

AutoQA Plus CT Catphan[®]

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QA Benchmark

Frederick, MD

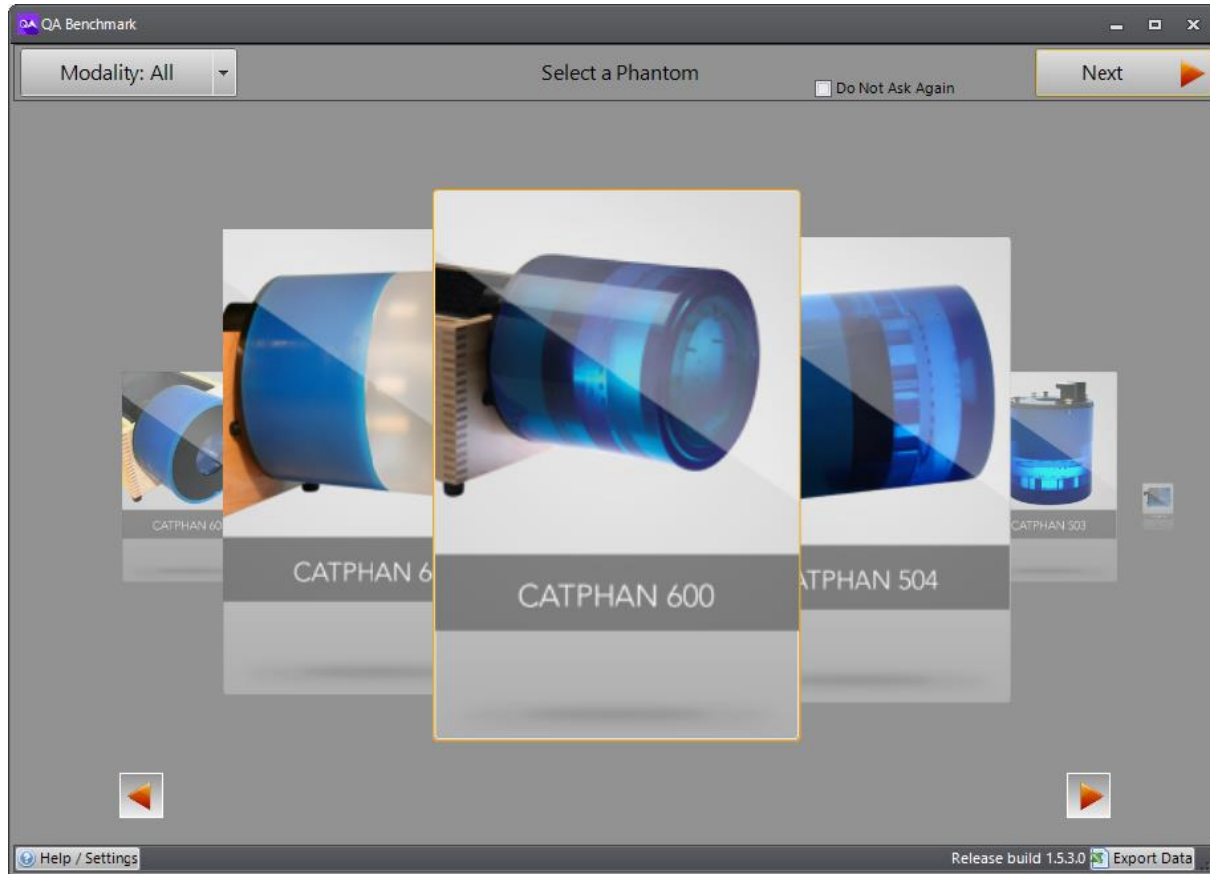


AutoQA Plus Product Highlights

- CT QA phantom processing application for image quality (IQ) evaluation .
- Diagnostic CT, radiation therapy and angiographic cone beam CT (CBCT) systems supported.
- The user interface is designed to minimize user interactions with automated image selection
- Custom report formatting with Pass/Fail tolerances defined by user.
- Simple access to robust trend analysis



