



**ISRRT**  
INTERNATIONAL  
SOCIETY OF  
RADIOGRAPHERS  
& RADIOLOGICAL  
TECHNOLOGISTS

# **ISRRT Guidance Document on QA/QC in CT**

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**The ISRRT is delivering a series of documents on professional practice to facilitate the daily clinical practice Radiographers/Radiologic Technologists around the world.**

Today, modern CT systems are equipped with routine quality control tests which are performed daily following x-ray tube warmup and calibration of detectors as well as monthly or at preset time intervals according to manufacturers' specifications. Nevertheless, it is vital that radiographers/radiological technologists performing such quality control testing procedures are acquainted with the aim, the technical aspects of measurements, the level of acceptance and the impact on image quality for each quality control test.

The standard image quality tests included in the following table and the frequency of testing is indicative and may not be based on CT relative performance but vary depending on manufacturers' quantitative acceptance criteria and national requirements. Hence the following table should serve as a guidance chart on CT quality control:

## QC/QA tests in CT: A radiographer's / radiological technologist's guidance chart

	QC test <sup>1</sup>	Aim	Instrument	Measurement <sup>2</sup>	Acceptance criteria <sup>3</sup>	Frequency <sup>4</sup>
1	<b>Image Noise</b>	Assess noise of images	Manufacturer's QC cylindrical water	Density in ROI at center and ROI at periphery of axial image of isocentric placed phantom	Within 0±5HU or manufacturer's reference values	Daily <i>(first test following tube warmup and calibration)</i>
2	<b>Visual check of artifacts</b>	Early detection of artifacts	Manufacturer's QC Cylindrical water phantom	Exclude streak, ring artifacts on axial image WL: 0HU/WW:100HU	No artifacts visible	daily
3	<b>Visual check of CT system and auxillary</b>					
3.1	Restricted area and pregnancy signs	Visibility of signs	N/A	N/A	National requirements	daily
3.2	Radiation protective devices/equipment	Ensure optimal function	N/A	N/A	N/A	daily
3.3	Red light exposure indicators	Ensure optimal function	N/A	N/A	N/A	daily
3.4	Door safety locks and safety switches	Ensure optimal function	N/A	N/A	N/A	daily
3.5	Gantry control pad and foot switch function	Ensure optimal function	N/A	N/A	N/A	daily
3.6	CT gantry tilt functions	Ensure optimal function	N/A	N/A	N/A	daily
3.7	CT table movement in Z and Y directions	Ensure effortless function	N/A	N/A	N/A	daily

3.8	Acoustic check of system	Ensure optimal function	N/A	N/A	N/A	daily
3.9	Patient positioning Laser light alignment	Ensure optimal function of CT laser light on axial, sagittal and coronal planes	N/A	N/A	N/A	daily
3.10	Audiovisual communication- (i.e. Camera and Microphone and headphone function)	Ensure optimal function	N/A	N/A	N/A	daily
3.11	Emergency stop	Ensure immediate shutdown of CT system operation	N/A	N/A	N/A	daily
3.12	Cooling equipment	Ensure optimal function	Thermometer	Deviation from temperature selected according to requirements	Manufacturer specification	daily
4	<b>Automatic injector function</b>	Ensure optimal function	N/A	N/A	N/A	daily
5	<b>Storage-Optical and printing devices</b>	Ensure optimal function of storage and image transfer devices	N/A	N/A	N/A	monthly
6	<b>Accuracy of laser light alignment and table position</b>	Ensure laser light and slice position concurrence	Manufacturer's QC phantom	Correlate slice position on image with selected laser light position values	Must not exceed $\pm 1\text{mm}$ or manufacturer's reference values	monthly
7	<b>Slice width</b>	Ensure accurate collimation-slice width during scanning	Manufacturer's QC phantom	Compare values on reference image with nominal slice width. Varies among manufacturers	Must not exceed 0,5mm for slice thickness <5mm and 1mm for slice thickness >5mm or manufacturer's reference values	monthly
8	<b>Homogeneity CT numbers</b>	Evaluation of CT number homogeneity	Manufacturer's QC cylindrical water phantom	Average density of central ROI and of 4 periphery ROIs at 3,6,9,12 clock positions	Difference ROI central-peripheral ROIs must not exceed $\pm 5\text{HU}$ or manufacturer's reference values	monthly

