Measuring System for Computed Tomography

Application

According to FDA regulation §1020.33, as well as to IEC 60601-2-44 and IEC 61223-2-6 the Computed Tomography Dose Index (CTDI) has to be measured during acceptance and constancy checks of CT systems by means of an ionization chamber and acrylic solid phantoms.

For constancy checks the CTDI must be measured at least after a period of six months or after major maintenance and service activities. The CTDI must comply with the reference value within a tolerance of ± 20 %.

CT chamber and CTDI

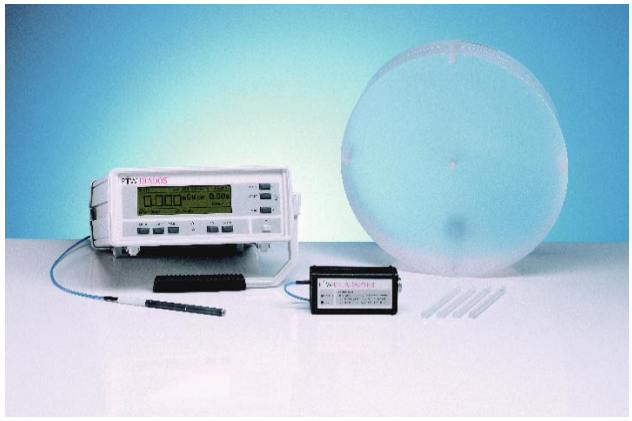
The CT chamber type 30009 is a pencil-shaped ionization chamber with 100 mm effective length, especially developed for the measurement and monitoring of the radiation output of a CT system. Since the chamber has a homogeneous response along its axis it integrates the entire dose of the CT slice which is widened by scattering within the phantom. When the measurement is made for a certain number of tomographic scans, the chamber measures the product of air kerma and exposed length, the dose-length-product (DLP). From the DLP both the CTDI and the weighted $CTDI_w$ can be derived: The CTDI is defined as the integral of the dose profile along a line perpendicular to the tomographic plane, i.e. the DLP, divided by the nominal slice thickness and numbers of scans (N):

$$CTDI = DLP / (\text{slice thickness} \cdot N)$$

The $CTDI_w$ more reflects the real absorption of X-rays in the examined body by taking into account the DLP values in the peripheral and central regions:

$$CTDI_w = 1/3 \cdot CTDI_C + 2/3 \cdot CTDI_P$$

where $CTDI_C$ is the CTDI measured in the center hole of the phantom and $CTDI_P$ is the average value of four peripheral CTDI's.



CT-DIADOS and Phantoms

The DLP is displayed by the diagnostic dosemeter DIADOS which is equipped with serial interface (RS232). A separate HV power supply is inserted between the DIADOS and the chamber in order to provide the high voltage (100 V) required for the CT chamber. Measurements also can be performed with the UNIDOS and UNIDOS E dosemeters.

The measuring phantoms are designed to represent the part of the body that the CT system is to scan. The head and the body phantom are made of acrylic cylinders with a diameter of 16 cm and 32 cm, respectively, and with a length of 15 cm. The CT chamber is inserted into the phantoms in order to measure the DLP. Holes which are not in use are closed by acrylic rods.

During measurement the phantoms are located directly on the CT couch and are aligned with respect to CT plane and rotational position by cross-hair lines. Specially designed supports keep the phantoms fixed in their measuring position. The CT chamber subsequently is inserted into the central and the four peripheral holes of the body and head phantom, respectively, in order to measure the required CTDI's during CT system scans.

Transport cases are available for CT-DIADOS, CT chamber with extension cable and acrylic phantoms.

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