

Standard Operating Procedure

Daily CT QC Phantom Test: Siemens Somatom Definition AS

ABCD-21-16-90226

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 Definition AS 128 slice 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:

Personnel required: 1	Phantom Weight: 4 kg (8.8 lbs.)
Task	Estimated time (minutes)
Phantom setup time	2
Acquisition time	2
Analysis time and data entry	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 (section 2)

Attachment of the Water Phantom to the Table Gantry

Figure 1: *System Phantom*

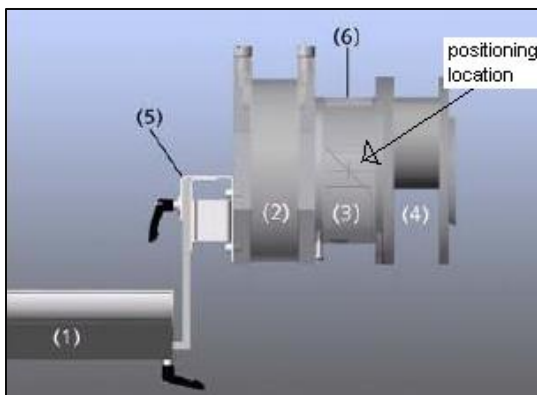


Figure 2: *Phantom Holder* (attaches to bed)



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°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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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 Attach and secure the phantom holder to the table (*Figures 1 and 2* above) and ensure the locking button is in locked position.
 - a. The phantom holder is secured by a locking button in the receptacle on the underside of the patient table. Press this button in to pull the holder out of the guide again after removing the phantom set.
- 1.2 Slide the phantom onto the phantom holder (**Figure 1**)
- 1.3 Turn off illumination mood lighting (to best visualize the laser lights)
- 1.4 Use the laser alignment lights to position the phantom (**Figure 1**)

Table 1: Position the Water Phantom in the Gantry

a. Set the gantry vertical (0^0)	
b. Activate the light marker	
c. Set the appropriate table height by aligning the horizontal laser light with the horizontal reference marker on the phantom (The numerical value for the correct table height will be displayed after the phantom position check)	
c. Move the patient table into the gantry. Align the vertical laser light with the vertical reference marking of the slice thickness phantom in the centre of the gantry.	
d. Press the Offset key until the table movement stops	

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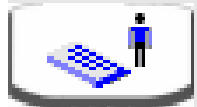


2. Scan Acquisition

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.

To do so, use site/scanner specific “QC patient name” entry.

See Cerner or Meditech support documents.

Table 2: Set-Up for Scan Acquisition

a. Select Scheduler	
b. Select site specific QC patient name. Formulated as: QC/Site, CT/unit number (ie- QCRH,CTONE) See RIS/PACs support documents	
c. Select QC test required “ CT QC Daily 10 minute ” folder	
d. Load patient using the PATIENT REGISTER button on keyboard keypad	
e. End the exam using CLOSE CURRENT PATIENT icon.	
f. QC patient should now be at the top of the Local Database list. CLOSE PATIENT BROWSER	
g. Choose Setup and Quality from menu	
h. Click O.K. <ul style="list-style-type: none"> The tilt of the gantry is automatically set to 0°, if necessary The QA patient is automatically selected. The patient table is positioned such that the water phantom is in the scan plane. 	
i. Press Start key when prompted in the dialog box. <ul style="list-style-type: none"> The position of the phantom is checked and displayed. The 1st measurement is started automatically. For incorrect positioning a message is displayed. Correct if necessary. Two measurements are performed at each KV setting. After the 2nd, the difference between the 1st and 2nd measurement is calculated and displayed. 	➤ ROI ➤ Mean value of CT number ➤ Standard deviation

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j. Review information in the dialogue box. If Quality scan fails, repeat. If it fails a 2nd time call Service immediately.

k. Click on O.K. when 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 Locate Series (9) and Image (2) to Display ROIs

