

Ray QAT Phantom Kit_A

(Quality Assurance Test)

User Manual



This Ray QAT Phantom Kit user manual for the RAYSCAN system includes information on how to use the kit. We recommend that you thoroughly familiarize yourself with this manual to carry out the service effectively.

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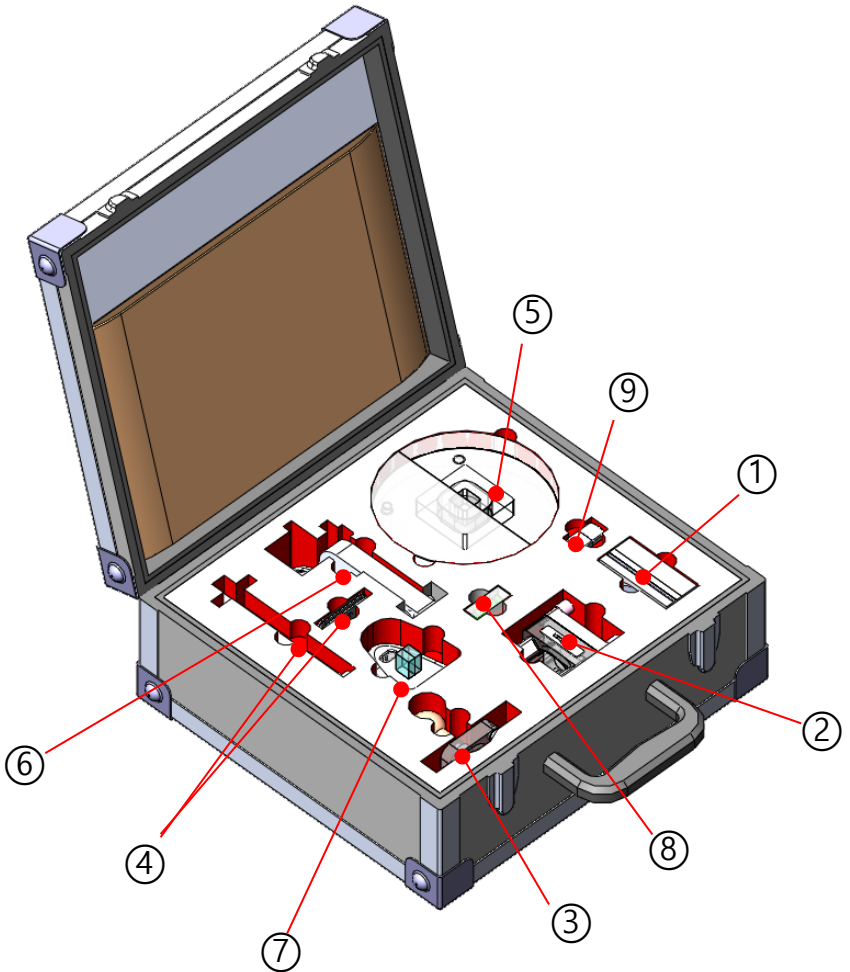
Introduction

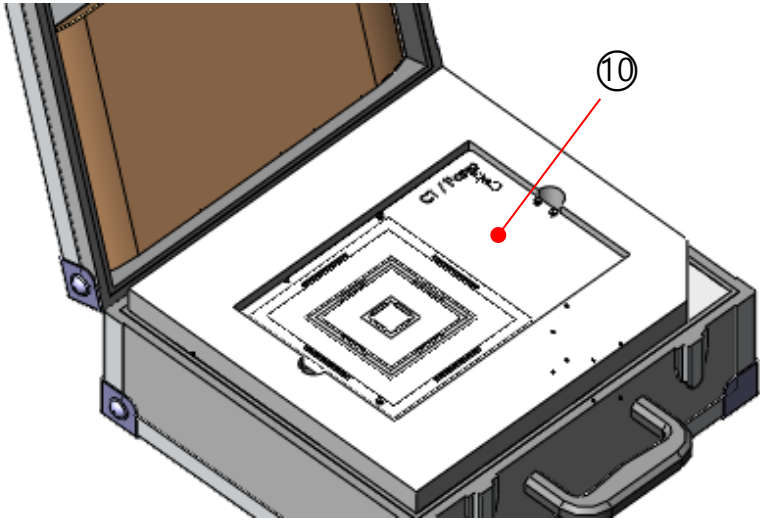
1

1 Introduction

The Rayscan Phantom Kit is used to test, check, and qualify image quality. The following table lists the contents of the phantom kits.

1.1 Product Information






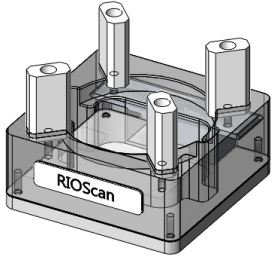
No	Name	Use
1	PANO/Ceph QA Phantom	QA
2	IO Sensor QA Phantom	QA
3	Ceph QA Phantom Holder	QA
4	Cooper Plate	QA
5	CT QA Phantom	QA
6	Pano Alignment Phantom	Panoramic optimization
7	CT Alignment Phantom	CT optimization
8	Leveler	Verifying device level
9	USB (Manual, Rayscan DVT)	Software and User Manual
10	Light Collimation Phantom	Light Collimation

1.2 QA Phantom List


1.2.1 PANO/Ceph QA Phantom

Item	Description	Tool
Manufacture	Quart	
Model	Digitest 2.1	
Purchase	Quart, Ray	
Intended Use	Line Pair Resolution (2.5/2.8/3.1/5.0/5.8/6.3LP/mm) Low Contrast (4 Steps)	
Standard Conformity	DIN 6868-5	
	DIN 6868-151	
	IEC 61223-2-7	
	IEC 61223-3-4	


1.2.2 IO Sensor QA Phantom

Item	Description	Tool
Manufacture	Ray	
Model 명	IO Sensor QA Phantom	
Purchase	Ray	
Intended Use	RIS500 Image Inspection RPS500 Image Inspection	

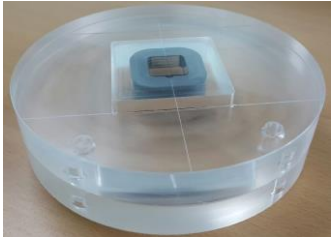
1.2.3 Ceph Phantom Holder

Item	Description	Tool
Manufacture	Ray	
Model	Ceph Phantom Holder	
Purchase	Ray	
Intended Use	Ceph Image Inspection	

1.2.4 Copper Plate

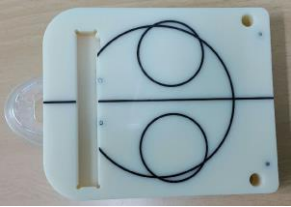
Item	Description	Tool
Manufacture	Ray	
	Copper Plate	
Model	- Copper Plate Jig - Cooper Plate 0.8T - Cooper Plate 1.0T	
Purchase	Ray	
Intended Use	PANO Image Inspection Ceph Image Inspection	

1.2.5 CT QA Phantom


Item	Description	Tool
Manufacture	Ray	
Model	Rayscan DVT	
Purchase	Ray	
Intended Use	CT Number Homogeneity Contrast Noise MTF	
Standard Conformity	DIN 6868-161	

1.3 Alignment Phantom List

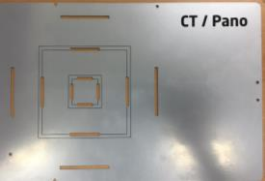

1.3.1 Pano Alignment Phantom

Item	Description	Tool
Manufacture	Ray	
Model	ARC Phantom	
Purchase	Ray	
Intended Use	System Alignment PANO Alignment	

1.3.2 CT Alignment Phantom

Item	Description	Tool
Manufacture	Ray	
Model	CT Ball Phantom	
Purchase	Ray	
Intended Use	CT Alignment	

1.3.3 Light Collimation Phantom

Item	Description	Tool
Manufacture	Ray	
Model 명	Light Collimation Phantom	
Purchase	Ray	
Intended Use	Light Collimation Alignment (CT/ Pano/ Ceph)	

Use the match sides on each protocol useage. (Turn over for Ceph protocol)

Phantom Guide

2

2 Phantom Guide

2.1 How to position the Pano QA Phantom

- 1) Insert the pano alignment phantom on the chinrest.



- 2) Separate the steel portion(line pair chart) from pano QA phantom. Then, insert on the pano alignment phantom and tighten the set screw.