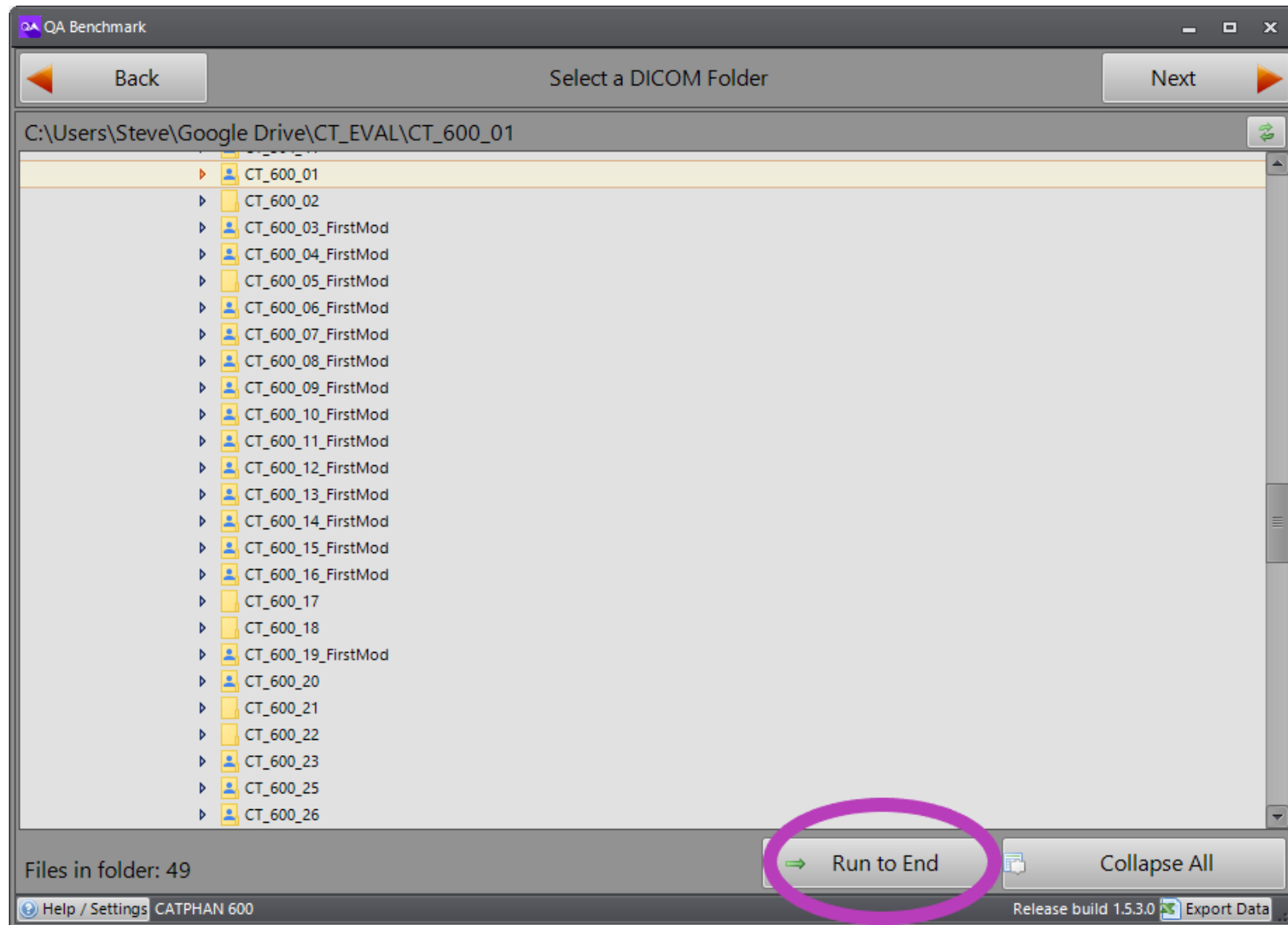
Catphan® Selection



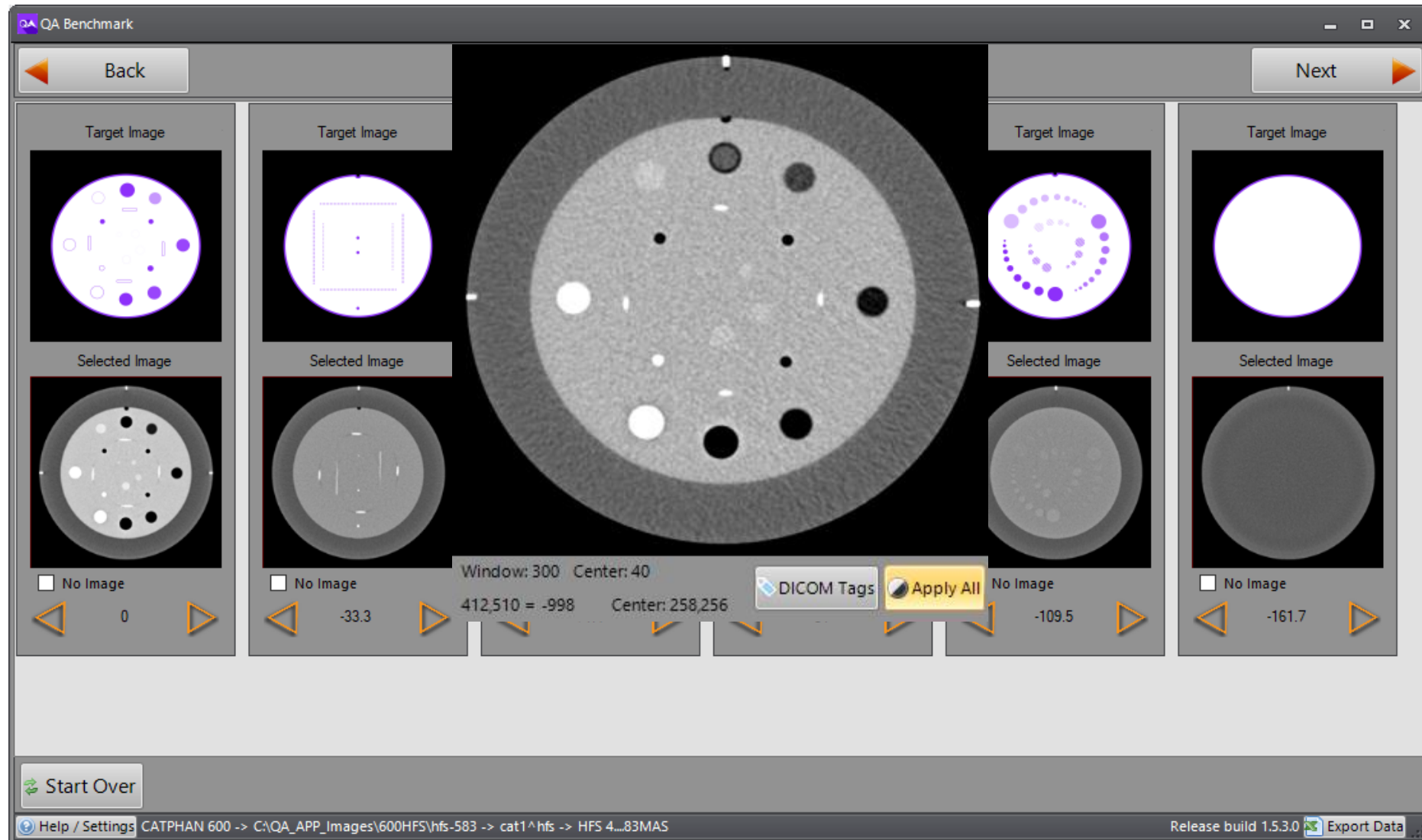
- Catphan Phantom models;
 - 500, 503, 504, 604, 700
- SSP - Slice Sensitivity Profile Analysis
- MTF – Manual MTF analysis



DICOM Image Folder Selection



Auto-Selection Screen



Report Options

AutoQA Plus

Back Report Options Next

Phantom Information

Scanner Name Scanner 1

Operator Initials

Phantom Serial # 600001

Select Pass/Fail Tolerance

Select Profile Helical

Helical - Head

Manage Report Profile

Help / Settings CATPHAN 600 -> C:\Users\steve\Goo...tphan600\CT_600_02 -> 15.08...yTraum -> BodySp... B30s Release build 1.7.4.0 Export Data



