INDEPENDENT X-RAY
QUALITY ASSURANCE

CT Dose Measurements on CT Scanners

DCT 10, DCT 30 and CTDI phantoms

In line with IEC 61223-2-6

Extract from IEC 61223-2-6

”Evaluation and routine testing in medical imaging departments - Part 2.6: Constancy tests - X-ray equipment for computed tomography”

5.4 *Dose*

5.4.1 *Summary*

The dose is determined by measuring the COMPUTED TOMOGRAPHY DOSE
INDEX at the centre of rotation and 1 cm beneath the surface inside the TEST DEVICE, using a RADIATION DETECTOR.

5.4.2 *Test equipment*

The TEST DEVICES shall consist of poly-methylmethacrylate cylinders of 16 cm (for head techniques) and 32 cm (for body techniques) in diameter. The TEST DEVICE shall be longer than the SENSITIVE VOLUME of the RADIATION DETECTOR used for the measurements.

The TEST DEVICE shall contain holes large enough to accept the RADIATION DETECTOR. These holes shall be parallel to the axis of symmetry of the TEST DEVICE, and shall be located at the centre and 1 cm beneath the surface of the TEST DEVICE at 90° intervals.

For the holes not used during a measurement, properly fitting insert parts of the same material as the TEST DEVICE shall be available and used.

The RADIATION DETECTOR shall have a SENSITIVE VOLUME of at least 10 cm in length and shall fit snugly into the holes of the TEST DEVICES. lf an adaptor is required, it shall be made of the same material as the TEST DEVICE.

In addition, the sensitivity of the SENSITIVE VOLUME. of the RADIATION DETECTOFR shall not vary by more than ± 3 % over the length of the SENSITIVE VOLUME, when measured with a RADIATION FIELD 2 mm wide (corresponding to a SLICE THICKNESS of 2 mm).

5.4.3 *Test procedure*

Centre the TEST DEVICE (either head or body technique type) within ± 5 mm of the scan field with one of the holes at the 12 o'clock position. The long axis of the TEST DEVICE should be within ± *2 mm* of the scanner centre line in both the horizontal (coronal) and vertical (sagittal) planes. In addition, the scan plane shall be in the centre of the TEST DEVICE.

For equipment for COMPUTED TOMOGRAPHY using less than, or more than, 360° scans, a position representing the maximum dose to the PATIENT shall be chosen.

Insert the RADIATION DETECTOR into the 12 o'clock position or the position of maximum exposure. The TEST DEVICE shall be scanned with a set of scan parameters according to 4.4. This same technique shall be used for future CONSTANCY TESTS.

Record the reading of the RADIATION DETECTOR.

The measurement shall be repeated at the centre of the TEST DEVICE.

5.4.4 *Data evaluation*

The COMPUTED TOMOGRAPHY DOSE INDEX measured at both positions shall be recorded.

5.4.5 *Criterion to be applied*

The COMPUTED TOMOGRAPHY DOSE INDEX shall be within ± 20 % of the BASELINE VALUE.

5.4.6 *Action to be taken*

If measured values do not fulfil the criterion given in 5.4.5, appropriate action shall be taken. Since the positioning of the TEST DEVICE and the calibration of the RADIATION DETECTOR are very important, the measurements should first be repeated after repositioning the TEST DEVICE.

A second RADIATION DETECTOR meeting the specifications in 5.4.2 may also be used to verify the integrity of the measurement equipment.

5.4.7 *Frequency of testing*
The COMPUTED TOMOGRAPHY DOSE INDEX shall be measured at least semi-annually. In addition, the COMPUTED TOMOGRAPHY DOSE INDEX shall be measured after any major maintenance action.
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Specifications DCT 10 and DCT 16

General:	Connector type	BNC banana or LEMO
		with 120 cm flexible low noise cable
	Length of measuring cable	Up to max. 30 m

		DCT 10	**DCT 30**
Dimensions:	Active volume	4,9 cm^3	14,7 cm^3
	Total active length	100 mm	300 mm
	Cylinder length	100 mm	300 mm
	Inner diameter of outer electrode	8,0 mm	8,0 mm
	Thickness of outer electrode	0,5 mm	0,5 mm
	Diameter of inner electrode	1,0 mm	1,0 mm
	Length of inner electrode	100 mm	300 mm
	Outer diameter	9,0 mm	9,0 mm
Operation:	Typical leakage	± $4x10^{-15}$ A	± $4x10^{-15}$ A
	Radiation Quality	80 – 150 kV	80– 150 kV
	Calibration factor (nominal)	70 mGcm/nC	70 mGycm/nC

Specifications for CT phantoms

Material:	Polymethylmethacrylat (PMMA)		
Phantom:		**5 hole head phantom**	**5 hole body phantom**
	Diameter:	16 cm	32 cm
	Thickness:	15 cm	15 cm
	Number of holes:	5	5
	Diameter of holes:	13 mm	13 mm

Specifications for CT probe adapters

Adapter:		LEMO
	Length:	165 mm
	Outer diameter:	12,5 ±1 mm
	Inner diameter:	9,3 ±1 mm

Correction Factors

Correction factors are shown in table 1 and 2 below. Table 1 shows corrections based on calibration performed at radiation quality RQR 8 (100 kV). Table 2 show corrections based on calibration performed at RQR 9 (120 kV). Use the proper table based on the calibration you have for your CT ion chamber.

Example:
The factors are multiplied with the measured value in the following manner:

Assume a kV setting of 80 kV, and measured dose of 15.2 mGycm using the calibration for RQR 8 (100 kV).

Correction factor from table 1:	1.019
Corrected dose:	15.2*1.019 = 15.5 mGycm

Uncertainty

The uncertainty of the typical correction factors is ±3 % at a confidence interval of 95%.

RQR 8, 100 kV, W/Al

Bq	Set kV	Nominal HVL (mm Al)	Correction Cq
RQR 6	80	3.0	1.019
RQR 8	100	4.0	1.000
RQR 9	120	5.0	0.978
RQR 10	150	6.6	0.945

Table 1. Correction factors from RQR 8, 100 kV, W/Al.

RQR 9, 120 kV, W/Al

Bq	Set kV	Nominal HVL (mm Al)	Correction Cq
RQR 6	80	3.0	1.041
RQR 8	100	4.0	1.022
RQR 9	120	5.0	1.000
RQR 10	150	6.6	0.966

Table 2. Correction factors from RQR 9, 120 kV, W/Al.