Standard Operating Procedure

Daily CT QC Phantom Test: Siemens Somatom Force

Document Number

ABCD-21-16-90225

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 Force Dual-Tube 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, ~ 10 minute / If Fails, ~ 16 minutes
Dismantle phantom setup	2
Total Time	**16 - 22 minutes**

PROCEDURE:

Tools and Test Equipment

Phantom: 20 cm water

Attachment of the Water Phantom to the Table Gantry

Figure 1: **System Phantom**

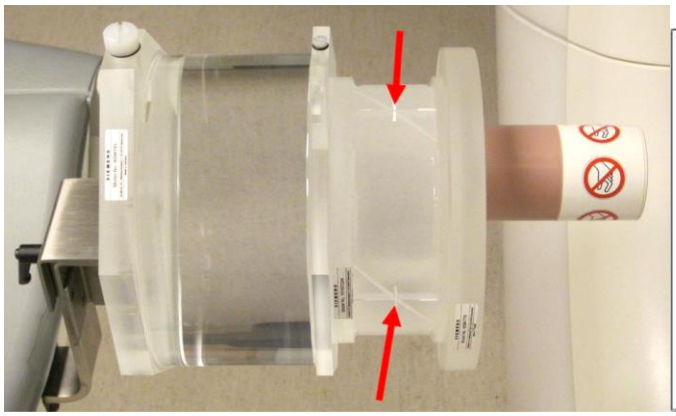
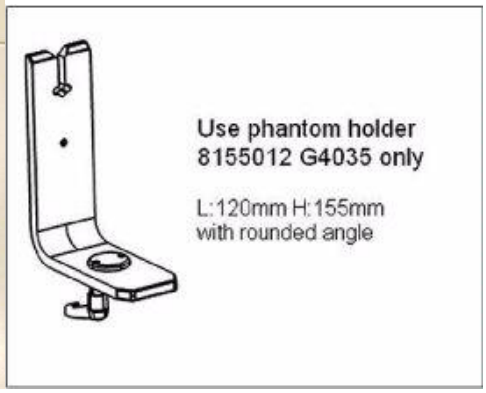


Figure 2: **Phantom Holder** (attaches to bed)



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

- The water phantom must be stored at a constant temperature of +21± 3 Celsius. For measurements, the water temperature in the phantom must be +21± 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 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 Center using internal laser (not external laser).

1.4 Turn off illumination mood lighting (to best visualize the laser lights).

1.5 Use the laser alignment lights to position the phantom (**Figure 1**).

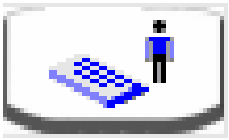
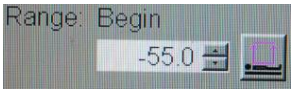
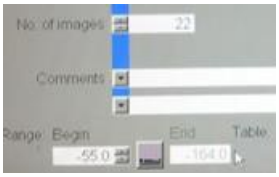
Table 1: Position the Water Phantom in the Gantry

a. Activate the light marker.	
b. Set the appropriate table height by aligning the horizontal laser light with the horizontal reference marker on the phantom. **(140 +/- 0.5 mm)** (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 zero button.	

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- QCVH,CTONE)	
c. Select QC test required **"CT QC Daily 10 minute"** folder.	
d. **Load patient** using the **PATIENT REGISTER** button on keyboard keypad. (rectangular key with small image of keyboard and person on it).	
e. Under **Specials** choose XX_**DailyQC.** f. Click on **OK.**	
g. Change the **"Begin"** part of the range to **-55.0.**	
h. **Range end is = -164.0** i. **Number of images = 22**	
j. Click **Load.**	
k. Follow prompts to complete the scan.	

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*

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3.1 **Scan Analysis**

a) Reconstruct all **four** data sets

b) Once complete, close the exam

c) Under **Browser**, locate **Local Database**, choose **QC patient**

d) Under **Specials**, select **XX-DailyQX (XX=site**), double-click on **Series "Tube A 5mm F_1.10"**

e) Scroll to **Image 10**. Move to **viewing screen** (drag and drop)

