





ABCD-21-16-90207

## **Standard Operating Procedure**

### Daily CT QC Phantom Test: GE Revolution, RevES, RevApex

#### SITE APPLICABILITY:

All Medical Imaging (MI) sites in Fraser Health (FH), Providence Healthcare (PHC), Provincial Health Services Authority (PHSA), and Vancouver Coastal Health (VCH).

#### **PURPOSE:**

To ensure consistent image quality over the CT scanner system's lifetime and to establish and maintain a regular Quality Assurance (QA) program.

To comply with the Diagnostic Accreditation Program (DAP) standard for Daily CT QC testing.

#### SCOPE:

Applicable to sites with a GE Revolution, Rev ES and Rev Apex CT scanner.

#### **RESPONSIBILITIES:**

The CT department (CT technologist) at the site will perform the Daily QC and ensure that a water phantom is scanned under a prescribed set of conditions:

- Ensure that the mean CT number falls within the range of the manufacturer's specifications.
- Ensure that the standard deviation representing image noise and the calculations for image uniformity are within acceptable parameters.
- Repeat this test on a daily basis to detect changes in image quality values before the problem becomes visible. This is performed 6 times per week in addition to the once Weekly Phantom test.
- Perform a "Checkup" scan or "FastCal" if it was last performed more than 12 hours ago.
- Ten Baseline QC scans must be performed by the site's CT technologists when specifically requested to do so by the physicist or a quality coordinator. This would occur when QC data does not fall within acceptable parameters in the 2 weeks following the replacement of CT imaging components. (tube, detector, collimator, etc.)

The CT Technologist will record baseline data (when required) and subsequent QC data in the **Daily** QC logbook and record on the Medical Imaging (MI) Quality [HealthBC] SharePoint site specific CT folder.

The CT technologist will compare the subsequent QA results from Daily QC against the baseline results.

• If degradation in image quality/obvious artifacts, failing noise and uniformity calculations, or CT number outside of the manufactures specifications is observed, contact radiology service.

Early intervention could prevent a major breakdown and/or negative impacts to patient care.









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#### **REQUIREMENTS:**

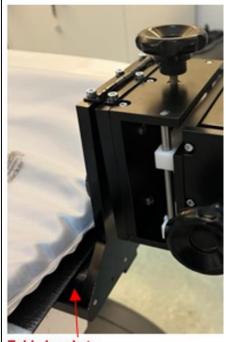
Personnel required: 1	Phantom Weight: 4 kg (8.8 lbs)	
<u>Task</u>	<b>Estimated time (minutes)</b>	
Phantom setup time	2	
Acquisition time	2	
Analysis/ Recording time	If Passes, ~ 4 minute / If Fails, ~ 6 minutes	
Dismantle phantom setup	2	
Total Time	10 - 12 minutes	

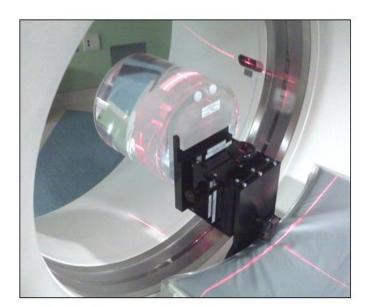
#### PROCEDURE:

### **Tools and Test Equipment**

Water Phantom: 20 cm water

Figure 1: Attachment of the Water Phantom to the Table Gantry





able bracket

Adhere to the following guidelines when handling or positioning the water phantom.

Visually inspect the phantom and phantom holder for damage before each use.
 If damaged, do not use the broken piece. Have it replaced immediately.









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- The phantom bracket on the water phantom, used to support it on the phantom holder, is not a handle. It should not be used to hold or carry the phantom. While transporting the phantom, carry it securely with both hands to avoid dropping it. A damaged phantom can potentially cause injury.
- The phantom bracket is meant to have a snug fit on the phantom holder. This minimizes motion during scanning, which could lead to false failures in the QA images. The snug fit requires the user to take care when positioning or removing the phantom from the phantom holder.

#### **Procedure**

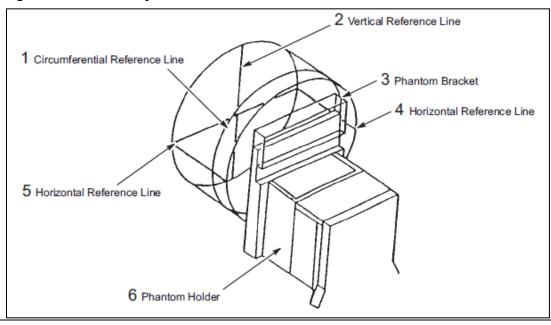
Daily Quality Control scans should be done after the daily start up (reboot), tube warmup and system calibrations (fast cal).

