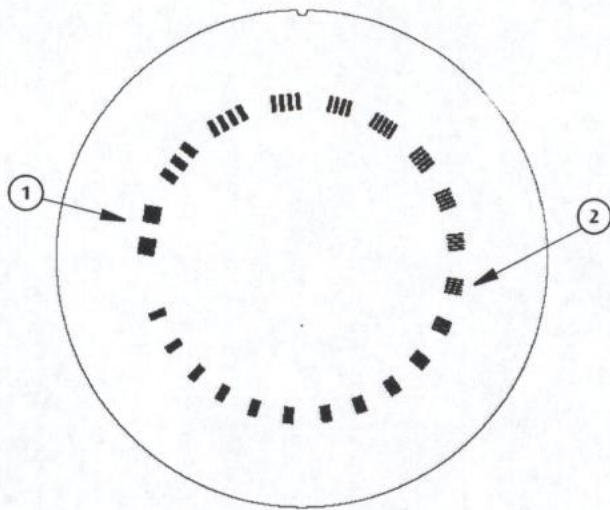
# 3D IMAGING SYSTEM TESTS

## ○ 3D spatial resolution

Scans in spatial resolution module and image analysis



Analysis area for count number  
line pair :



(1) Line pair 1

(2) Line pair 10

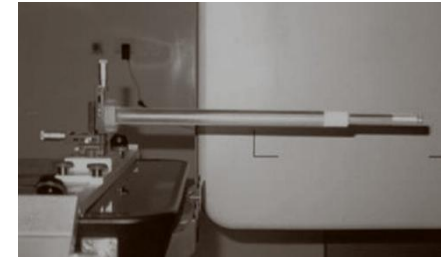
Results:

|                            | Results |
|----------------------------|---------|
| Slice number (Step 9)      | 26      |
| Slice number (Step 10)     | 35      |
| Spatial resolution (lp/cm) | 11      |

Comparison with initial  
(acceptance) test.

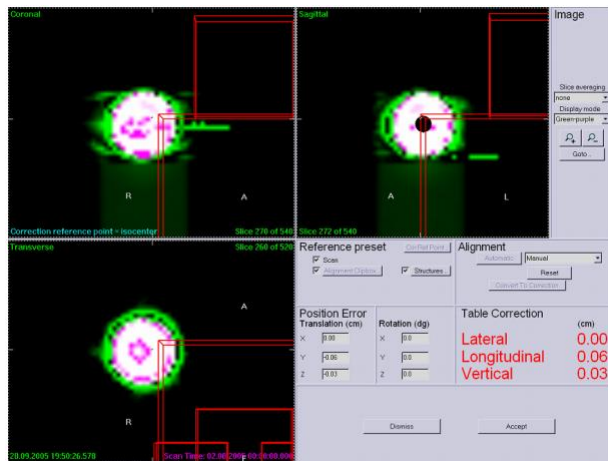


# 2D GEOMETRIC ACCURACY TEST



- Difference between MV and KV isocenter with Ball-bearing phantom

Scan and results in XVI:



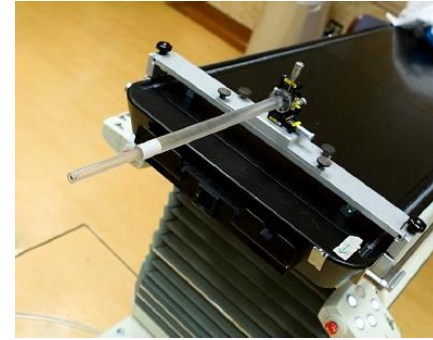
Use MV planar view of the different gantry angles ( $0^\circ$ ,  $90^\circ$ ,  $180^\circ$  and  $270^\circ$ ) for MV isocenter.

Compare MV and XVI isocenter.

Tolerance: 1mm



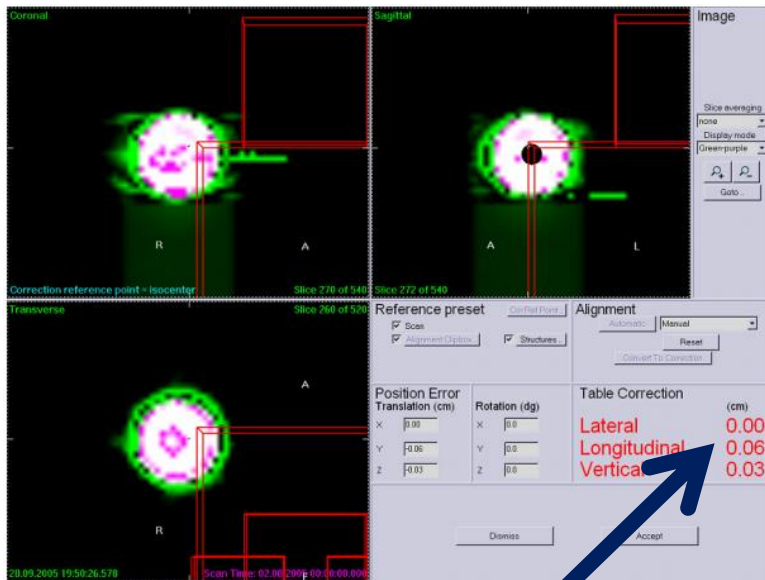
# TABLE MOVE ASSISTANT ACCURACY TESTS



- Test for Table Move Assistant (TMA) in Elekta XVI system with Ball-bearing phantom

Use 15mm offset in Lat., Long. and Height and use functions “Automatic Registration” and “Convert to correction” on XVI

Results:

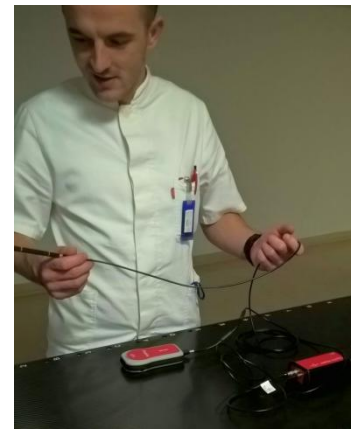


| Axis             | Manual offset | XVI calculated shifts |    | XVI convert to corrections after move |    | ≤ spec |
|------------------|---------------|-----------------------|----|---------------------------------------|----|--------|
|                  |               | cm                    | mm | cm                                    | mm |        |
| Lateral (X)      | 15 mm         | 1                     | 14 | 1                                     | 15 | 1 mm   |
| Longitudinal (Y) | 15 mm         | 1                     | 15 | 1                                     | 15 | ∅      |
| Height (Z)       | 15 mm         | 1                     | 14 | 1                                     | 14 | ∅      |

Tolerance: 2mm



# DETERMINATION OF DOSE



- $CTDI_{100}$  with Piranha multimeter,  $3\text{ cm}^3$  and 100mm ionization chamber and CT cylindrical phantom

10 cm CBCT scans for each of position chambers in the phantom.

Comparison with initial tests.

Tolerance: 20%



# FREQUENCY OF TESTS

- Daily QA – (System safety tests and simple geometric accuracy test)
- Monthly QA - (System safety tests, 2D geometric accuracy test and image quality tests)
- Annual QA (image quality of kV detector tests and dose measurement)
- QA following system repairs or upgrades (After each service or upgrade it is necessary to make an appropriate set of checks. Its breadth depends on the type of service / upgrades.)



# THANK YOU/HVALA!

