

AbstractID: 11739 Title: Conditions for Practical Measurement of X-ray Spectra for Clinical Radiography of the Chest

Purpose: To establish conditions necessary for measuring x-ray spectra in simulated clinical chest radiography examinations.

Method and Materials: X-ray spectra were obtained for simulated chest examinations of the CDRH LucAl Chest phantom for 12 cases: 141, 125, and 109 kilovolt peak; with/without 0.2 mm Cu pre-patient filtration; and with/without a scatter reduction grid. X-ray spectra were acquired using an Amptek XR-100T-CdTe semiconductor detector and PX4 digital pulse processor behind the phantom. Acquired spectra were corrected for characteristic CdTe x-ray escape events using Amptek XRF-XP software, and for the energy-dependent absorption of Cd and Te. Channel-to-energy calibration was verified with Gd-153, Co-57, and Ba-133. Spectra were acquired with 8mm Pb shielding of off-axis radiation. Validity of acquired spectra was tested by three methods: comparison with simulated x-ray spectra; comparison of the measured half-value layer (HVL) to HVL calculated from spectra acquired without attenuation; and comparison of measured exposure to exposure calculated from acquired spectra.

Results: Collimating the beam results in narrow beam geometry that does not represent broad beam clinical geometry. However, when off-axis radiation is excluded from the detector, acquired spectra agree with simulated spectra and measured HVL. The calculation of exposure from the spectra depends strongly on actual collimator orifice diameter, but results suggest approximately 80% measurement efficiency. Off-axis radiation may be over-represented in spectra collected without extensive forward shielding for broad beam exposure conditions. The digital pulse processor allows acquisition at higher incident flux than the older PX2T analog version.

Conclusion: Using improved electronics and appropriate methods to limit flux and off-axis radiation, it is possible to collect accurate spectra under simulated clinical conditions. These methods could be used to study optimization of radiographic technique for clinical examinations.