Manage Report Profile

Profile Editor

Profile Name: Description:

Image Uniformity

Slice Thickness (Bead) Resolution Gauge MTF (BeadSingle) Slice 4 Low Contrast Uniformity Index

Verification Pixel Size **CT Linearity** Slice Thickness (Wire) MTF (Wire) MTF (Bead) Slice 2

Test Output ☐ ON ☐ OFF

Pass/Fail ☐ ON ☐ OFF

Graph Output ☐ ON ☐ OFF

ROI Output ☐ ON ☐ OFF

Test will pass when:

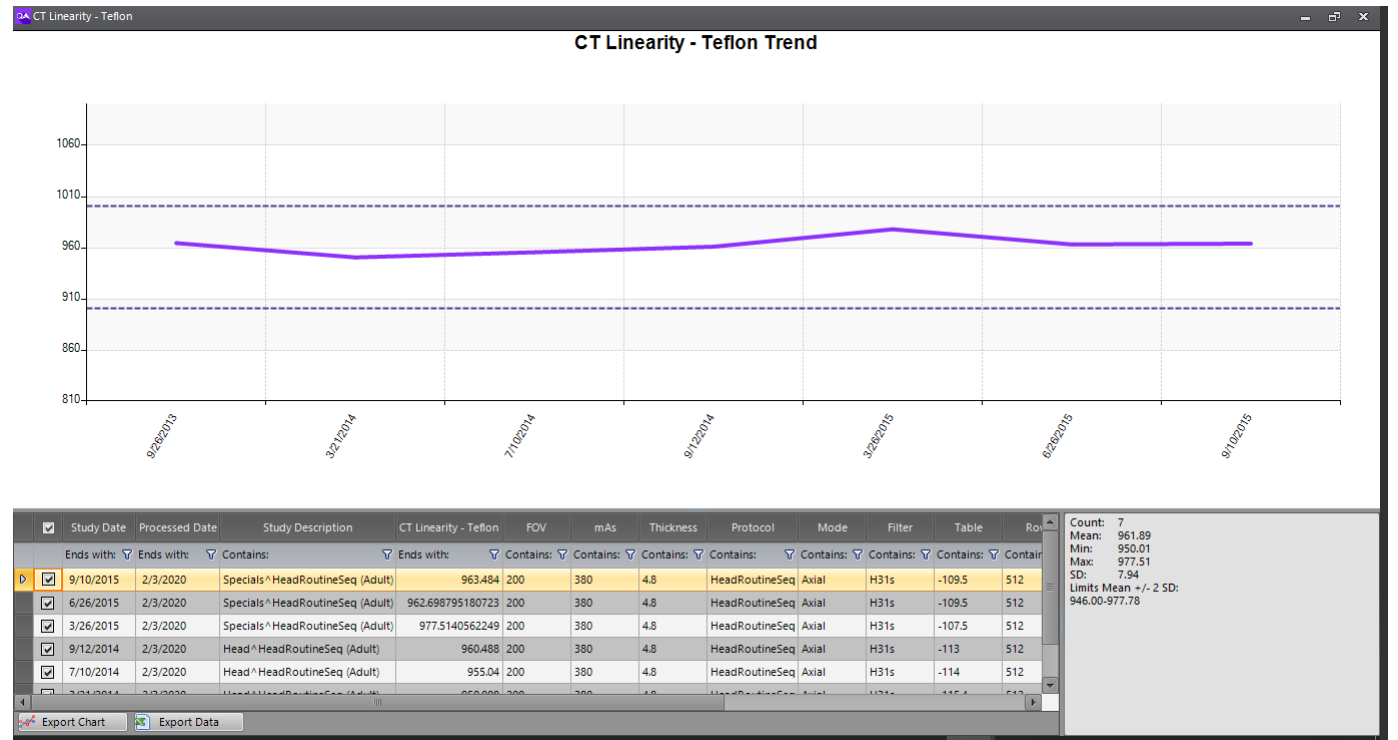
Teflon	950.00	Expected Value	±	50.00
Air	-1000.00	Expected Value	±	50.00
LDPE	-90.00	Expected Value	±	20.00
Delrin	340.00	Expected Value	±	20.30
Acrylic	120.00	Expected Value	±	20.00
Polystyrene	-35.00	Expected Value	±	20.00
PMP	-185.00	Expected Value	±	20.00

Save as New Save Cancel

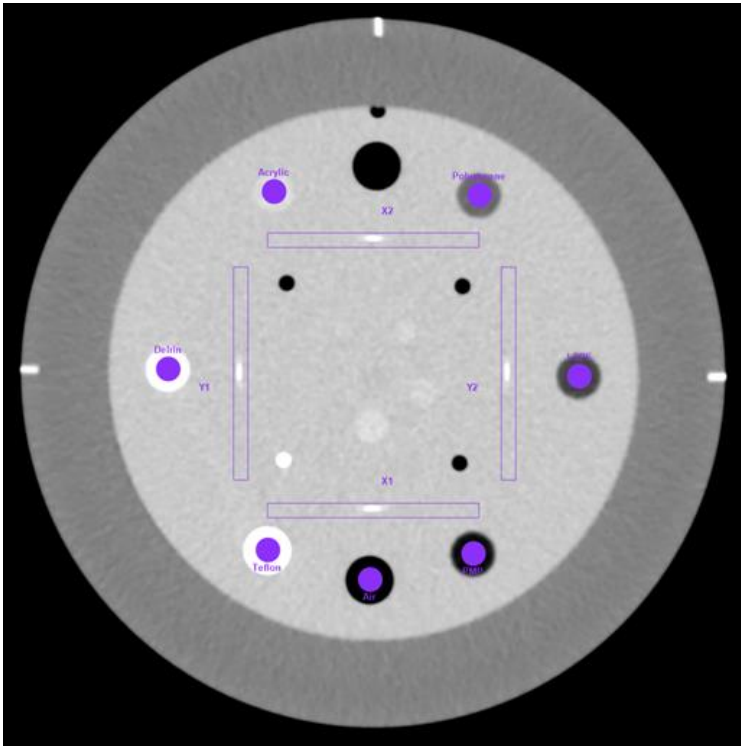


Trend Analysis

CT # Linearity	
Expected	Measured
Contrast Scale	2.000E-001 (1/CT#HU)cm
Teflon 950.0 ± 50.0	934.2
Air -1,000.0 ± 50.0	-965.6
LDPE -90.0 ± 20.0	-91.1
Delrin 340.0 ± 20.3	338.1
Acrylic 120.0 ± 20.0	121.1
Polystyrene -35.0 ± 20.0	-35.7
PMP -185.0 ± 20.0	-176.5



