

# Standard Operating Procedure

ABCD-21-16-90224

## Daily CT QC Phantom Test: Siemens Somatom Edge

### 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 Siemens Somatom Edge 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 and:

- 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 artifacts or changes in image quality values before the problem becomes visible. This fully replaces the 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:

<b>Personnel required:</b>	<b>1</b>	<b>Phantom Weight:</b>	<b>4 kg (8.8 lbs.)</b>
<b>Task</b>		<b>Estimated time (minutes)</b>	
Phantom setup time		2	
Acquisition time		2	
Analysis time and data entry	If Passes, ~ 10 minute	/	If Fails, ~ 16 minutes
Dismantle phantom setup		2	
<b>Total Time</b>	<b>16 - 22 minutes</b>		

### PROCEDURE:

#### Tools and Test Equipment

Water Phantom: 20 cm water

Figure 1: **Water Phantom Handling Precautions**

Do not handle area circled in red



Phantom holder stand and tie down strap assembly



Adhere to the following guidelines when handling or positioning the Water Phantom:

- The water phantom must be stored at a constant temperature of  $+21 \pm 3$  Celsius. For measurements, the water temperature in the phantom must be  $+21 \pm 3$  Celsius.
- The density of the water in the phantom is dependent on the water temperature. Changing the temperature by  $+1$  Kelvin ( $1^\circ\text{C}$ ) corresponds to changing the water equivalent to 0.3 HU (Hounsfield unit) in the CT image.
- Be careful when handling the phantom. Do not touch the ball at the very end when lifting it up.
- Air bubbles in the 20 cm water phantom can lead to an abort of the table generation procedure. Therefore, be very careful when filling the 20 cm water phantom with water, if instructed to do so by a physicist or quality coordinator.
- In Somaris/7, some table generation procedures use different phantoms compared to the previous software. For example, the channel correction now uses the 20 cm water phantom.

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### Procedure

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

#### 1. Position the Water Phantom

Be careful when handling the phantom.

Do not touch the ball at the very end when lifting it up.

- 1.1 Ensure CT bed is on table base, and have table centered over the base. (if the table is moved too close to the scanner the weight of the phantom may cause the table to dip and then the phantom won't align to the laser lights)
- 1.2 Fold mattress back at the head end of table to uncover table surface closest to scanner.
- 1.3 Place phantom holder stand on exposed table with the end of phantom holder flush with the ends of the Velcro (approx. 2" from table end) on the head end of the table, ensuring that the phantom holder is at table end that's closest to the scanner.

Figure 2: Position of the Phantom Holder



- 1.4 Loop tie down strap over phantom holder, placing it closer to the end of the stand that is farthest away from scanner.

Figure 3: Securing the Phantom Holder to the Table



**\*\*CAUTION:** If the strap is too loose, the phantom can slip off the table and be damaged **or** the weight of the phantom will cause the stand to lift and phantom will nose down and will not align with the laser lights \*\*

- 1.5 Tighten tie down strap by ratcheting. (Opening and closing metal clasp)  
Tighten until strap is taut.

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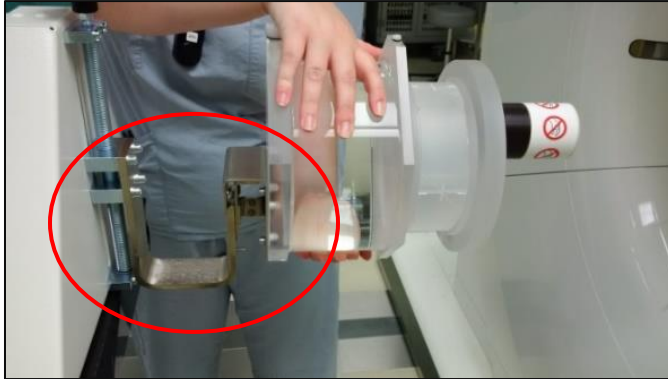
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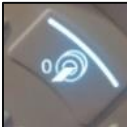
- 1.6 Place phantom securely on phantom holder.

Figure 4: **Securing the Phantom to the Holder**

*Magnified view of the attachment*



- 1.7 Turn off the overhead general lighting (to best visualize the laser lights).  
1.8 Center using the **internal laser** (not the external laser).  
1.9 Use the laser alignment lights to position the phantom.

a. Activate the light marker	
b. Use table remote to align <b>side to side</b> crosshairs. It may require several fine adjustments to line up the phantom. It may not sit perfectly. Align as closely as possible.	
c. Use table remote to align <b>height</b> crosshairs. It may require several fine adjustments to line up the phantom. It may not sit perfectly. Align as closely as possible.	
d. Feed the phantom into the scanner and align with the <b>in/out</b> crosshair	
e. Press the <b>Zero</b> button	

