AbstractID: 8011 Title: Attenuation and Lead Equivalence of Lead-Free and Lead-Composite Aprons

A study was performed to determine the lead equivalence of lead-free and lead-composite radiation protection aprons. Manufacturers of these items often image both the apron material and a lead step wedge on a screen-film cassette and then determine lead equivalency by comparing film densities. We find that this gives misleading results when the attenuating material in the apron is other than just lead. Measurements using an ion chamber to determine the x-ray transmission are a much more appropriate method that can be used with aprons made of lead or of other heavy metals.

The transmission measurements were made using broad-beam geometry with the ion chamber directly under the apron. Transmission calibration curves were generated using 99.9% pure lead foils, with nominal thickness of 0.125, 0.25, 0.5 mm. Transmission measurements were made every 0.125 mm from 0 to 1.0 mm at 80 to 110 kV. Lead thickness vs. transmission curves for each kV were derived from these measurements using a cubic spline interpolation algorithm. Transmission measurements of the lead aprons could then be used to determine lead equivalency at the different kV's.

Using the method of imaging with a lead step wedge we found that aprons from various manufacturers tested close to their labeled lead equivalency. However, transmission measurements indicated that the lead-free and lead-composite aprons had less lead equivalency than labeled, by as much as 25%, while full lead aprons generally exceeded their labeled lead equivalency.