Geometric Performance Slice Thickness Accuracy



- Full-width half-maximum (FWHM) of single pixel profile of angled wire ramps
- Phantom position
 - Tilt (Vertical angle)
 - Yawl (Horizontal angle)

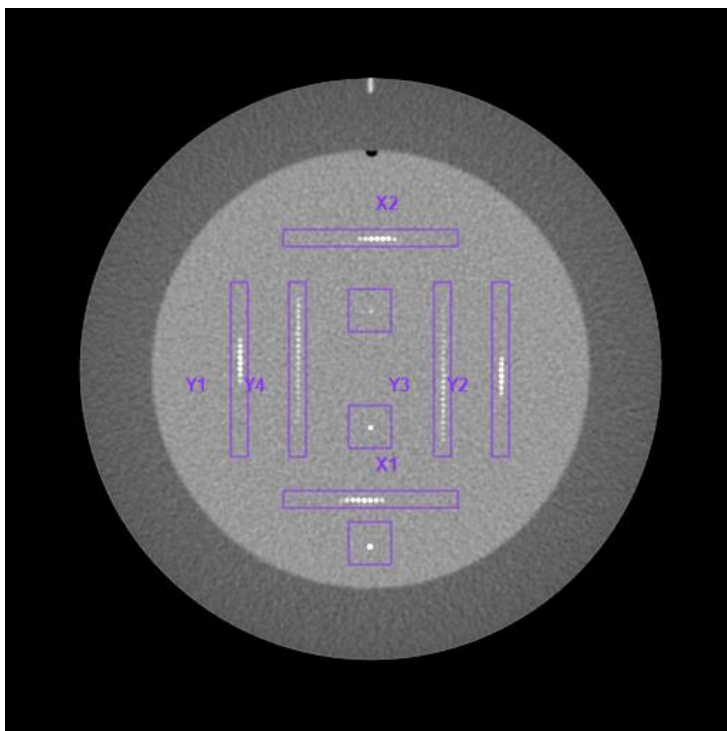
X-Axis		Y-Axis	
X1	1.25	Y1	1.29
X2	1.24	Y2	1.36
Table Position Offset (mm)			0.38
Vertical Angle			0.6°
Horizontal Angle			0.1°

Slice Thickness	
Expected	Measured (Avg)
1.00 ± 0.50 mm	 1.29 





Slice Thickness Accuracy Bead Ramps



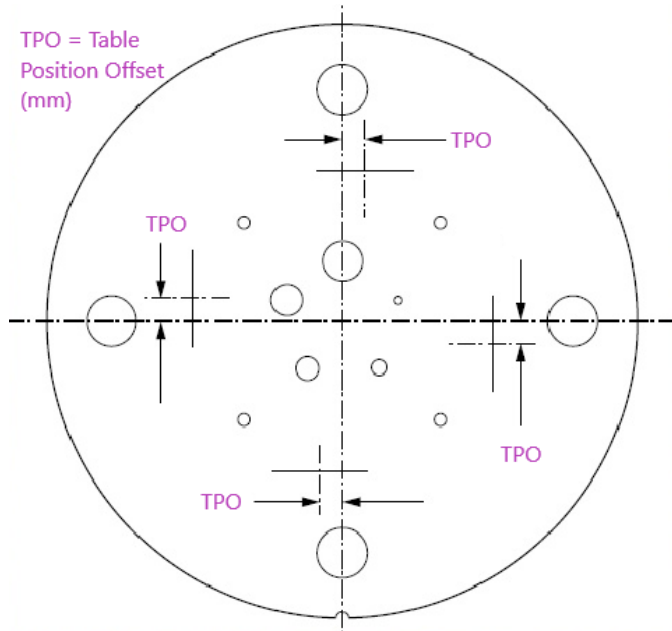
- 1 set of 0.25 mm diameter bead ramps
 - Used for slice thickness ≤ 3 mm
- 2 sets of 1.0 mm diameter bead ramps
 - Used for slice thickness > 3 mm

X-Axis		Y-Axis	
X1	5.06	Y1	5.19
X2	5.07	Y2	5.22
Table Position Offset (mm)			-1.80
Vertical Angle			0.1°

Slice Thickness	
Expected	Measured
5.00 ± 0.50 mm	5.14 



Geometric Performance Laser Alignment/Scan Localizer Accuracy



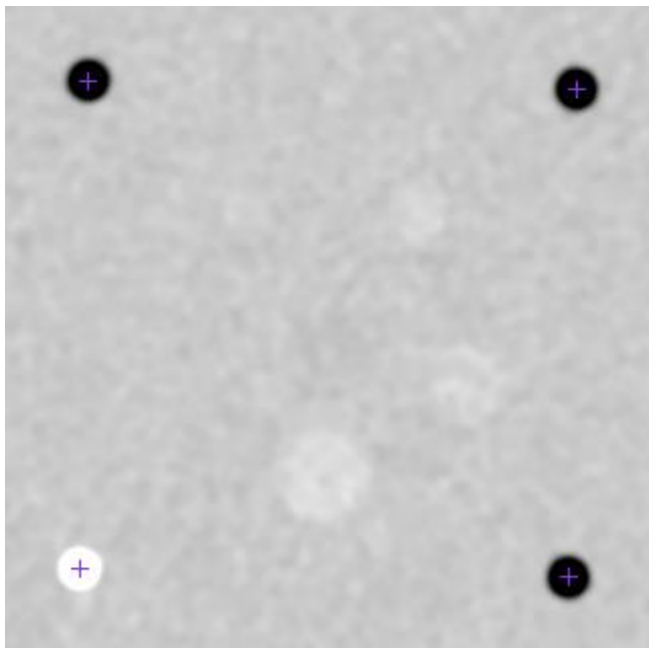
- Laser alignment – module scanned using external reference mark
- Scan localizer – module scanned by selecting the center of the angled ramps
- Table Position Offset – slice location relative to module center