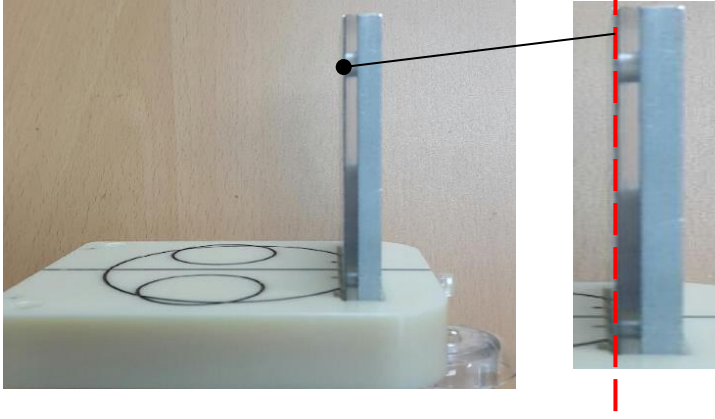


Set screw



Make sure that the phantom is inserted in correct position.

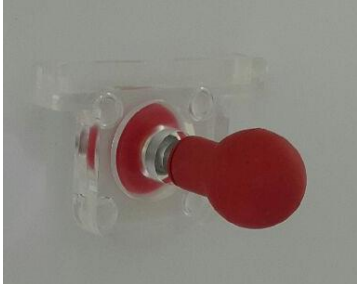
- 3) Use the remote controller or touch screen to move the canine laser to the position as marked in the figure below.



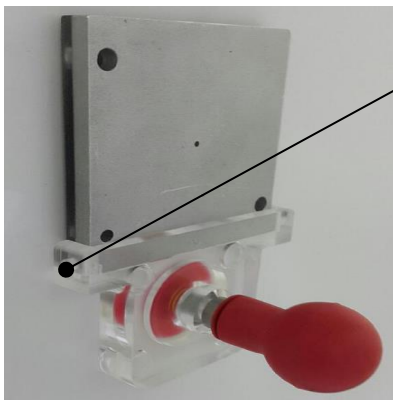
Canine laser

2.2 How to position the Ceph QA Phantom

- 1) Rotate the headrest module in PA position and fold up the nasion bar.
- 2) Put the carpus plate on the back of nasion block.
Attach the ceph phantom holder at the center of the carpus plate.



- 3) Separate the steel portion(Line pair chart) from pano QA phantom. Then, insert on the ceph phantom holder and tighten the set screw.



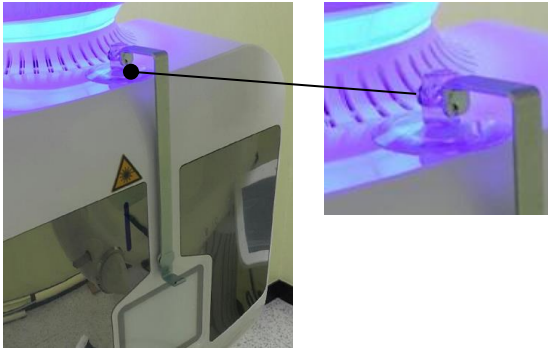
Set screw



Make sure that the phantom is inserted in correct position.

2.3 How to position the Copper Plate

- 1) Attach the copper plate jig on the tube tank case.



- 2) Hang either copper plate 0.8T or 1.0T on the hook to perform the test.



<Copper plate 0.8T>



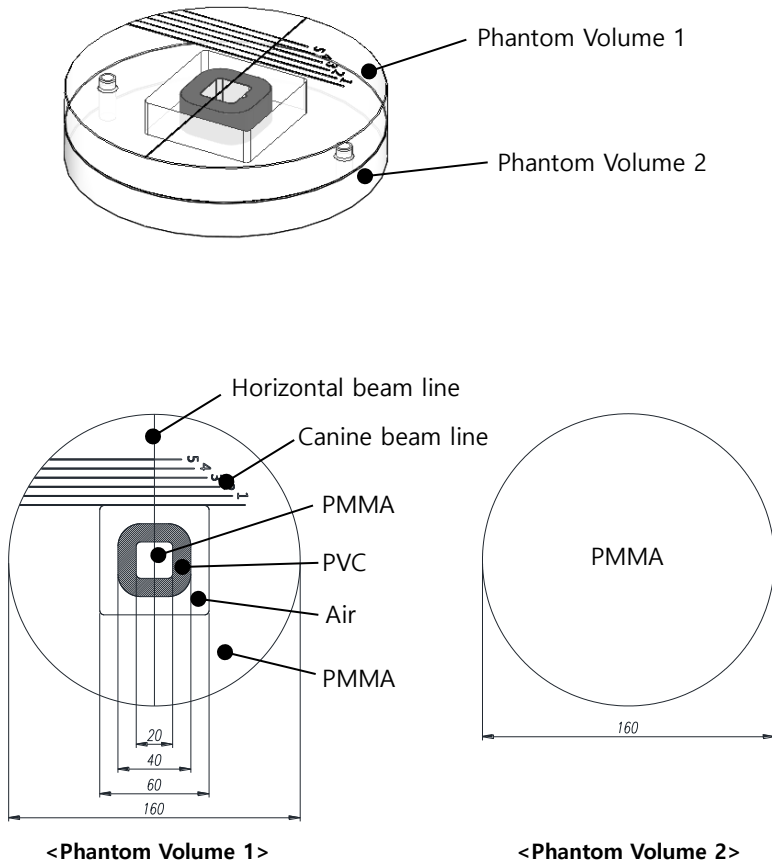
<Copper plate 1.0T>



Overlap both Copper Plates to perform 1.8T

2.4 How to position the CT QA Phantom

2.4.1 CT QA Phantom Description

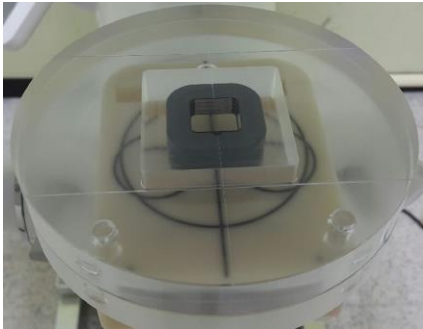


2.4.2 How to position the CT QA Phantom

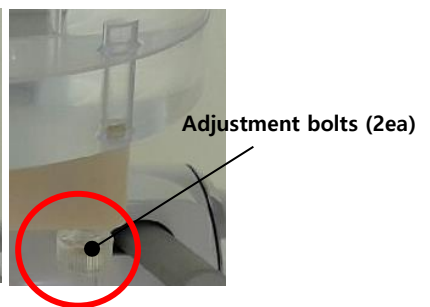
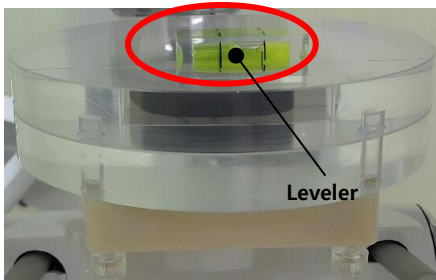
- 1) Insert the pano alignment phantom on the chinrest.



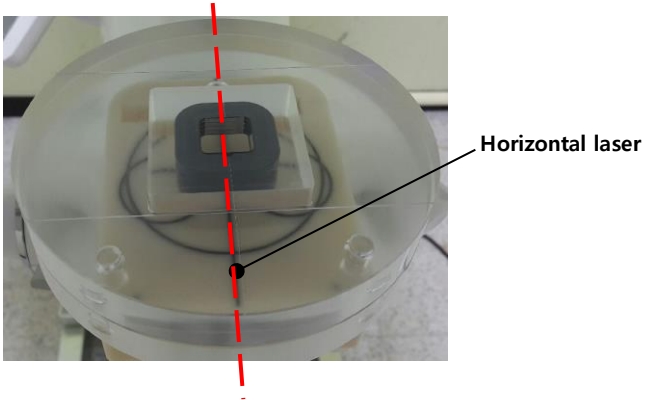
- 2) Put the CT QA phantom on top of the pano alignment phantom.



- 3) Put the leveler on the CT QA phantom and perform the level with the adjustments.

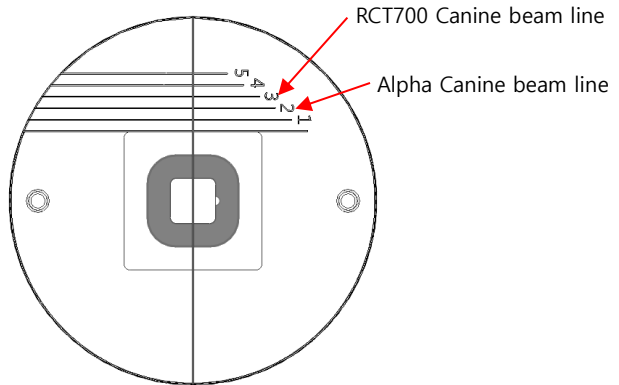


- 4) Make sure that the Horizontal laser goes through the groove on the CT QA phantom.



- 5) Make sure that the Canine laser goes through the groove on the CT QA phantom.

- Alpha : No.2
- RCT700: No.3



2.5 How to position the Pano Alignment Phantom

- 1) Insert the pano alignment phantom on the chinrest.



- 2) Perform the system calibration and pano alignment in setting wizard.