#### 1. Position the Water Phantom

- 1.1 Place the water phantom on the phantom holder and level it.
- 1.2 Turn the knob facing the cradle clock-wise to tilt the top of the phantom AWAY from the gantry.
- 1.3 Use the laser alignment lights to position the phantom (see **Figure 2**):
  - a. Align the axial light to the circumferential line marking.
  - b. Align the coronal light to the horizontal lines on either side of the phantom.
  - c. Align the sagittal light (where it strikes the top of the phantom) to the vertical line on the top of the phantom.
  - d. Position the phantom and select laser alignment button



Figure 2: Phantom reference lines.









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- 2. Prescribe the QA Series for the Noise and Uniformity Tests
- 2.1 Select the scheduled **QC patient** from the worklist
- 2.2 Select protocol from the **default** protocol list:

[Adult < Miscellaneous < LMMI Daily CT QC < Water Phantom]

- 2.3 Click on Accept
- 2.4 Ensure any **Auto-push** function is set to **off**
- 2.5 Verify the protocol uses the acquisition parameters in <u>Table 1</u>
- 2.6 Click on Confirm Settings
- 2.7 Press **Start Scan** on keyboard (120 kV)
- 2.8 Click on Continue
- 2.9 Click on Confirm Settings
- 2.10 Press **Start Scan** on keyboard (80 kV)
- 2.11 Click on Continue
- 2.12 Click on Done Scanning
- 2.13 Click on Done Scanning
- 2.14 Close Exam
- 3. If the facility hasn't created a Daily QA protocol, use the following parameters to finish the QA series prescription:

On the **Helical View Edit** screen select the following parameters:

Table 1: Parameters for QA Protocol Name: LMMI Daily CT QC
120 kV and 80 kV (Patient Supine) Water Phantom

	Interface	Input for 120 kV	Input for 80 kV			
Anatomy Selection						
	Full FOV Start	S7.5	S7.5			
	Full FOV End	17.5	17.5			
	Scan FOV	Small Body	Small Body			
	DFOV	22.7 mm	22.7 mm			
	A/P Centre	A0.0mm	A0.0mm			
	R/L Centre	R0.0 mm	R0.0 mm			
kV and mA Control						
	kV Mode	Manual	Manual			
	kV	120kV	80 kV			
	mA Mode	Manual	Manual			
	mA	315 mA	315 mA			







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	Interface	Input for 120 kV	Input for 80 kV		
Scan Type					
	Scan Type	Axial	Axial		
	Hi Res Mode	Off	Off		
	Rotation Time	1s	1s		
Coverage and Spe	ed				
	Table Positions	One	One		
	Detector Coverage	80 mm	80 mm		
	Number of Passes	1	1		
	Rotation Time	1 s	1 s		
	Total Exposure Time	1 s	1 s		
Primary Recon Set	ttings CT Number Accu	racy & Uniformity, No	oise		
	Thickness	5 mm	5 mm		
	Recon Type	Stnd	Stnd		
	ASiR-V	0%	0%		
	Window Width	400	400		
	Window Level	40	40		
	Flip/Rotate	None	None		
Secondary Recon	Settings Artifact	1			
	Thickness	0.625 mm	0.625 mm		
	Recon Type	Stnd	Stnd		
	ASiR-V	0%	0%		
	Window Width	400	400		
	Window Level	40	40		
	Window Level	None	None		

#### 4. Analyze the QA Images

- 4.1 Display the reconstructed **120 kV** (5mm) water phantom images of the helical scan and perform analysis as described in the following sections.
- 4.2 Perform the following:
  - a. CT Number, Noise and Uniformity tests at scan location S2.5 of the helical scan.
  - b. **Artifact test**: Inspect all primary and secondary reconstructed images for any obvious artifacts.
- 4.3 Record the data from the tests in the corresponding columns of the QC log sheet. (Orange cell colour = Failure)
- 4.4 If a significant change in values is noticed, first check the Small FOV calibration status.
  - a. Calibrate the Small FOV if the most recent calibration data falls outside the guidelines established by the facility







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- 4.5 Repeat the entire procedure if either the CT number, noise and uniformity or artifact tests fail, ensuring the correct phantom positioning and protocol have been used.