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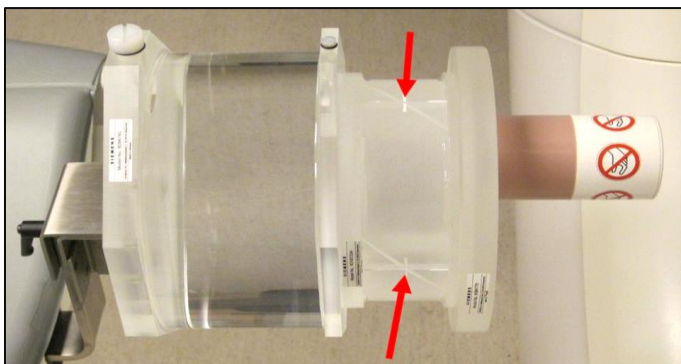


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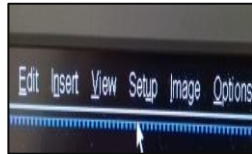
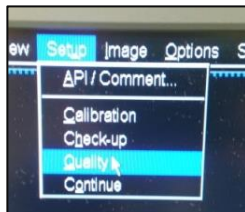
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Figure 5: Crosshairs of Phantom Aligned to the Laser



## 2. Scan Acquisition

- 2.1 Prior to scan acquisition, it is necessary to create an entry for the “Quality Assurance Patient” in the Local Database, if one does not already exist. This is for workload tracking purposes. To do so, use site/scanner specific “QC patient name” entry. See Cerner or Meditech support documents.

a. Select <b>Scheduler</b> .	
b. Select site specific QC patient name. Formulated as: <b>QC/Site, CT/unit number</b> (ie- QCCH,CTEDGE)	
c. Select QC test required “ <b>CT QC Daily 10 minute</b> ” folder	
d. <b>Load patient</b> using the <b>PATIENT REGISTER</b> button on keyboard keypad	
e. End the exam using close <b>CURRENT PATIENT</b> icon	
f. QC patient should now be at the top of the Local database list. Close Patient Browser.	
g. Choose <b>Setup &amp; Quality</b>	 

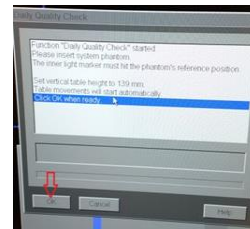
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h. Click **OK** & press the **Start** Key on the control box when prompted in the dialog box



i. The position of the phantom setup is checked and displayed. Then the first measurement is started automatically.

j. For incorrect positioning of the phantom setup, a message is displayed. Correct the position, if necessary.

k. Two measurements are automatically performed at each available kV setting.  
l. After the second, the difference between the first and second measurement is calculated and displayed with the evaluations of →

- i. ROI
- ii. Mean value of the CT Value
- iii. Standard deviation

m. **Review information in the dialogue box** to see if the Quality scan was successful. If it fails, repeat the scan. If it fails a second time, call Service immediately

n. Click on **O.K.** when the Quality test is complete

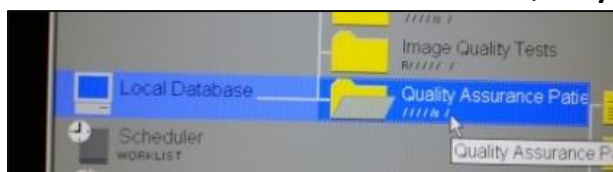
### 3. Analyze the QA Images for CT number, Noise and Uniformity

- **ME** = Center ROI Mean **CT number** of water,
- **SD** = **Standard deviation** representing Noise
- **ME 12, 3, 6, 9 o'clock** = Peripheral Mean numbers used to calculate 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

#### 3.1 Scan Analysis

Locate **Series (8)** and **Image (2)** to Display ROIs

a. Access the **Local Data base** and select **Quality Assurance Patient**

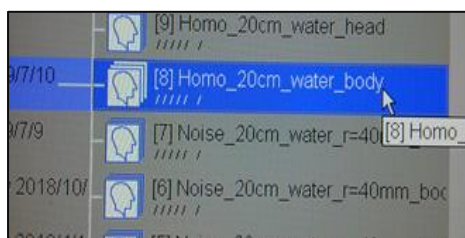


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- b. Select **series 8, image 2** and drag it into the **viewing tab**



- c. The ROIs are automatically displayed, including the **ME** and **SD** values



- d. **Transfer** the values to the CT Daily QC logsheet:
- the **Center ROI (ME) CT number**
  - the **standard deviation (SD)**
  - the **mean (ME) CT number for each of the peripheral ROIs**
- e. **Compare** the current values to the previously recorded values
- f. **Report** significant change or values that fall outside suggested ranges to the supervisor. An orange-coloured cell indicates a failing value. Follow facility procedures to notify service personnel and/or medical physicist.
- g. Record the failed and repeated data on the log sheet.

- 3.2 If performing **ten baseline scans**, repeat steps **3.1 a** through **3.1 d** for each of the ten baseline scans.

### 4. Analyze the QA Images for Artifacts

- 4.1 **Assess** reconstructed phantom images for obvious artifacts. If present, repeat scan to confirm artifact. Immediately report artifact to the supervisor and follow facility procedures to notify service personnel.
- 4.2 Record in **Daily QC and room checklist** on MI Quality site.