2.6 How to position the CT Alignment Phantom

- 1) Insert the CT alignment phantom on the chinrest.



- 2) Perform the CT alignment in setting wizard.

QA Test Method and Criteria

3

3 QA Test Method and Criteria

3.1 QA Test List

3.1.1 Pano/ Ceph QA Test List

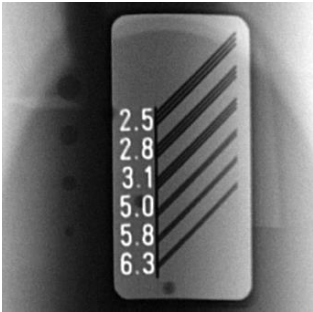
No.	Required Test or Procedure	Frequency	Substitute Test or Procedure	Standard
1	Panrama Line Pair Resolution Test	Initial & Annually	QC Manual	Line Pair Resolution ≥ 2.5 lp/mm
2	Panrama Low Contrast Test	Initial & Annually	QC Manual	Low Contrast ≥ 2 Steps
3	Ceph Line Pair Resolution Test	Initial & Annually	QC Manual	Line Pair Resolution ≥ 2.5 lp/mm
4	Ceph Low Contrast Test	Initial & Annually	QC Manual	Low Contrast ≥ 1 Steps

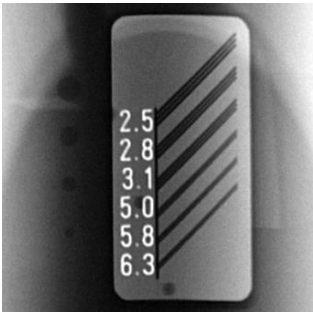
3.1.2 CT QA Test List

No.	Required Test or Procedure	Frequency	Substitute Test or Procedure	Standard
1	CT Number For Water	Daily & Initial & Annually	QC Manual (RayDVT SW PMMA)	HU= 0 ± 100 If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
2	Field Uniformity	Daily & Initial & Annually	QC Manual (RayDVT SW Homogeneity)	Homogeneity ≥ 25 If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
3	Patient Dose (Multiple Scan Average Dose) MSAD or Computed Tomography Dose Index-CTDI	Initial & Annually	QC Manual	CTDIw < 7.5
4	Contrast Scale	Initial & Annually	QC Manual (RayDVT SW Air/PMMA/PVC)	Air(HU)= -1000 ± 100 PMMA (HU)= 0 ± 100 PVC (HU) ≥ 500 If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
5	Low Contrast Resolution	Initial & Annually	QC Manual (RayDVT SW Air/PMMA/PVC)	Air(HU)= -1000 ± 100 PMMA (HU)= 0 ± 100 PVC (HU) ≥ 500 If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
6	High Contrast Resolution	Initial & Annually	QC Manual (RayDVT SW MTF)	MTF 10% ≥ 1 lp/mm If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
7	Noise	Initial & Annually	QC Manual (RayDVT SW Noise)	Noise ≤ 200 If 3D QC test result is "Pass" then measurements are within manufactures specified limits.
8	HVL	Initial & Annually	IEC 60601-1-3 7.1 HALF-VALUE LAYERS and TOTAL FILTRATION in X-RAY EQUIPMENT	IEC 60601-1-3 7.1 HALF-VALUE LAYERS and TOTAL FILTRATION in X-RAY EQUIPMENT

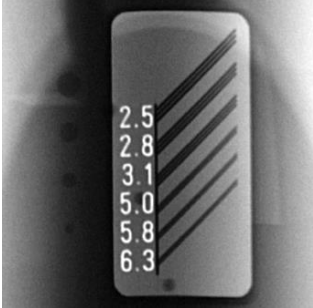
3.2 QA Test Method and Criteria

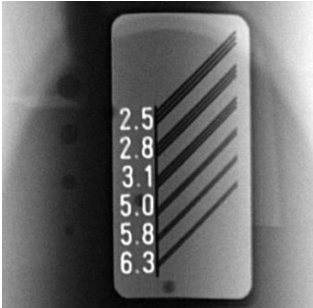
3.2.1 PANO QA Test Method and Criteria

Item	Line Pair Resolution Test
Test Method	<ol style="list-style-type: none">1. Place line pair chart in canine beam.2. Scan panoramic standard protocol.3. Measure the line pair resolution.  A photograph of a line pair resolution test chart. The chart is a vertical rectangular card with a white background. On the left side, there are six numerical labels: 2.5, 2.8, 3.1, 5.0, 5.8, and 6.3, arranged vertically from top to bottom. To the right of these labels are six sets of parallel diagonal lines, each set corresponding to a numerical label. The lines are black and the background is white. The sets of lines become progressively more closely spaced from top to bottom, corresponding to the increasing numerical values. The chart is placed on a dark surface, and the lighting is even.
Quality Criteria	Line Pair Resolution \geq 2.5 lp/mm

Item	Low Contrast Test
Test Method	<ol style="list-style-type: none">1. Place line pair chart in canine beam.2. Scan panoramic standard protocol.3. Measure the low contrast.  A photograph of a low contrast test chart, which is identical to the line pair resolution test chart described above. It features six numerical labels (2.5, 2.8, 3.1, 5.0, 5.8, 6.3) and six sets of parallel diagonal lines on a white background. The chart is placed on a dark surface, and the lighting is even.
Quality Criteria	Low Contrast \geq 2 Steps

3.2.2 Ceph QA Test Method and Criteria

Item	Line Pair Resolution Test
Test Method	<ol style="list-style-type: none">1. Place line pair chart in canine beam.2. Scan ceph LA protocol.3. Measure the line pair resolution  A photograph of a line pair resolution test chart. The chart is a vertical rectangular plate with a white background. On the left side, there are six pairs of parallel black lines, each pair corresponding to a numerical value. From top to bottom, the values are 2.5, 2.8, 3.1, 5.0, 5.8, and 6.3. The lines become progressively thinner and closer together as the numerical value increases. The chart is placed on a dark surface, and the lighting is even.
Quality Criteria	Line Pair Resolution ≥ 2.5 lp/mm

Item	Low Contrast Test
Test Method	<ol style="list-style-type: none">1. Place line pair chart in canine beam.2. Scan ceph LA protocol.3. Measure the low contrast.  A photograph of a low contrast test chart, which is identical in design to the line pair resolution test chart. It features six pairs of parallel black lines on a white background, with numerical values 2.5, 2.8, 3.1, 5.0, 5.8, and 6.3 on the left side. The lines are thinner and more widely spaced than in the resolution test chart, reflecting the lower contrast. The chart is placed on a dark surface.
Quality Criteria	Low Contrast ≥ 1 Steps

3.2.3 CTDI Test Method and Criteria _ Alpha

Item	Patient Dose Test
------	-------------------

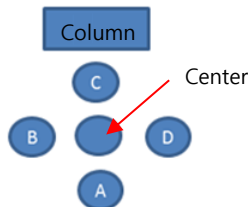
1. ion chamber : 3.2cc, 100mm (Model 6000-100)
2. ICE 60601-2-44
203.108 Dosimetry Phantom
- Diameter: 160mm. Length: above 140mm
- Material: PMMA
3. X-ray detector: Nero 8000

Test Instrument



1. Place the ion chamber in dosimetry phantom.
2. Place dosimetry phantom in center position of the rotatating axis.
3. Connect the ion chamber and Nero 8000
4. Set Nero 8000 program to CT EXP (Sens: High / Beam: 1 mm) mode
5. Mesure the mR
 - X-ray condition: 85kV, 5mA, 14sec, Jaw protocol
 - Make an average out of 3 measurements on each exposure conditions
 - The unit of the detector is mR

Test Method



2. CTDI₁₀₀ is calculated as the fomula below:

$CTDI_{100} = [f \times \text{Ave. of 3 measurements}] / (\text{beam width equals to } 8.9, \text{ so divide by } 8.9\text{cm})$

$f = 0.0087 \text{mGy/mR}$ (unit conversion factor)

Example)

Measure Location	Measurement [mR]				Calculated $CTDI_{100}$
	1st	2nd	3rd	Ave.	
Center	6400	6290	6720	6470	6.32
A(0 Deg.)	5690	5870	5670	5743.33	5.61
B(90 Deg.)	6310	6490	6840	6546.67	6.40
C(180Deg.)	7160	6900	7340	7133.33	6.97
D(270Deg.)	6650	6990	6790	6810	6.66

3. $CTDI_w$ is calculated as the fomula below:

$CTDI_w = 1/3CTDI_{100} \text{ center} + 2/3CTDI_{100} \text{ (Ave. of 4 measure locations)}$

Quality Criteria	$CTDI_w < 7.5$
-------------------------	----------------

3.2.4 CTDI Test Method and Criteria _ RCT700

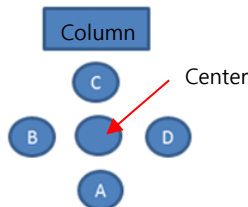
Item	Patient Dose Test
------	-------------------

