Technical Brief Series

The Concept of Exposure Index For CARESTREAM DIRECTVIEW Systems

Author: Jacqueline Gallet, PhD

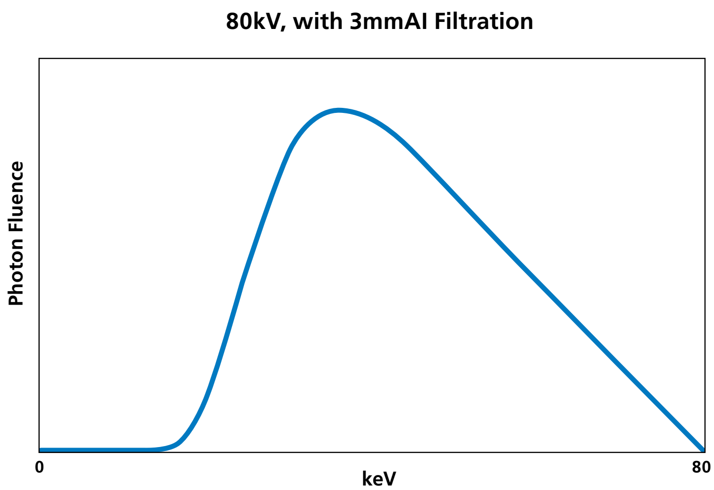

Figure 1 (a) Simulated tungsten anode 80kVp spectrum with an equivalent 3.00mmAl total filtration. Mean X-ray energy is approximately 48keV.

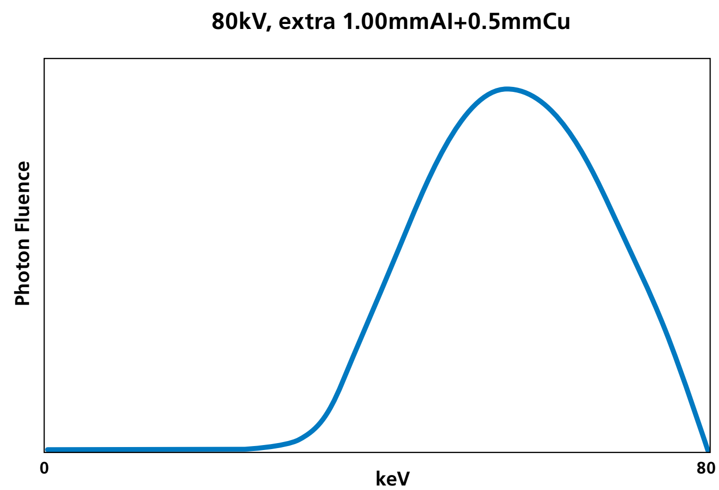

Figure 1(b) Simulated tungsten anode 80kVp spectrum with additional filtration of 0.5mmCu and 1.0mmAl. Mean x-ray photon energy is approximately 57keV.

Carestream Health, in developing its digital radiography (DR) and computed radiography (CR) imaging products, developed a physical quantity called the Exposure Index or EI.

In simple terms, the exposure index is computed from the average code value in those areas of the image data used by the image processing algorithm to compute the optimal tone scale. In other words, after the image data is collected, but before any tonal rendering occurs, the anatomical regions are identified. The average value is calculated from the pixels contained within the anatomical boundaries.

A separate exposure index is calculated for every image and can vary between anatomical parts. For clinical images, the anatomic region of interest is identified by the image processing algorithm. The average code value of this region is reported as the exposure index. Therefore, the exposure index is correlated with the exposure of the digital image receptor in the clinical region of interest.

Most manufacturers of digital radiography equipment provide a method to relate the exposure at the image receptor plane to a set of image pixel values. The EI used in DirectView digital radiographic equipment is obtained in the following manner. DirectView CR and DR Systems are calibrated for a heavily filtered (an additional 0.5 mm copper and 1 mm aluminum) 80 kVp x-ray beam (compare Figure 1(a) to 1 (b)). Filtration removes the low energy photons which only contribute to scatter. Reading of the CR storage phosphor screen is performed following a 15-minute delay after exposure. At the beam quality obtained with this additional filtration, the relationship between exposure to the imaging plate and the exposure index is given by:

E =10 (EI-2000)/1000 or EI =1000 log(E) + 2000
where E is the exposure is mR and EI is the exposure index.

Because digital image processing optimally displays the image regardless of the exposure, rendering of an image will not change due to different exposure levels as it would for film-screen systems. It is, therefore, very important to follow the principles of ALARA (As Low As Reasonably Achievable) as well as maintain good radiographic techniques. An over-exposed image will not appear darker. Proper collimation and proper positioning will also decrease scatter absorbed by the patient. Hence, dose to the patient can be kept low while still obtaining diagnostic images.

The exposure index can serve as an indicator of the relative exposure used for a particular exam. It can become part of a general Quality Control (QC) dose management program and a useful diagnostic tool for monitoring relative exposure values. For instance, once a digital system has been fully optimized in terms of diagnostic image quality and patient entrance skin exposure dose, the corresponding EI could then be monitored as part of the daily or weekly QC audits. The EI is not an absolute number, even for the same body part examination. Variations in EI will occur due to changes in technique and body positioning.

Carestream Health, Inc.
150 Verona Street
Rochester, NY 14608
U.S.A.

For More Information

To learn about Carestream Health's CR and DR systems, contact your Carestream Health representative or call 1-877-865-6325, ext. 227.

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