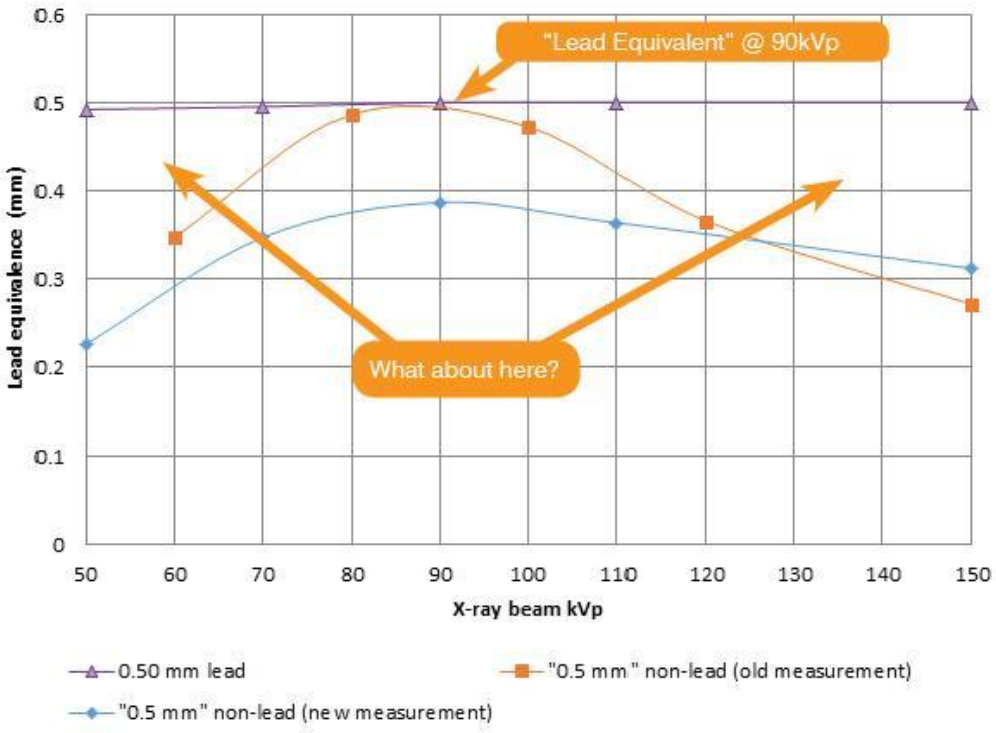
NON-LEAD VS LEAD-BASED PROTECTIVE MATERIALS

For many years, manufacturers of non-lead aprons have been promoting their garments as lightweight solutions in order to meet market demands for reduced weight. They claim their aprons are able to offer the same levels of protection as their lightweight lead-based counterparts. But are these non-lead solutions really as good as they sound? With extensive lab testing the true results become known.

There are two key factors at play. Firstly, current Australian standards (based off older international standards) provide a method for testing lead equivelance using a narrow beam geometry. This method does not adequately model the real-world effects of fluorescent radiation and results in a gross over representation of a material's lead equivalence. Secondly, lead equivelancy is often stated at the single kVp energy level where the material performs the best and the remainder of the picture is purposefully left out.

NON-LEAD PERFORMANCE BEYOND 90 KVP

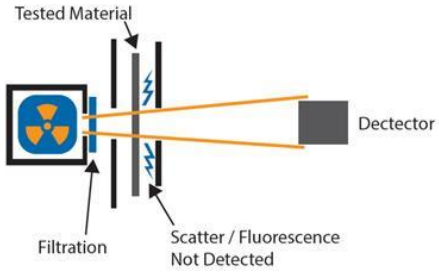


This graph perfectly illustrates the missing picture. **It is made from a set of real data of a non-lead material's lead equivalence plotted against the x-ray beam kVp and compared against a lead-based material**. The key thing to note here is that **while the non-lead material is equivalent to lead at the 90 kVp mark, it drops off at lower and higher energies.** Manufacturers can get away with claiming a 0.5mm lead equivelance but this shows what is really happening.

The second thing that this graph shows us is that even though this material is lead equivalent (albeit within a narrow range of energies) when tested with narrow beam, when tested with the broad beam method it performed significantly worse than lead. In some cases, if a manufacturer used enough of their non-lead material that it became lead equivalent at even a single kVp, it would weigh more than a lead-based alternative.

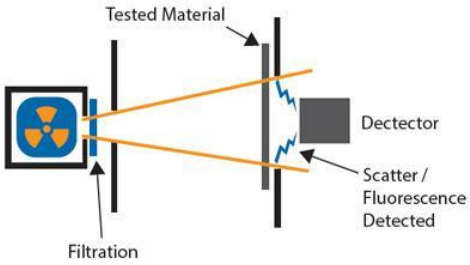
THE KEY FACTS

1. The radiation absorbing characteristics of non-lead materials are different to lead. Critically, the protective properties of non-lead formulations, when expressed as lead equivalence, vary with the x-ray energy. The lead equivalence of non-lead materials generally peaks between 80-90 kVp, and then drops away.
2. The historical methods prescribed for determining lead equivalence (attenuation comparisons using a narrow beam measurement geometry) are not representative of real-world exposure circumstances, and can provide unrealistically good results for a lot of the non-lead products available.
3. Manufacturers of non-lead products have used the above facts to claim similar levels of protection to lead, but at substantially reduced weights. In reality, in some circumstances, per unit weight, the protection offered by non-lead materials can be worse than lead, and in others, the reduction in weight is at best marginal. This is particularly true when the protective ability over a reasonable range of energies is considered.
4. Without a full set of test data across a range of kVp levels, users of non-lead aprons cannot know what level of protection they are receiving. The stated lead equivelance on the apron's label does not provide enough information to make an informed judgement.



Shows how secondary scatter is missed and not shown in test results.

Narrow Beam



Reveals missed secondary scatter and gives more accurate results.

Broad Beam

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https://www.radsafemedical.com/resources/lead-vs-non-lead