1. ion chamber : 3.2cc, 100mm (Model 6000-100)
2. ICE 60601-2-44
203.108 Dosimetry Phantom
- Diameter: 160mm. Length: above 140mm
- Material: PMMA
3. X-ray detector: Nero 8000

Test Instrument



1. Place the ion chamber in dosimetry phantom.
 2. Place dosimetry phantom in center position of the rotatating axis.
 3. Connect the ion chamber and Nero 8000
 4. Set Nero 8000 program to CT EXP (Sens: High / Beam: 1 mm) mode
 5. Mesure the mR
 - X-ray condition: 85kV, 5mA, 14sec, Airway protocol
 - Make an average out of 3 measurements on each exposure conditions
- Test Method**
- The unit of the detector is mR



2. CTDI₁₀₀ is calculated as the fomula below:

$CTDI_{100} = [f \times \text{Ave. of 3 measurements}] / (\text{beam width equals to } 8.9, \text{ so divide by } 8.9\text{cm})$

$f = 0.0087 \text{mGy/mR}$ (unit conversion factor)

Example)

Measure Location	Measurement [mR]				Calculated $CTDI_{100}$
	1st	2nd	3rd	Ave.	
Center	6400	6290	6720	6470	6.32
A(0 Deg.)	5690	5870	5670	5743.33	5.61
B(90 Deg.)	6310	6490	6840	6546.67	6.40
C(180Deg.)	7160	6900	7340	7133.33	6.97
D(270Deg.)	6650	6990	6790	6810	6.66

3. $CTDI_w$ is calculated as the fomula below:

$CTDI_w = 1/3CTDI_{100} \text{ center} + 2/3CTDI_{100} \text{ (Ave. of 4 measure locations)}$

Quality Criteria	$CTDI_w < 7.5$
-------------------------	----------------

Software Guide

4

4 Software Guide

4.1 Software Overview

This software is designed to fulfil the requirements for so called acceptance test. These kinds of tests are performed after setting up the x-ray equipment. Therefore, acceptance tests must be performed by accordingly trained engineers, physicists, or service specialists.

This software is designed to analyze the x-ray image with RayScan DVT. The program supports the images acquired from RAYSCAN Alpha or RAYSCAN RCT700 Plus in DICOM format.

It is required to connect the equipment with a console PC in order to use the software.

4.2 System Requirements

Item	Description	Remark
OS	Windows 7 or above	32bit / 64bit
Software Requirement	.Net 4.0 or above	

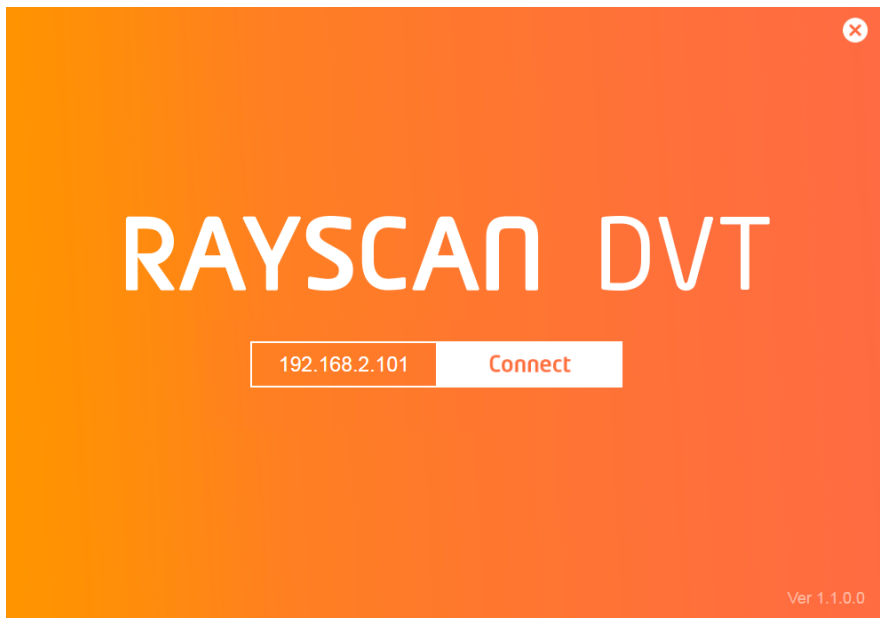
4.3 Scanning

Model	Test	Protocol	X-ray tube condition
Alpha	- CT Number - Homogeneity - MTF - Noise - CNR	Surgical Guide - Mode: HD - Patient: Adult	90kV 11mA
RCT700	- CT Number - Homogeneity - MTF - Noise	Jaw SD - Patient: Adult	90kV 4mA
	- CNR	Sinus - Patient: Adult	90kV 5mA

4.4 Operation

4.4.1 Preparation

The software requires to connect the device with a console PC in order to operate the tests.
Note that no kVp, mA, and patient size adjustment needed to proceed the tests.



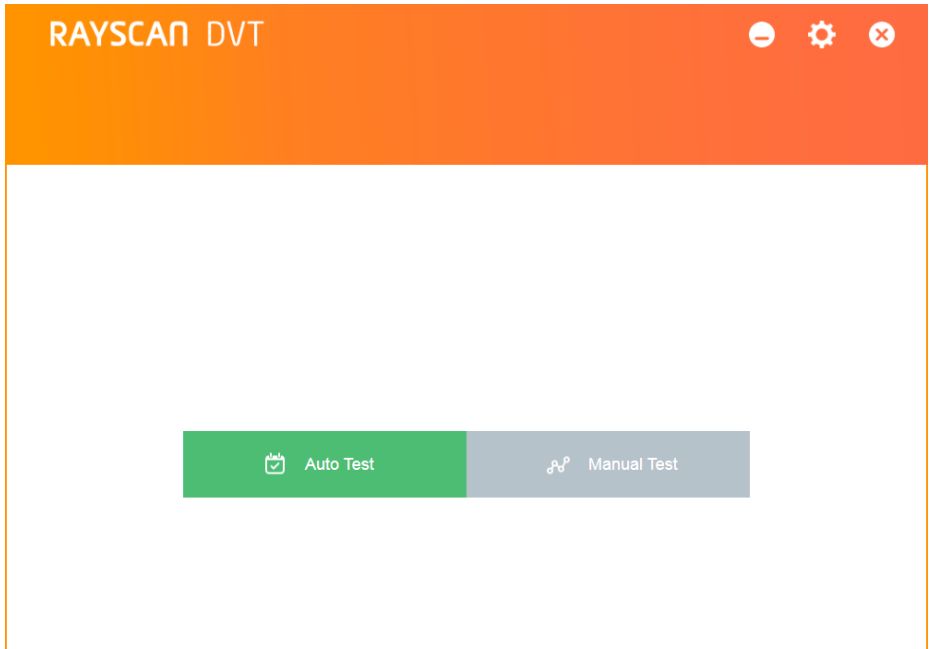
Launch the RAYSCAN (Acquisition software) to acquire the image of CT QA Phantom.
Click on [Connect] button to launch the Main window.





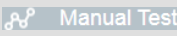


Dedicated IP address for RAYSCAN Alpha THU - "192.168.1.101"





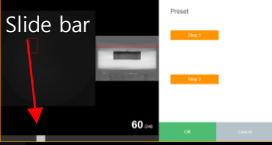
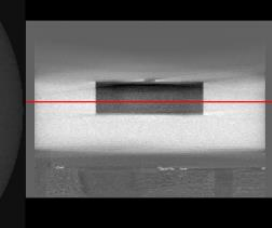
Dedicated IP address for RAYSCAN Alpha Plus and m+ THU - "192.168.2.101"

4.4.2 Main Menu

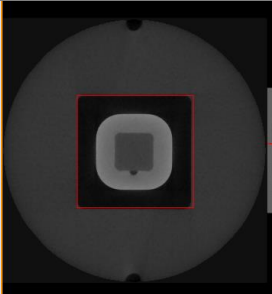


Item	Tool	Description
Minimize		Minimize currently operating window.
Configuration		Setup the software preference in need. (Refer to “4.4.7 Configuration” for more details.)
Close		Close the software
Auto Test		Start new analysis using the new phantom acquisition (Refer to “4.4.3 Auto Test” for more details.)
Manual Test		Load the previously analyzed data. (Refer to “4.4.4 Manual Test” for more details.)

4.4.3 Auto Test

No.	Figure	Description
1		Click on [Auto Test] button to start a new test.
2		Wait until the RAYSCAN software is launched automatically.
3		Select the proper protocol according to your device filter option. (Refer to setup guide at the end of acquisition guide.)
4		Click on [Ready] button to acquire image..
5		When acquisition is complete, the image selection window will be displayed.
6		Use the bottom slide bar to select the slice of the Nyquist image as show.

7



Set the ROI (Region of Interest) to match the Air area in the left top view.

8



Click on [Step 1] button in the right view.