9	<b>CT number Uniformity</b>	Ensure accuracy and reproducibility of CT numbers	Manufacturer's QC phantom	Measurement of 3 or more ROIs of 100pixels and of different densities on a10mm axial image	Must not exceed $\pm 5$ HU in water Must not exceed $\pm 10$ HU in other structures or manufacturer's reference values	monthly
10	<b>Contrast resolution</b>	Evaluate system ability to visualize the most discrete structure	Manufacturer's QC phantom	Determining the most minimal visible structure	Smallest visible structure of 4mm diameter or manufacturer's reference values	monthly
11	<b>Spatial Resolution</b>	Evaluate the system ability to visualize the most distinct structure in size	Manufacturer's QC phantom	Determining the minimal distinct structure on an axial image of 1-2mm thickness using High resolution reconstruction	Not exceed 0,7lp/mm or manufacturer's reference values	monthly
12	<b>Accuracy of CT table movement on Z axis</b>	Ensure accurate patient movement on Z axis during scanning	Ruler and a sandbag of recommended weight	Deviation of value during 300mm craniocaudal and caudocranial CT table movement at 10mm intervals	Must not exceed $\pm 2$ mm or manufacturer's reference values	monthly
13	<b>Artifact Interference</b>	Visualize artifacts prior to their interference	Manufacturer's QC phantom with high atomic number structures mimicking high density anatomical structures	Check for artifacts on 10mm axial image	Presence of all artifacts interfering with diagnostic information are recorded	3 months
14	<b>Dosimetry - CTDIw</b>	Evaluate CTDIw consistency with manufacturer's reference values	16cm and 32 cm diameter phantoms and 10cm CT pencil ionization chamber	Measurement using scanning parameters and exposure factors for all protocols (AEE is not to be used during QC)	Consistent with manufacturer's reference values and within DRLs	3 months
15	<b>Precision of Measurements (i.e. Distance, density)</b>	Ensure correct and reproducible measurements on images	Manufacturer's QC phantom	Measurement of dimensions, distance and densities on 10mm axial image	Must not exceed $\pm 1$ mm or manufacturer's reference values	Annually
16	<b>Leakage Radiation</b>	Ensure patient and staff safety	Survey meter	Measurement of dose rate or total dose around gantry	Recommended values	Annually
17	<b>Phantom Backscatter</b>	Ensure patient and staff safety	Survey meter and special patient backscatter cylinder	Measurement of instantaneous dose rate 1m from phantom at angles $-90^\circ$ , $-45^\circ$ , $0^\circ$ , $45^\circ$ , $90^\circ$ around the gantry	Recommended values by National Authorities	Annually

<sup>1</sup> Modern CT systems allow for automated QC testing procedures and self diagnostic assessment

<sup>2</sup> All measurements must be recorded on designated charts developed by the QA/QC team of the department or as recommended by national authorities and manufacturers specifications

<sup>3</sup> Acceptance criteria based on CT system configuration and quoted in manufacturer's specific documentation

<sup>4</sup> Frequency of QC tests may depend on local, regional or national requirements and/or departmental policy and/or as quoted on manufacturer's operator's manual.

#### References:

ACR, American College of Radiology (2017). *Computed Tomography Quality Control Manual*

IAEA International Atomic Energy Agency (2012). *Quality assurance programme for computed tomography : diagnostic and therapy applications.*

EC (European Commission). (2000). *European guidelines on quality criteria for computer tomography. EUR 16262EN.: Luxembourg: Office for Official Publication of the European Communities.*

IEC 61223-2-6. (2006). *Evaluation and routine testing in medical imaging departments – Part 2-6: Constancy tests – Imaging performance of computed tomography X-ray equipment*