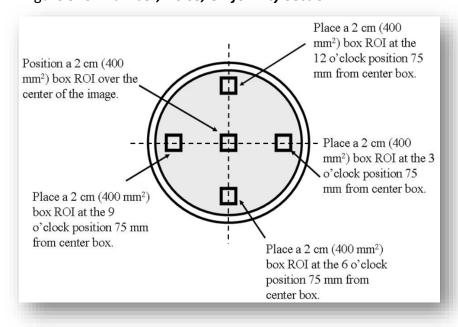
  Record the repeated data on the log sheet.
- 4.6 If a test fails a second time, report the failure to the supervisor and site coordinator.
- 4.7 Follow facility procedures to notify radiology service.
- 4.8 Repeat the above procedure (4.2–4.7) for all reconstructed 80 kV (5mm) water phantom images

#### 5. CT Number, Noise, and Uniformity of Water

Water phantom test for CT number, noise and uniformity (see **Figure 3**). Use scan location **S2.5** (Recon1) 5mm **primary** reconstructed images Use the **Standard** algorithm to reconstruct the image.

- 5.1 Select **Grid** overlay. Precisely center the grid vertically and horizontally.
- 5.2 Select **Box ROI** to position a 400 mm $^2$  ± 20 mm box ROI over the center of the image.
- 5.3 Record the <u>center</u> ROI mean CT number and standard deviation (Noise) in the QC log sheet.
- 5.4 Select **Box ROI** and move the cursor to the 12 o'clock position (75 mm from Center ROI's center to the 12 o'clock ROI's center).
- 5.5 Record that mean CT number on the QC log sheet on MI Quality site.
- 5.6 Repeat step 5, 6 and 7 for each of the 3, 6 and 9 o'clock positions.
  - \*Note: Uniformity = the absolute difference between the CT numbers from the Centre ROI and the each of the 12, 3, 6 and 9 o'clock ROIs

Figure 3: CT Number, Noise, Uniformity Section









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#### 6. Artifact Test

- 6.1 Assess the 120 kV and 80 KV secondary reconstructed (0.625mm) phantom images for obvious artifacts.
- 6.2 Record in Daily logsheet and QC Room Checklist on the MI Quality site.

#### 7. Finalization

- 7.1 Close any image files still open on the screen.
- 7.2 Save to PACS, only those images that have obvious artifacts. (Ensure that auto-push is not on)
- 7.3 Remove the phantom from the system bore and return to storage location.
- 7.4 Record all data on both the MI Quality Site log sheet and QC Room Checklist.
- 7.5 Take exam to **Completed** status in PACS (if required) and then RIS.

#### 8. Typical Results and Allowable Variations

GE expects the standards of allowable variation in image quality parameters to vary with the installation and image evaluator(s).

Ensure the prescribed technique was used, then follow the facility guidelines to inform service when the variations reach the specified maximum deviation as indicated by the log sheet or observations.

#### 8.1 CT Number, Noise and Uniformity of water

When imaging and analyzing the water section of the phantom is performed correctly, the following should be seen:

- CT number of the center ROI within the range of **0** ± **4** HU, exceeding GE's specifications.
- Standard deviation (Noise) of the center ROI should not vary from the baseline by more than **0.2 HU.**
- Uniformity within the allowable range of 2 HU from the established acceptance baseline values.

#### 8.2 **Phantom Image Artifacts**

Because the human eye determines clinical image quality, it remains subjective and difficult to define.

No obvious artifacts should be visible when viewing the reconstructed image with standard window width and window level.

Examples of artifacts that are serious enough to be reported to radiology service are shown in *Figures 4 and 5* below:

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Figure 5: Ring Artifact



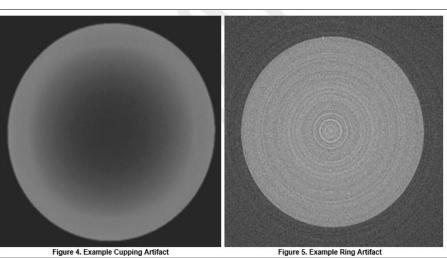
**Document Number** 

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#### **REFERENCES/ASSOCIATED DOCUMENTS:**

Diagnostic Accreditation Program Accreditation Standards – Diagnostic Imaging https://www.cpsbc.ca/accredited-facilities/dap/accreditation-standards-DI

5443887-1EN, Rev# 2 (March, 2015 Revolution CT Technical Reference Manual







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First Released Date:	26-JUN-2023				
Posted Date:	05-MAR-2024				
Last Revised:	23-FEB-2024				
Last Reviewed:	23-FEB-2024				
Approved By:	Medical Physicist Lead, MI				
Owners:	Quality Coordinator, MI				
Revision History:	Version	Date	Description/ Key Changes	Revised By (Name and Position)	
	1.0	21-JUN-2023	Initial release	Cheryl Mason, Quality Coordinator	
	2.0	05-MAR-2024	Revise responsibility section, Clarify frequency of daily and weekly test, Change QA to Water phantom, Change 10% to 0.2 HU, Change WW and WL to standard	Cheryl Mason, Quality Coordinator	