9



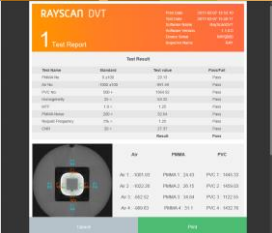
Click on [Step 2] button in the right view.

10



Click on [OK] button.

11



The report will be generated automatically.






For RAYSCAN Alpha, RAYSCAN V2.4.3.0 or later will automatically select the protocol for acquisition. Otherwise, a user is required to set the protocol manually.



For RAYSCAN Alpha Plus, RAYSCAN V2.1.4.3 or later will automatically select the protocol for acquisition. Otherwise, a user is required to set the protocol manually.

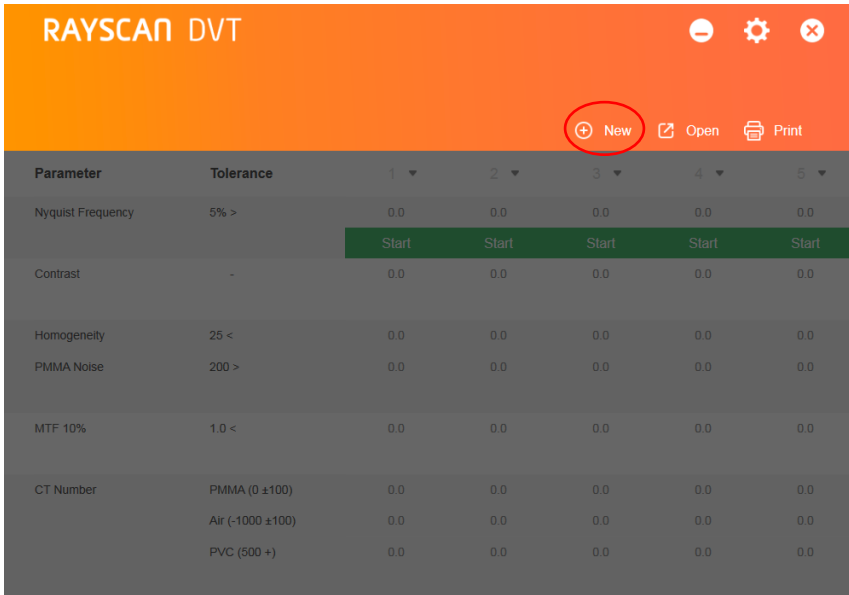
4.4.4 Manual Test

RAYSCAN DVT						
Parameter	Tolerance	1 ▾	2 ▾	3 ▾	4 ▾	5 ▾
Nyquist Frequency	5% >	0.0	0.0	0.0	0.0	0.0
		Start	Start	Start	Start	Start
Contrast	-	0.0	0.0	0.0	0.0	0.0
Homogeneity	25 <	0.0	0.0	0.0	0.0	0.0
PMMA Noise	200 >	0.0	0.0	0.0	0.0	0.0
MTF 10%	1.0 <	0.0	0.0	0.0	0.0	0.0
CT Number	PMMA (0 ±100)	0.0	0.0	0.0	0.0	0.0
	Air (-1000 ±100)	0.0	0.0	0.0	0.0	0.0
	PVC (500 +)	0.0	0.0	0.0	0.0	0.0

Item	Figure	Description
New		Start a new test report. (Refer to “4.4.5 New” for more details.)
Open		Open the previously analyzed data. (Refer to “4.4.6 Open” for more details.)
Print		Print out the current test result. (Refer to “4.4.8 Print” for more details.)

4.4.5 New

To start analysis, click on [New] button on the main screen to set the storage path / device information.






Clicking on the [New] button will display the window for setting the device information and storage path.



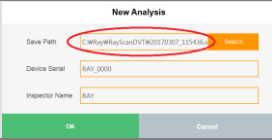
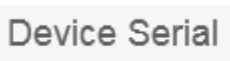


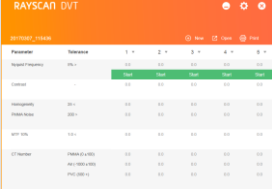
New Analysis

The 'New Analysis' dialog box contains three input fields and two buttons. The 'Save Path' field is filled with 'C:\Ray\RayScanDVT\20170307_115002.x' and has a 'Search' button to its right. The 'Device Serial' field is filled with 'RAY_0000'. The 'Inspector Name' field is filled with 'RAY'. At the bottom, there are two buttons: 'OK' (green) and 'Cancel' (grey).

Save Path	C:\Ray\RayScanDVT\20170307_115002.x	Search
Device Serial	RAY_0000	
Inspector Name	RAY	
OK		Cancel

Item	Figure	Description
Save Path		Displays the storage path of the analysis data. Unable to be modified directly as read-only.
Search		Generate Browser to set save path. The storage path can be set only by clicking the button.
Device Serial		Enter the serial number of the device. (This field is required.)
Inspector		Enter the name of the inspector. (This field is required).
OK		Save the current set value and start analysis.
Cancel		Cancel the analysis.

The following table shows how to generate new analysis data.

No.	Figure	Description
1		Click on [New] button to display the new creation window.
2		Click on [Preset] button.
3		Set the preferred save path and file name in the Set Path window. <i>The default storage name is automatically set to "Date_Time" format.</i>
4		Enter the serial number of the device. This is a required field. <i>It is possible to enter the name instead of the serial number.</i>
5		Enter the name of the inspector.
6		Click on [OK] button to complete the creation.
7		The window is closed and the button for analysis is activated. .

4.4.6 Open



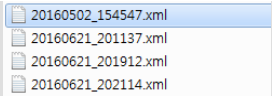
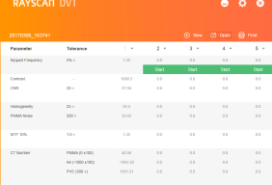
Check the result of the data and print out the report by loading the previously analyzed data. Note that modification of existing data is not supported.

The screenshot shows the RAYSCAN DVT software interface. At the top, there is a title bar with the text "RAYSCAN DVT" and three icons: a minus sign, a gear, and a close button. Below the title bar, the ID "20170306_163741" is displayed on the left, and three buttons labeled "New", "Open", and "Print" are on the right. The main area contains a table with the following data:

Parameter	Tolerance	1 ▾	2 ▾	3 ▾	4 ▾	5 ▾
Nyquist Frequency	5% >	1.25	0.0	0.0	0.0	0.0
			Start	Start	Start	Start
Contrast	-	1008.5	0.0	0.0	0.0	0.0
CNR	20 <	27.94	0.0	0.0	0.0	0.0
Homogeneity	25 <	55.5	0.0	0.0	0.0	0.0
PMMA Noise	200 >	32.65	0.0	0.0	0.0	0.0
MTF 10%	1.0 <	1.25	0.0	0.0	0.0	0.0
CT Number	PMMA (0 ±100)	40.56	0.0	0.0	0.0	0.0
	Air (-1000 ±100)	-1042.82	0.0	0.0	0.0	0.0
	PVC (500 +)	1501.31	0.0	0.0	0.0	0.0

Item	Figure	Description
Open		<p>The button loads the analysis data. However, the items that have already been analyzed cannot be edited.</p> <p>Note that the items that have not been analyzed can be analyzed subsequently.</p>

The following table shows how to import analysis data.

No.	Figure	Description
1		Click on [Manual Test] button.
2		Click on [Open] button to display the new creation window.
3		Load the existing data.
4		Existing data will be loaded.

4.4.7 Configuration

Change the settings by clicking the [Settings] button in the upper right corner.

Setting

Language	<input type="text" value="English"/>
Device Serial	<input type="text" value="RAY_0000"/>
Inspector Name	<input type="text" value="RAY"/>
Use CNR	<input checked="" type="radio"/> Use <input type="radio"/> Non Use

Item	Description
Language	Change the displayed language setting. Language settings are applied at restart.
Device Serial	Fill in the serial number of the device that is input by default when performing Auto Test.
Inspector Name	Fill in the name of the inspector that will be entered as default during Auto Test.
Use CNR	Select to activate or deactivate the use of CNR. The default setting is unused.

4.4.8 Print

The print function prints the results of current analysis data or imported analysis data. In order to use the print function, at least one "Nyquist" step analysis result must exist to operate.