Slice Thickness	X-Axis		Y-Axis	
	X1	1.25	Y1	1.29
	X2	1.24	Y2	1.36
	Table Position Offset (mm)			0.38
	Vertical Angle			0.6°
	Horizontal Angle			0.1°

Slice Thickness	
Expected	Measured (Avg)
1.00 ± 0.50 mm	1.29



Spatial Linearity



- 50 mm spaced 3 mm air and Teflon pixel size 'plugs'
- Vertical and horizontal profiles used to determine plugs centers
- 4 center to center distances measured
- Center locations used to estimate phantom rotation angle

Pixel Size

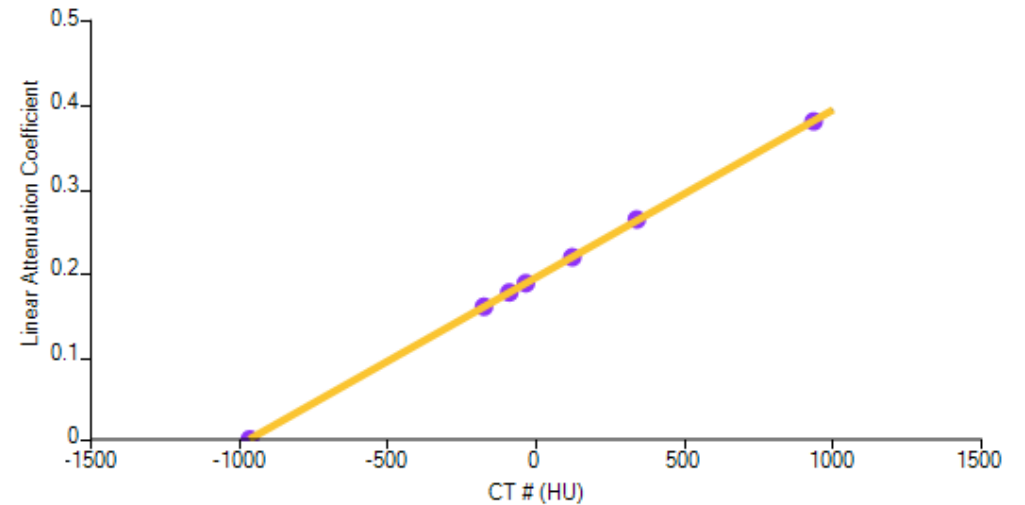
X-Axis (mm)			Y-Axis (mm)		
X1	0.41	50.0	Y1	0.41	50.0
X2	0.41	50.0	Y2	0.41	50.4
Rotation Angle	→ -0.8				

Pixel Size	
Expected	Measured
0.41 ± 0.10	→ Avg: 0.41
Spatial Linearity	
Expected	Measured
50.0 ± 1.0	→ Avg: 50.1



CT Number Accuracy

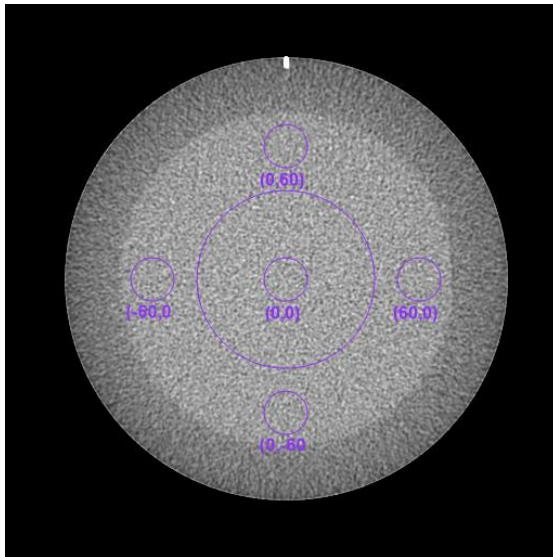
CT # Linearity	
Expected	Measured
Contrast Scale	1.870E-004 1/CT(HU)cm
Teflon 950.0 ± 50.0	947.6
Air $-1,000.0 \pm 50.0$	-1,003.4
LDPE -90.0 ± 20.0	-91.5
Delrin 340.0 ± 20.3	349.7
Acrylic 120.0 ± 20.0	125.1
Polystyrene -35.0 ± 20.0	-32.6
PMP -185.0 ± 20.0	-183.1



Effective Energy (keV)	74
R (coefficient)	0.999988
ROI Diameter (mm)	7.00



CT Number Uniformity



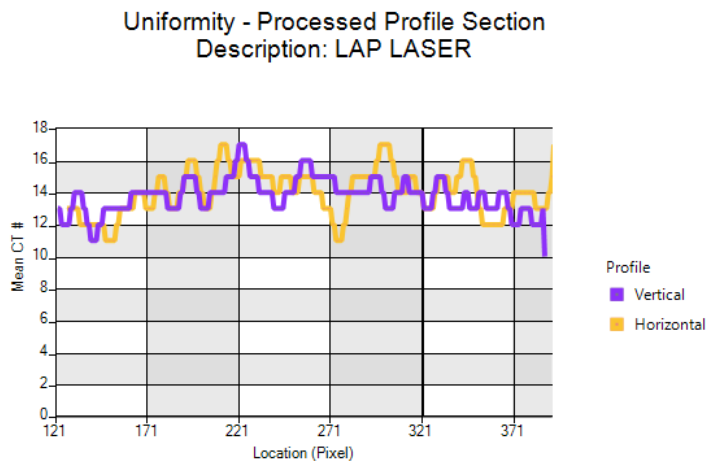
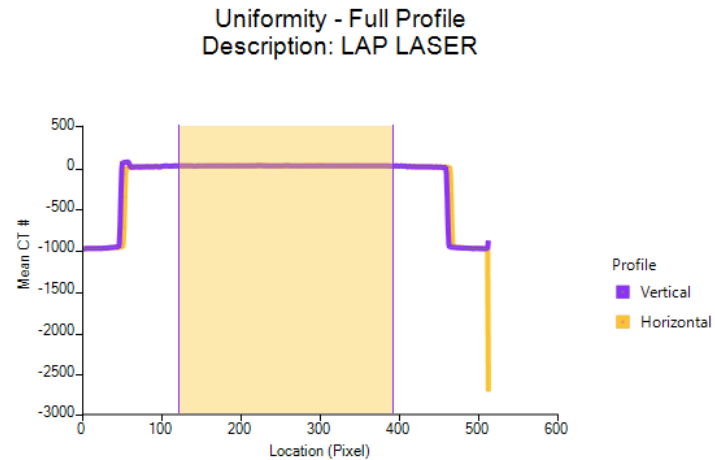
- Mean and noise (SD) of 5 regions of interest (ROI)
- ROI diameters 10% of the phantom diameter
- Measured uniformity absolute value of the maximum difference of the center and 4 peripheral means