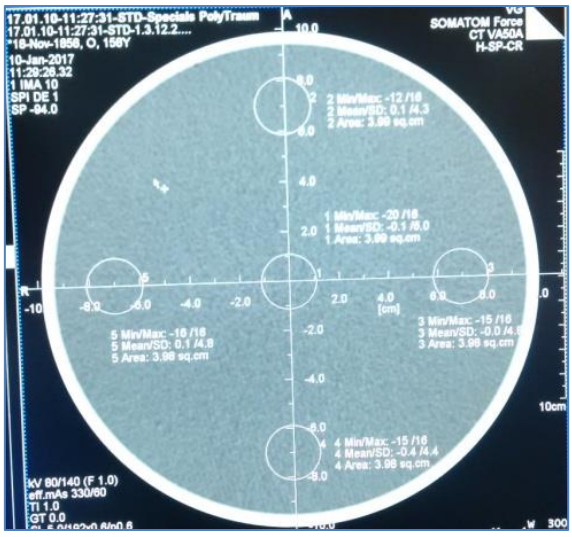
f) Select **Cross-hair** tool

g) Place Cross-hair at **centre of image** (within a few mm)

h) Select **Circle ROI** tool

i) Create a **4sq cm circle** and center on the cross-hairs on the **middle** of the image (3.9-4.1 sq cm allowable)

j) **Copy and paste** and center on the **7cm marker** on the **12, 3, 6 and 9 o'clock** axes positions. Adjust the numerical measurement boxes as needed



k) **Transfer** the **mean** and **standard deviation** values to the CT Daily QC logsheet

i. Record the following in the QC Excel spreadsheet:
   a) the **Centre ROI Mean (ME) CT number**
   b) the **Standard Deviation (SD)**.
   c) the **Mean (ME) CT number for each of the four peripheral ROIs**.

ii. **Compare** the current values to previously recorded values.

iii. **Report** significant change or values that fall outside suggested ranges to your supervisor. An orange colored cell indicates a failing value. Follow facility procedures to notify service personnel and/or medical physicist.

iv. Record the <u>failed and repeated data</u> on the log sheet

ONLY if verifiable artifacts present: (Do not routinely send images to PACs)

a) Click on **Patient**
   i. **Save As** / Save image in **New series**: Series name "**Tube A**"
   ii. Set Workflow status to **None**
b) Select **OK**
c) Repeat points a) through k) for **Series Tube B**
d) Click on **Patient**
   i. **Save As** / Save image in **New series**: Series name "**Tube B**"
   ii. Set Workflow status to **None**

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

4. Analyze the QA Images for Artifact

4.1 Select Artifact images

a) Open Series **"Tube A Artifact F_1.0"**
b) **Scroll through images** to see if any **artifacts are visible.**
c) Open Series **"Tube B Artifact F_1.0".**
d) **Scroll through images** to see if any **artifacts are visible**

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

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 system bore and return to storage location

5.5 Record all data on the MI Quality **Daily CT QC Logsheet**, 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 log sheet 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**
c) Uniformity does not exceed the allowable range of **2 HU** from the established acceptance baseline values

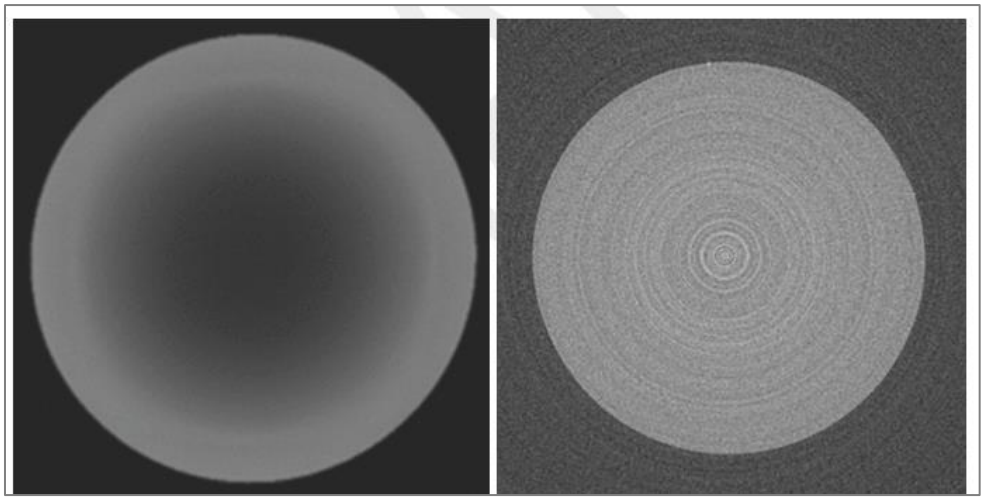
6.2 Phantom Image Artifacts

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 Force syngo CT VA50A Print No. C2-058.620.01.02.02 (basis for this procedure).

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First Released Date:	30-JAN-2024			
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Owners: *(committee or position)*	Medical Physicist Lead, MI			
	Regional Quality Coordinator, MI			
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	1.0	30-JAN-2024	Initial release	Cheryl Mason, Quality Coordinator