RAYSCAN DVT

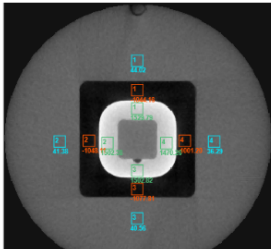
1

Test Report

Print Date 2017-03-07 14:20:18
 Test Date 2017-03-06 16:37:38
 Software Name RayScanDVT
 Software Version 1.1.0.0
 Device Serial RAY0000
 Inspector Name RAY



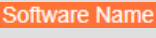

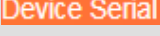

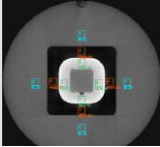

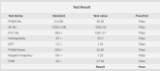
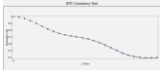


Test Result

Test Name	Standard	Test value	Pass/Fail
PMMA No.	0 ±100	40.56	Pass
Air No.	-1000 ±100	-1042.82	Pass
PVC No.	500 +	1501.31	Pass
Homogeneity	25 <	55.5	Pass
MTF	1.0 <	1.25	Pass
PMMA Noise	200 >	32.65	Pass
Nyquist Frequency	5% >	1.25	Pass
CNR	20 <	27.94	Pass
Result			Pass



Air	PMMA	PVC
Air 1 : -1044.16	PMMA 1 : 44.02	PVC 1 : 1529.79
Air 2 : -1048.11	PMMA 2 : 41.38	PVC 2 : 1502.38
Air 3 : -1077.81	PMMA 3 : 40.56	PVC 3 : 1502.82
Air 4 : -1001.2	PMMA 4 : 36.29	PVC 4 : 1470.26

Cancel
Print

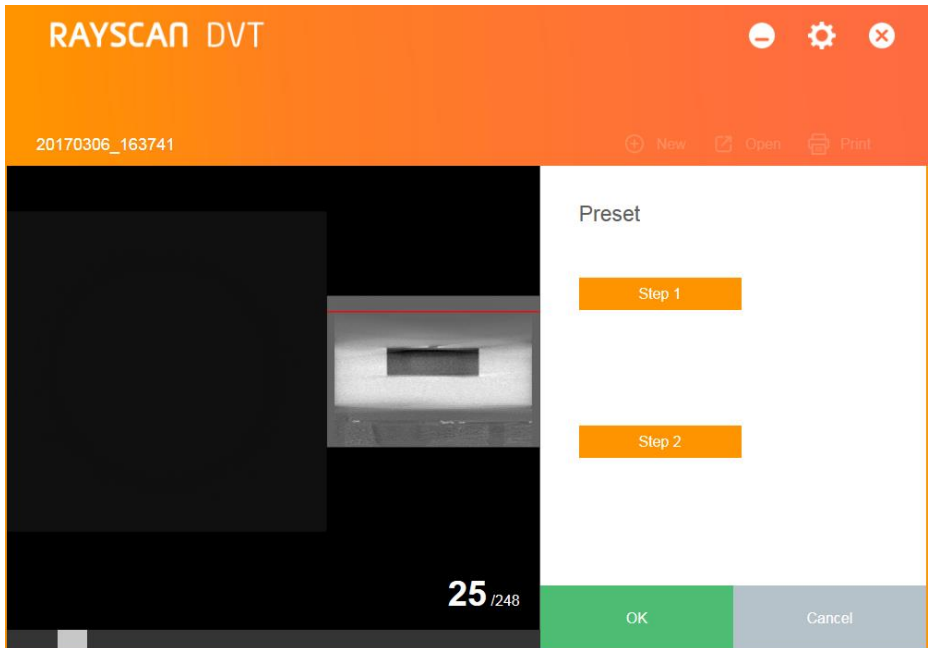
Item	Figure	Description
Print Date		Record the start data of printing.
Test Date		The time that the analysis starts is recorded.
Software Name		Displays the name of the software being analyzed. The name is fixed by RayScanDVT.
Software Version		Displays the version of the software analyzed.
Device Serial		Displays the serial number of the analyzed device.
Inspector		Displays the name of the analysis inspector.
CT No. image		CT Number displays the measured image when measuring. The number in each measurement matches with the value in "CT No. Result".
CT No. Result		The number of measurement result is displayed. The result is same as the number in "CT No. Image" and displays the values of Air / PMMA respectively.
Test Result		The final test result is displayed. Pass or Fail is indicated according to the passage index for each test.
MTF		Mark the graph measured at the MTF step.
Print		Start printing.
Cancel		Cancel printing.


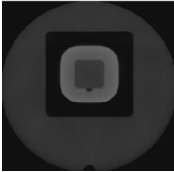
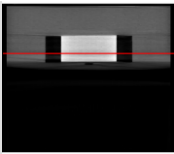



No.	Figure	Description
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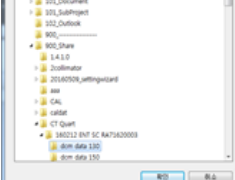
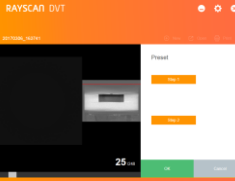
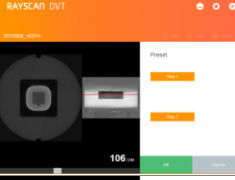

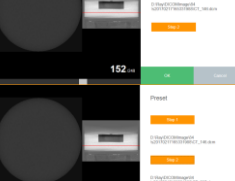
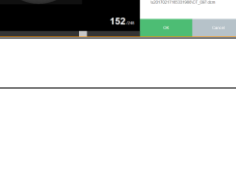
4.5 Evaluation

4.5.1 Image selection

Before proceeding with image analysis, a user must select the image to be used in each analysis step. The selected images are used in the "Nyquist" and "Homogeneity" stages, and can be loaded at that stage. However, the manufacturer recommend to select this step for ease of use.

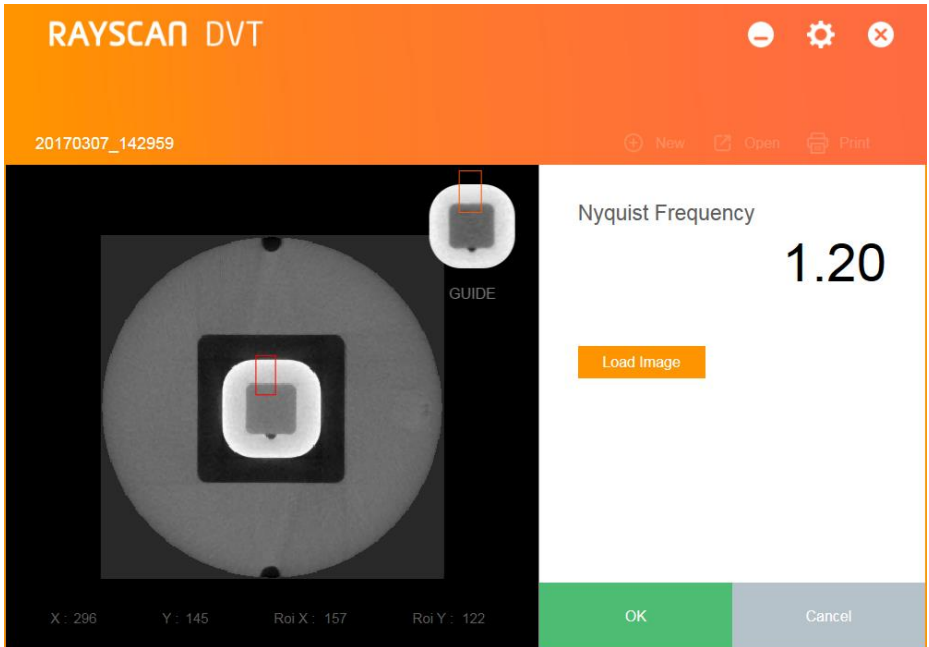


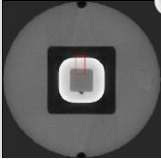


Item	Figure	Description
Slice Number		Displays the total number of images and the slice number of the currently viewed image.
Image View		Image of currently selected slice
Slice Position		Displays the current slice location information for the entire image.
Select Nyquist		Set slice to the image currently used in the Nyquist, CNR, and MTF steps. When a user set the Nyquist image, it automatically moves to the position to set the slice used in homogeneity step.
Select Homogeneity		Sets the current slice to the image used in the Homogeneity step.
Slice Bar		Each time a user moves the Slice bar, the image and position display of "Image View" and "Slice Position" changes.

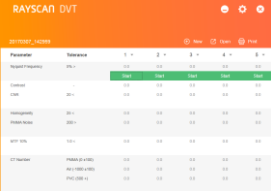


No.	Figure	Description
1		Click on [Preset] button on the Main screen. <i>A user can set different images for each trial.</i>
2		Select the path where the image is located. <i>Images only support DICOM format.</i>
3		Move the Slice bar to select the image to use in the "Nyquist" step.
4		Click on [Step 1] button to complete the image setup.
5		The setup path is entered and the slide is automatically moved to the image near the slice to be used in the "Homogeneity" step.
6		Move the Slice bar to select the image to use in Step 2.
7		Click on [Step 2] button to complete the image setup.
8		Click on [OK] button to complete the image setup.

4.5.2 Nyquist

Proceed with Nyquist Frequency analysis. The images used in that step are used in the “CNR” and “MTF” steps. Also, if a user selects an image in the “4.5.1 Image Selection” step, the image will be automatically registered. If it is not set, a user must register the image by clicking the “Load Image” button.