Image Uniformity	
Uniformity Value	0.6  ≤ 3.0

Location	Center	3 o'clock	6 o'clock	9 o'clock	12 o'clock
ROI Center (mm)	0,0	60,0	0,-60	-60,0	0,60
ROI Diameter (mm)	20	20	20	20	20
Mean $\pm$ SD	12.6 $\pm$ 4.8	12.2 $\pm$ 4.2	12.4 $\pm$ 4.5	12.4 $\pm$ 4.7	12.1 $\pm$ 4.3
Difference (HU)		-0.4	-0.2	-0.2	-0.6



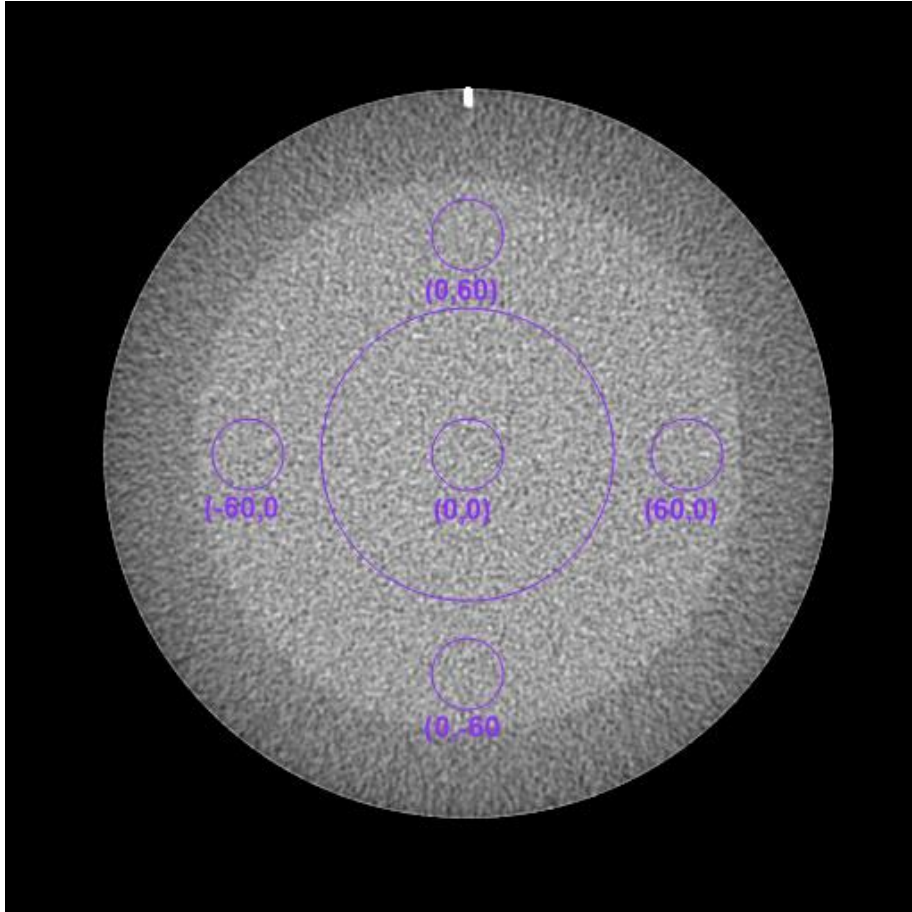
Uniformity Index



- Vertical and Horizontal profiles generated through the center of the uniformity module
- 10 pixel x 130mm profiles
- Limit is the ± 10 HU or $\pm 2 \times \text{SD}$ of the averaged 10 pixel wide profile, the smallest value
- Uniformity Index - ratio of pixels within the limits and number of pixels in 130mm profile



Noise Magnitude



- Noise (SD) derived from a centered ROI at a diameter 40% of the phantom diameter (IEC)
- ROI diameter size variable field accessible by user

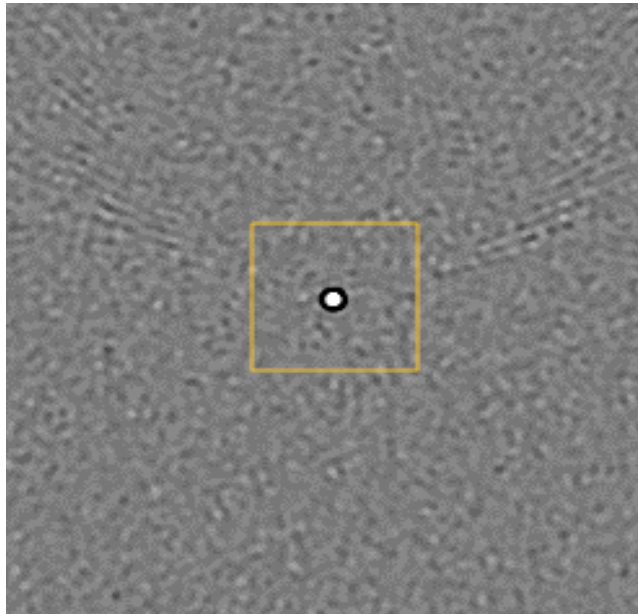
Central Noise

± 4.9 
< 5.0

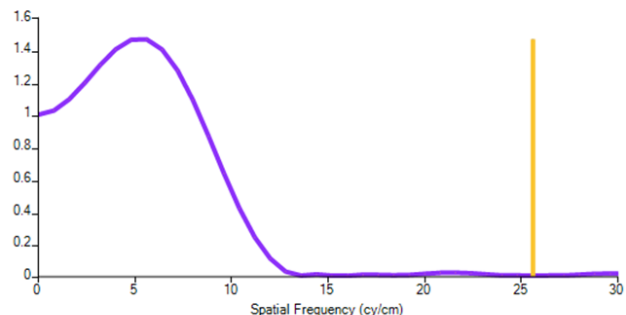
**40% of phantom
diameter**



Spatial Resolution Modulation Transfer Function (MTF)