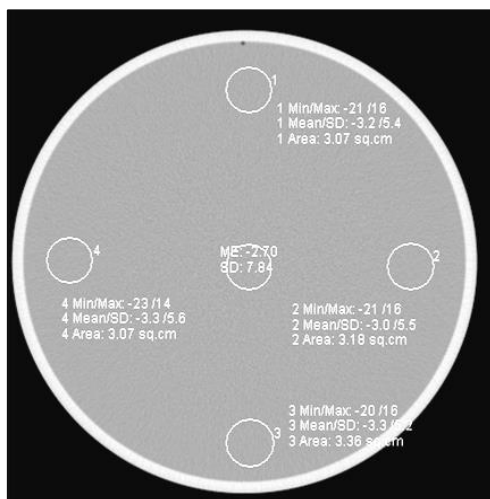
- a. Click on the **Viewing** tab.
- b. Open the **Patient Browser**.
- c. Select the **Quality Assurance Patient** in the **Local Database**.
- d. Double-click on **"Daily"** folder.

To display the QCRH, CTONE patient and the Quality Assurance Patient folders side by side in the Patient Browser list right click on the **Quality Assurance Patient** and chose **Mark**.

Do the same with the **QCRCH, CTONE** 'patient'. Then choose **Filter** and **Marked** from the Main Menu

3.2 Display Series 6. Scroll to image number 2 of 3.

Figure 3: **ROI position**



3.3 Transfer the values to the CT Daily QC logsheet

- a. the **Center ROI (ME) CT number**
- b. the **standard deviation (SD)**
- c. the **mean (ME) CT number for each of the peripheral ROIs**

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- 3.4 **Compare** the current values to the previously recorded values
- 3.5 **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 medial physicist.
Record the failed and repeated data on the log sheet.
- 3.6 If performing **ten baseline scans**, repeat steps **2.1 a** through **3.2 a** for each of the ten baseline scans.

4. Analyze the QA Images for Artifacts

- 4.1 **Assess** reconstructed phantom images in **Series 9** 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.

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). See support document for sending images to PACs for artifacts.
- 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 phantom from the system bore and return to storage location.
- 5.5 Record all data on the MI Quality CT QC log sheet, and complete the QC room checklist.
- 5.6 Complete the exam in the RIS and then PACs system.

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

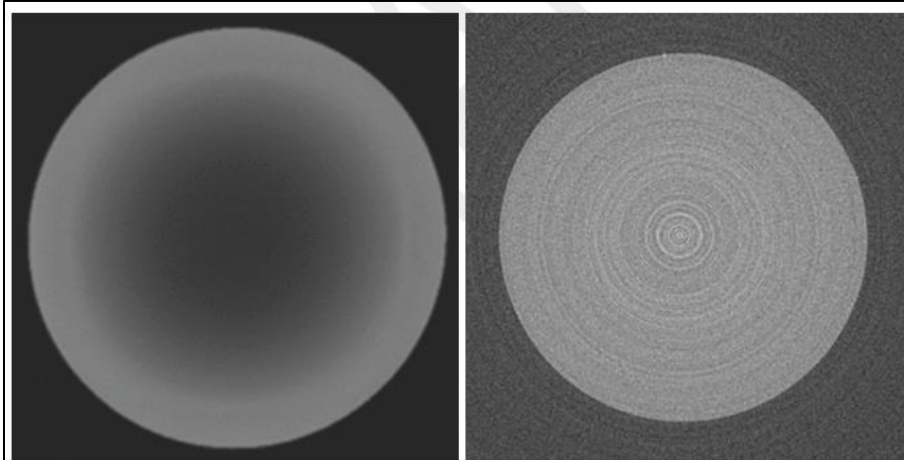
Because the human eye determines clinical image quality, it remains subjective and difficult to define.

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 Definition AS syngo CT VB20A- IFUA 621.01.02.02 (basis for this procedure).

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First Released Date:	30-JAN-2024			
Posted Date:	05-MAR-2024			
Last Revised:	23-FEB-2024			
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Approved By:	Medical Physicist Lead, MI			
	29-JAN-2024			
Owners: (committee or position)	Medical Physicist Lead, MI			
	Regional Quality Coordinator, MI			
Revision History:	Version	Date	Description/ Key Changes	Revised By (Name and Position)
	1.0	30-JAN-2024	Initial release	Cheryl Mason, Quality Coordinator
	2.0	05-MAR-2024	Change analyze and assess QA image from 6 to Series 9, Revise estimated time of test from 9 to 6 minutes	Cheryl Mason, Quality Coordinator

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