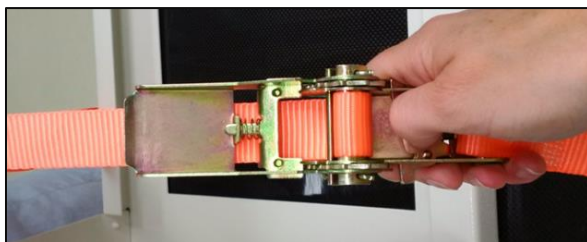
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### 5. Finalization

- 5.1 Close any image files still open on the screen.
- 5.2 **Do not send routine phantom images to PACS.** Save to PACS, only those images that have obvious artifacts (Ensure that auto-push is not on)
- 5.3 Delete QC images from Acquisition workstation.
  - a. Press **Delete** key on keyboard.
  - b. **Yes** at prompt.
  - c. **Yes to All** at prompt.
- 5.4 Remove the phantom from the stand **before** releasing the tie down strap.
- 5.5 Return to storage location.
- 5.6 To release tie down, open clasp while squeezing the release button.



- 5.7 Record all data on the MI Quality **Daily CT QC Logsheet**, and complete **the QC room checklist**
- 5.8 Complete the exam in the **RIS and then PACS** system.
- 5.9 Close out the exam.



### 6. Typical Results and Allowable Variations

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

Ensure the prescribed technique is used and facility guidelines are followed to inform service when the variations reach the specified maximum deviation as indicated by the logsheet or observations.

#### 6.1 CT Number, Noise and Uniformity

When the water section of the phantom is correctly imaged and analyzed the:

- a. CT number of the center ROI within the range of **0 ± 4 HU** which meets Siemens's specifications.
- b. Standard deviation (Noise) of the center ROI should not vary from the baseline by more than **0.2 HU**.



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- c. Uniformity does not exceed the allowable range of **2 HU** from the established acceptance baseline values.

#### 6.2 Phantom Image Artifacts

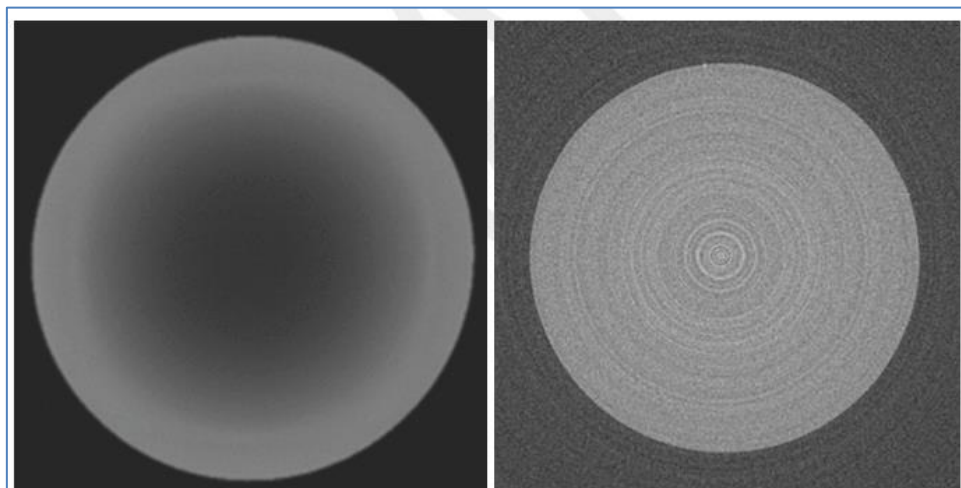
Because the human eye determines clinical image quality, it remains subjective and difficult to define.

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 *Figure 3* and *4*.

Figure 3: **Cupping Artifact**

Figure 4: **Ring Artifact**



#### REFERENCES/ ASSOCIATED DOCUMENTS:

Diagnostic Accreditation Program Accreditation Standards – Diagnostic Imaging

<https://www.cpsbc.ca/accredited-facilities/dap/accreditation-standards-DI>

Instructions for use = Somatom Edge syngo CT Print No. C2-058.620.01.02.02 (basis for this procedure)

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<b>First Released Date:</b>	30-JAN-2024			
<b>Posted Date:</b>	30-JAN-2024			
<b>Last Revised:</b>	24-JAN-2024			
<b>Last Reviewed:</b>	29-JAN-2024			
<b>Approved By:</b> <i>(committee or position)</i>	Medical Physicist Lead, MI			
	29-JAN-2024			
<b>Owners:</b> <i>(committee or position)</i>	Medical Physicist Lead, MI			
	Regional Quality Coordinator, MI			
<b>Revision History:</b>	<b>Version</b>	<b>Date</b>	<b>Description/ Key Changes</b>	<b>Revised By</b> (Name and Position)
	1.0	30-JAN-2024	Initial release	Cheryl Mason, Quality Coordinator

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