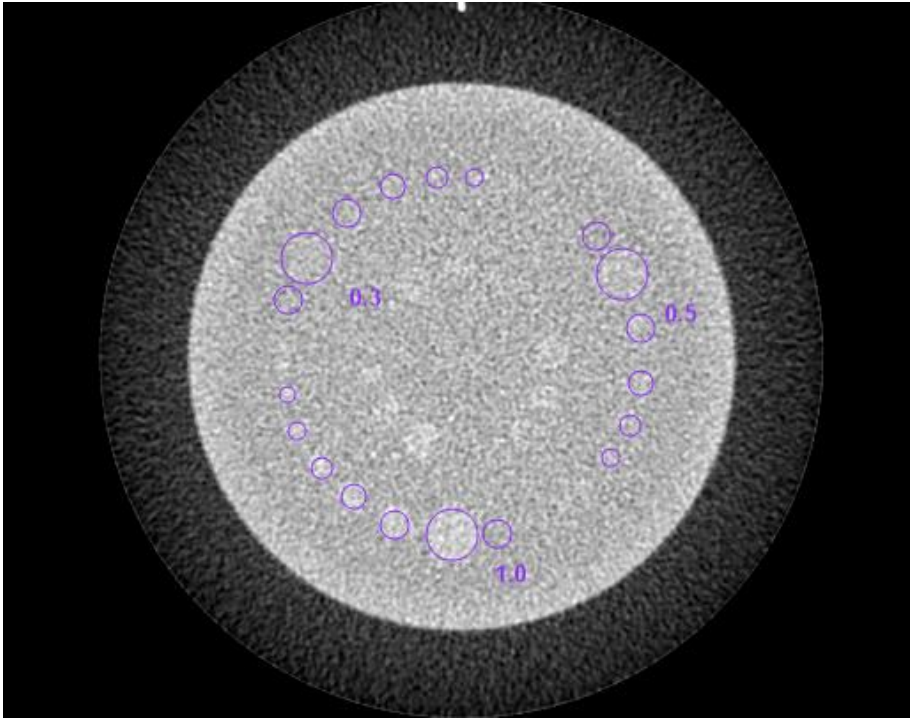
MTF Bead
Description: CTP528 120kV 100mAs Multi2s 0.80 Br64 S5 FOV100



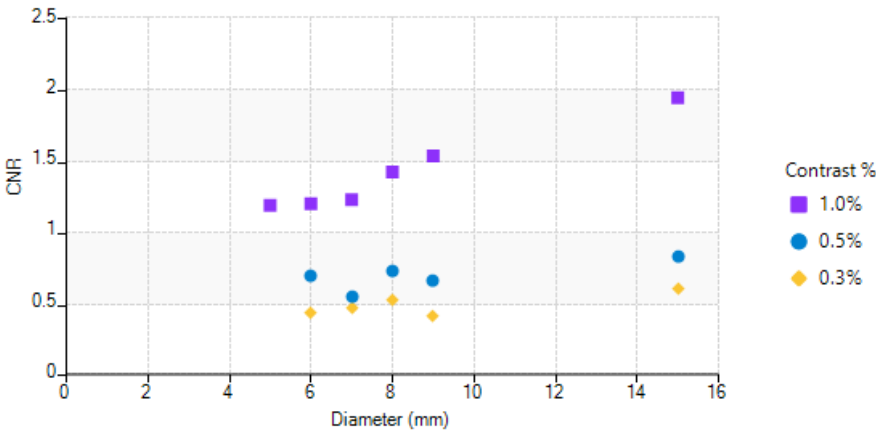
- In-plane spatial resolution
- Fast Fourier transform of the vertical and horizontal line spread function of a wire or bead impulse source
- Measurements of the average 50%, 10% and 2% MTF values from the vertical and horizontal LSF



Low Contrast CNR



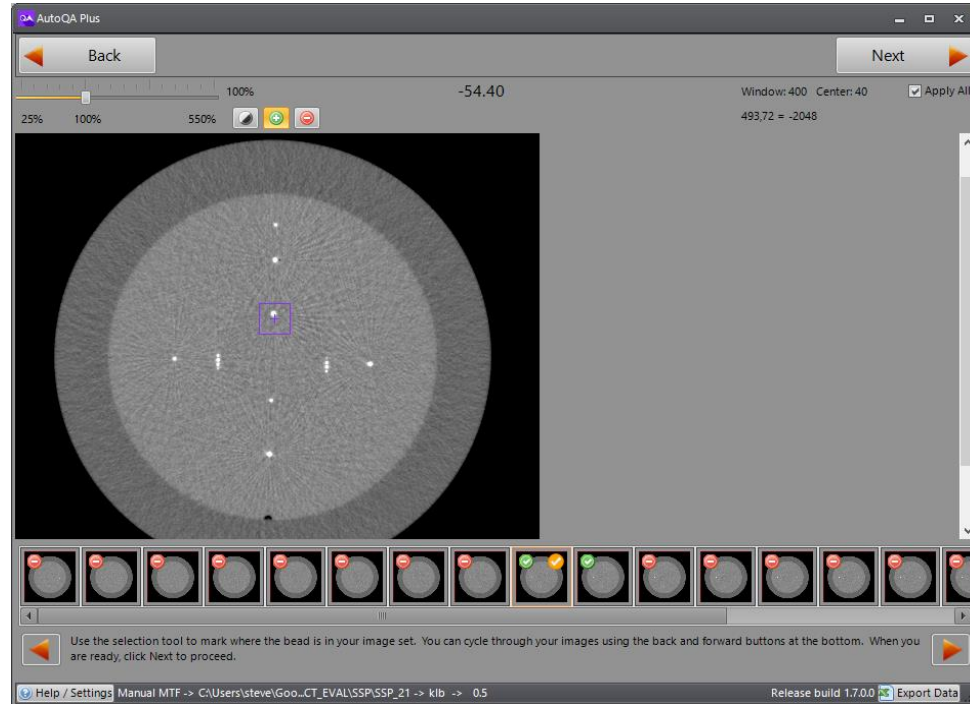
- Contrast to noise ratio (CNR) measured for the supra slice targets in the low contrast module



