Guidance on Screening of Lead Aprons

Introduction

According to UK law (the Ionising Radiations Regulations 2017), all personal protective equipment provided should be thoroughly examined at suitable intervals and properly maintained.
It is recommended that lead aprons are inspected at least once a year[1]. In order to quantify any defect detected, it is important to know both the size of the defects and their location. In the quantification of a defect, we also need to know the lead equivalence of the apron. Finally, the type of lead apron, e.g., single or double layer, is important[2]. These details should be noted as part of an apron screening program.
Manufacturers recommend all newly purchased lead aprons are radiographically assessed prior to use. This is to rule out the possibility of any manufacturing defects in the protective material, that aren't visible to the naked eye and damage during transportation.

Visual inspection

The best way to regularly inspect lead aprons is to first lay them out on a flat surface and visually inspect all of the seams and coverings for any obvious damage. In addition, check the belts and fastening devices to ensure they are in proper working order. Then feeling the surface of the apron with your hands, look for any lumps, cracks, or signs of separation from the seams or sagging. If it passes this visual inspection, it is probably in good condition.

X-ray Inspection

When it comes to the radiographic inspection of aprons, there are a number of methods that have been adopted. Availability of equipment and personnel is a determining factor.

Fluoroscopy. Many fluoroscopy systems only work within pre-programmed protocols making it challenging to set optimised exposure factors for crack detection. When possible, a bespoke protocol for the screening of aprons should be created.
A recommended exposure would be 70 to 80 kV and a low mA setting to help protect the tube and lower the dose to the person performing the inspection.
CT scan tomograms / scout views. IMPORANT – Always check the pixel resolution of the scout view, manufacturers have different pixel resolutions for the scout/planning view which can be lower than the stated scan resolution. In some cases, it reduces as the length of the scout view increases. A pixel resolution of 5mm may not demonstrate a tear <5mm.
Once again, a recommended exposure would be 70 to 80KV and a low mA setting to help protect the tube and lower the dose to the person performing the inspection. Where possible, manually set the exposures and avoid using any automatic exposure control system.
Purpose built apron screening systems. There are a number of systems available that have been designed specifically for screening lead aprons. These reduce the need to tie up valuable personnel and equipment, have larger fields of view and much lower scan times. They are available as a service or for hire from a number of manufacturers. These systems produce reports and often include an apron management system.

Image post-processing recommendations

It is important to note that modern imaging systems are designed for diagnosis in human tissues and there are a wide number of post-processing algorithms, designed to detect abnormalities that may demonstrate apron manufacturing anomalies (which are well within technical tolerances) as an area of concern.

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Therefore, when viewing the images, post-processing algorithms such as edge enhancement should be removed and the window and level selection should demonstrate an un-enhanced image. A simple way of achieving this is to use the stitch holes as a guide and adjust the image until any 'halo' effect is removed.

Apron Rejection Criteria

Identifying the rejection criteria for x-ray aprons should be decided at each location with the consultation with your Radiation Protection Adviser.
A number of articles[2,3] look at the effective dose relating to cracks and holes and can be used to determine a local protocol for apron acceptance.
Special consideration should be given to any defect that occurs over a critical organ.

Further Information

The BIR has put together a collection of resources on PPE for staff working with radiation, to help develop radiation protection knowledge both within and beyond the radiology department. These include a guidance document, handy posters and free-to-view videos.
http://www.birpublications.org/page/ppe

References

1. Michel R, Zorn MJ. Implementation of an X-ray radiation protective equipment inspection program. Health Phys 2002;82(2 Suppl):S51-3.
2. Stam, W, Pillay, M. Inspection of Lead Aprons: A Practical Rejection Model. Health Phys. 2008 Aug;95 (Suppl) 2:S133-6
3. Lambert K, McKeon T. Inspection of lead aprons: criteria for rejection. Health Phys 2001;80(5 Suppl):S67-9.

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