Item	Figure	Description
Image		Selected image
ROI		Currently region of interest for analysis The ROI of the Nyquist stage can be scaled.
Load Image		The image to be used in the current step is loaded. Only DICOM format is supported.
Result	Nyquist Frequency 1.20	The current measured value is displayed. If the measurement result is fail, it will be displayed in red color.

No.	Figure	Description
1		Click on [Start] button in the Nyquist step.
2		Nyquist Viewer is generated. If there is any image selected in "4.5.1 Image Selection" step, it is automatically registered. If there is no image selected, click on [Load Image] button to register the image.
3		Set the ROI area to the shape shown in the upper right figure. <i>The result measurement is updated every time a user places an ROI area at a desired point.</i>
4		Click on [OK] button to save the results.

5

The screenshot shows the RAYSCAN DVT software interface. The title bar is orange and contains the text "RAYSCAN DVT" and standard window control icons. Below the title bar, there is a header row with "Parameter" and "Reference" columns, followed by five numbered steps (1 to 5). The table contains several rows of parameters with their corresponding values for each step. The "CNR" row is highlighted in green, and the "CNR" value in step 5 is also highlighted in green.

Parameter	Reference	1	2	3	4	5
Maximal Frequency	160	160	160	160	160	160
Center	0	0	0	0	0	0
SNR	10	10	10	10	10	10
Maximal Scale	100	100	100	100	100	100
Image Matrix	256	256	256	256	256	256
SNR 50%	10	10	10	10	10	10
CT Number	1000 HU (0)	100	100	100	100	100
	1000 HU (0)	100	100	100	100	100
	1000 HU (0)	100	100	100	100	100

The window closed and the button to enable the CNR step is activated.

4.5.3 CNR

RAYSCAN DVT

20170307_142959

Now Open Print

CNR
68.93

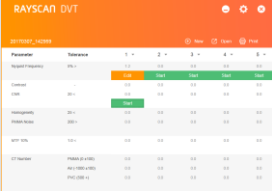
Contrast
2679.41

X: 346 Y: 7 Roi X: 156 Roi Y: 119

OK Cancel

Item	Figure	Description
Image		Selected image slice.
ROI		Region of interest. ROI is movable only.
CNR		Displays CNR result value.
Contrast		Displays Contrast result value.

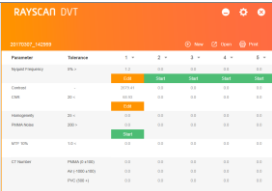
No.	Figure	Description
-----	--------	-------------

1		Click on [Start] button in the CNR step.
---	---	--

2		<p>CNR Viewer is generated.</p> <p>The image uses the image registered at the Nyquist step.</p>
---	---	---

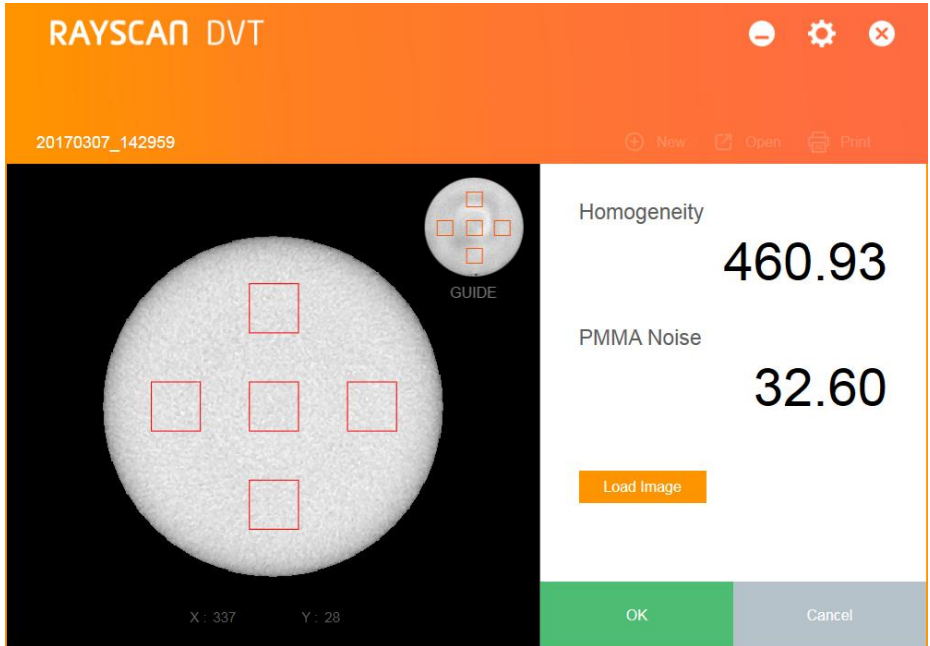
3		Set the ROI as shown in the upper right figure.
---	---	---

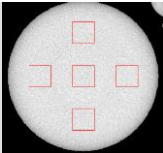
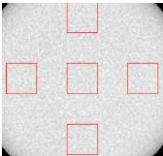
4		Click on [OK] button to save the analysis value.
---	--	--

5		The window is closed and a button is activated to allow the Homogeneity step to proceed.
---	--	--

4.5.4 Homogeneity

ROI settings for the Homogeneity step are automatically generated. Therefore, without completing the step, click [OK] button to finish.

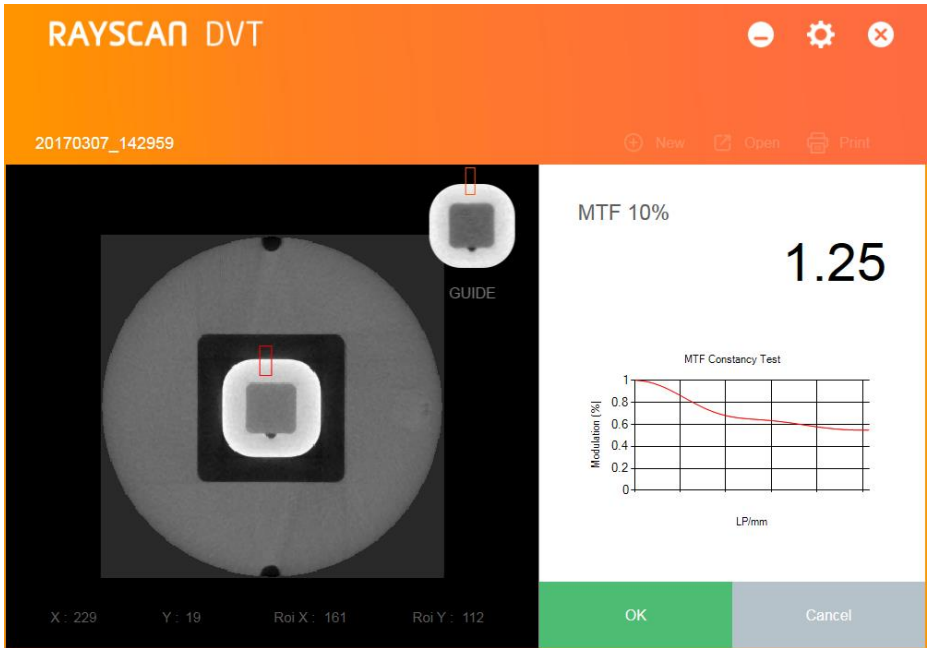


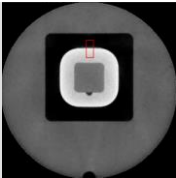

Item	Figure	Description
Image		Selected image slice.
ROI		Region of interest. The ROI is set automatically and cannot be modified or moved.

Homogeneity	Homogeneity	Displays CNR result value.
PMMA Noise	PMMA Noise	Displays Contrast result value.
Load Image	Load Image	The image to be used in the current step is loaded. DICOM format is only supported.

4.5.5 MTF

As the last step of the analysis, use the same image used in the "Nyquist" step.



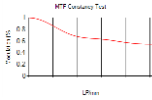
Item	Figure	Description
Image		Selected image slice.
ROI		Region of interest. ROI is movable only.

MTF

MTF 10%

Displays the MTF result value.

Graph



Displays the selected area in the graph.