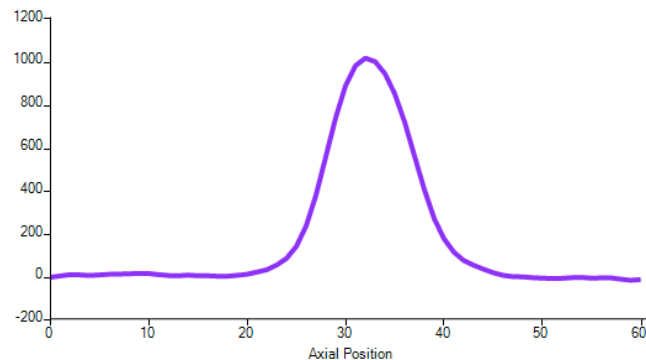
Contrast (%)	Cylinder Diameter (mm)					
	15.0	9.0	8.0	7.0	6.0	5.0
1.0%	5.6	4.4	4.6	4.2	3.2	2.5
0.5%	3.1	2.5	2.7	1.7	1.6	-
0.3%	2.0	1.6	1.2	1.1	1.0	-



Spatial Resolution - SSP



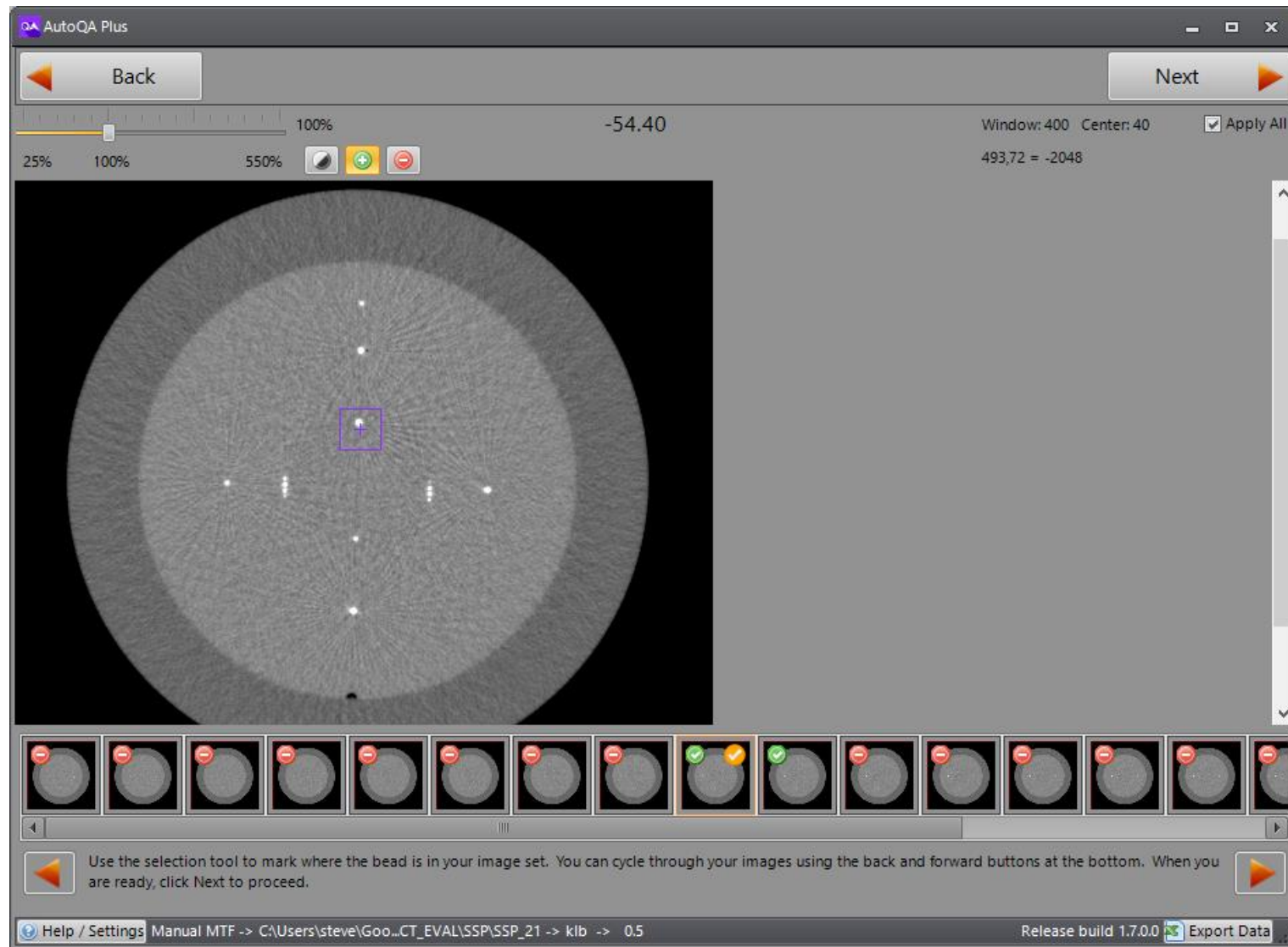
- Z-axis spatial resolution
- FWHM of the maximum pixel profile of an impulse source from a helical scan



Total Images:	61
Module Material:	92.54 ± 6.74
Bead Baseline:	110.23
Peak Value:	1,010.00
Bead Position:	258, 213
FWHM:	0.96mm
FWTM:	1.69mm



MTF Manual Selection Processing



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