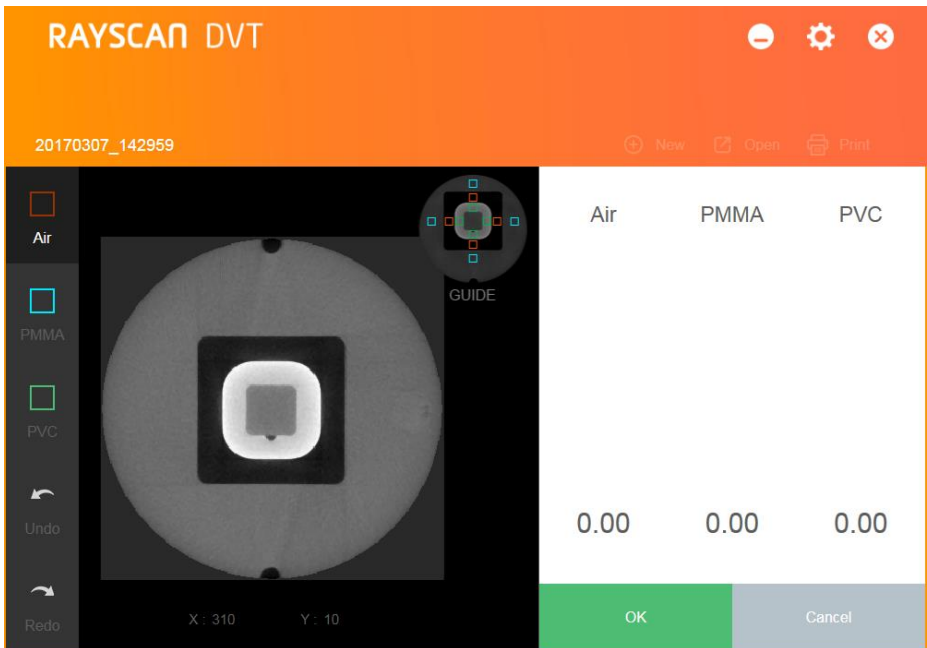
If the graph cannot be extracted, an error message is generated.

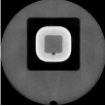

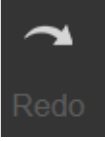
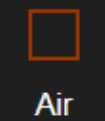


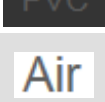


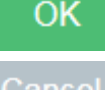

No.	Figure	Description
1		Click [Start] button in the MTF step.
2		MTF Viewer is displayed. The image uses the image registered at the Nyquist step.
3		Set the ROI as shown in the upper right figure.
3-1	<p>The MTF area is abnormal.</p>	If a user selects an area that cannot be analyzed, a warning message window will be displayed.
4		Click [OK] button to save the analysis value.
5		The CT Number measurement is activated.

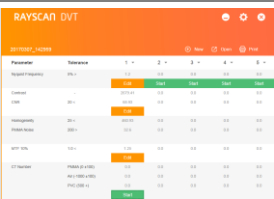
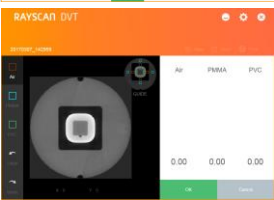
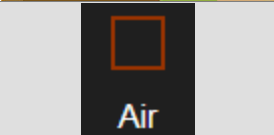
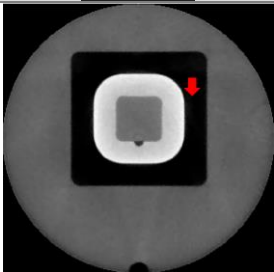
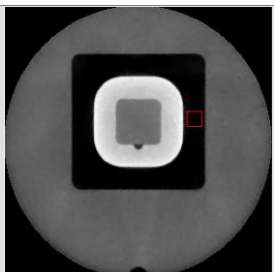
4.5.6 CT Number

The CT Number check step can be confirmed by completing the "MTF" step.

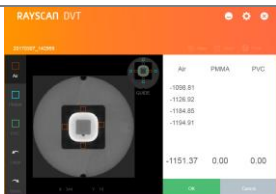
This step automatically registers the images used in the "Nyquist" step.



Item	Figure	Description
Image		CT Number measurement image. The image uses the same as the “Nyquist” step.
Undo		Undos the previous action f the curenly selected measurement “Mode”. If a user selects Air, the dedicated action of Air is canceled.
Redo		Undo the previous action.
Air		Start the Air value measurement. Up to 4 measurements can be operated.
PMMA		Start the PMMA value measurement. Up to 4 measurements can be operated.
PVC		Start the PVC value measurement. Up to 4 measurements can be operated.
Air Result		The average value of current registered air and the value of each term are displayed.
PMMA Result		The average value of PMMA registered at present and the value of each term are displayed.
PVC Result		The average value of current registered PVC and the value of each term are displayed.
OK		Save the current value and close the window. It is not active until all measurements have been completed.
Cancel		Cancel the measurements.

No.	Figure	Description
1		Click on [Start] button of CT Number.
2		CT Number measurement viewer is displayed.
3		Select "Air" area.
4		Click the left mouse button to start the measurement.
5		Hold down the button and move the mouse.
6		Release the left button when finished.
7		The Air area is set.

8



Measure additional three air areas as following.

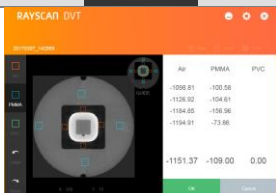
After the first area is set, it is automatically set to the same size.

9



Select [PMMA].

10



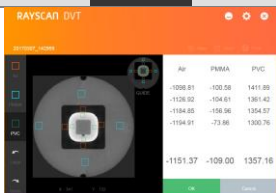
Measure in the same way as the Air measurement.

11



Select [PVC].

12



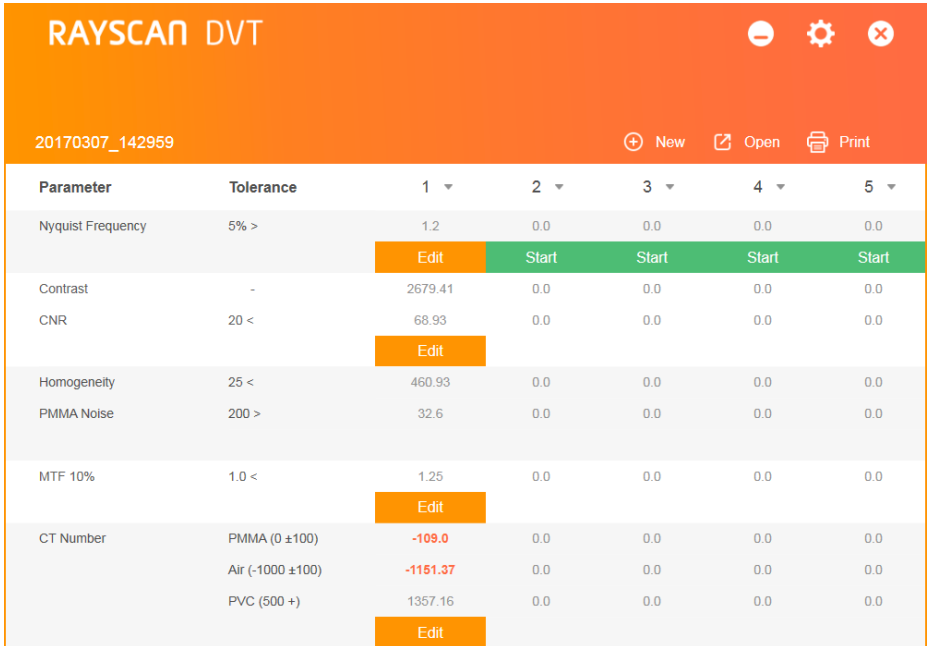
Measure in the same way as the Air measurement. However, when measuring PVC, set the bottom "Air" area to not be measure.

13

Click on [OK] button when the measurement is completed.

4.5.7 Editing

The software provides the ability to modify the steps that have already completed the analysis. However, the step after the modified step is initialized.



The screenshot shows the RAYSCAN DVT software interface. At the top, there is an orange header with the title "RAYSCAN DVT" and three icons: a minus sign, a gear, and a close button. Below the header, the ID "20170307_142959" is displayed on the left, and "New", "Open", and "Print" buttons are on the right. The main content is a table with columns for "Parameter", "Tolerance", and five steps (1-5). The table data is as follows:

Parameter	Tolerance	1	2	3	4	5
Nyquist Frequency	5% >	1.2	0.0	0.0	0.0	0.0
		Edit	Start	Start	Start	Start
Contrast	-	2679.41	0.0	0.0	0.0	0.0
CNR	20 <	68.93	0.0	0.0	0.0	0.0
		Edit				
Homogeneity	25 <	460.93	0.0	0.0	0.0	0.0
PMMA Noise	200 >	32.6	0.0	0.0	0.0	0.0
MTF 10%	1.0 <	1.25	0.0	0.0	0.0	0.0
		Edit				
CT Number	PMMA (0 ±100)	-109.0	0.0	0.0	0.0	0.0
	Air (-1000 ±100)	-1151.37	0.0	0.0	0.0	0.0
	PVC (500 +)	1357.16	0.0	0.0	0.0	0.0
		Edit				

No.	Figure	Description
1		<p>Click on [Edit] button for the step a user needs to modify.</p> <p>The Homogeneity step cannot be modified.</p>
2		A confirmation window will be displayed.
3		Click on [Yes] button.
4		Modify the ROI location for that step.
5		Click [OK] button to complete the step.
6		<p>All steps will be reset after one step of editing.</p> <p>Example) When modifying Nyquist, initialize both CNR to CT Number steps are reset.</p>



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