

Aprons for Protection Against X-rays

It is recommended that all aprons should comply with Australian Standard AS/NZS 4543.3:2000 for light and heavy aprons depending on the application.

Introduction

For staff working in environments which have X-ray producing equipment, one of the main means of protection is the lead apron.

Conventional aprons are primarily composed of lead impregnated vinyl material. ARPANSA, has over recent years, received a number of inquiries regarding the testing of apron integrity and on the performance of new light weight 'Lead Equivalent' materials on the market.

The Australian/New Zealand Standard (AS/NZS 4543.3:2000) IEC 61331-3:1998 *Protective devices against diagnostic medical X-radiation. Part 3: Protective clothing and protective devices for gonads*, states the required attenuation equivalent of light protective aprons shall be not less than 0.25mm Pb over entire area. For heavy protective aprons, not less than 0.35mm Pb for the front section and 0.25mm Pb for remaining parts.

Please note the reference to light and heavy aprons in the standard, is for its usage and is not weight related. Light aprons are recommended for operating theatres and heavy, in examination rooms.

Testing of Aprons

The Department of Human Services of Victoria (Aust) advisory information, states aprons should be tested for integrity on initial receipt and then every 12-18 months.

Testing for imperfections in an apron can be achieved by fluoroscopy on a floating top table, or by radiography. Any cracks or holes found should be marked and recorded. To reduce costs, a lead apron may only have to be replaced if the defect is greater than 15mm² in areas close to critical organs and for areas at the back or along the seams, replace only if the defect is greater than 670mm².



The measurement of the 'lead equivalent' of an apron requires sophisticated equipment not normally available in a clinical environment. Figure 1 shows the setup used to measure 'lead equivalent' at ARPANSA. This setup essentially meets the requirements of AS/NZ 4543.1:1999 "Protective devices against medical X-radiation, Part 1: Determination of attenuation properties of materials".

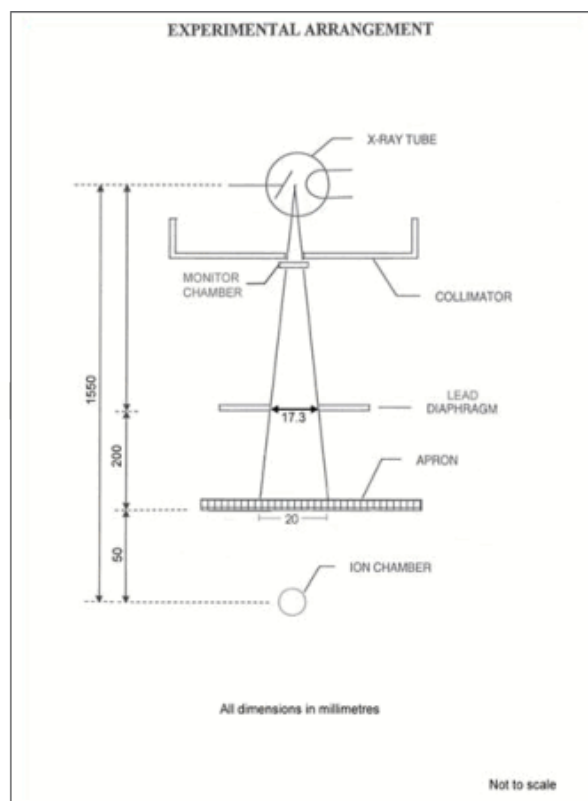


Figure 1

Measurements are made either with IEC/AS standard beams or common beams in clinical use.

The transmission through pure lead is determined and plotted as a function of thickness. The transmission through apron material is then measured and the 'lead equivalent' is read off the pure lead transmission plot.

Light Weight Aprons

Although lead is effective in reducing primary and secondary X-radiation, it has the drawback of being heavy. Worn occupationally over a number of years, the weight can have a detrimental effect on the health of the wearer, particularly spinal problems. If not addressed, this can become an occupational health and safety issue. There are now a number of lead apron manufacturers making aprons lighter in weight. These aprons are manufactured from composite materials such as barium, tin and lead. Manufacturers quote weight reductions of around 20 - 30% with one stating close to 50%.

Because these aprons are made of composite materials, the 'lead equivalent' will also vary with beam quality (e.g. kVp, HVL).

Conclusion

It is recommended that all aprons should comply with Australian Standard AS/NZS 4543.3:2000 for light and heavy aprons depending on the application. In Victoria for fluoroscopic X-ray equipment, it is a required condition of license that aprons meet the AS/NZS standard for heavy aprons.

To ensure an apron complies with AS/NZS 4543.3:2000, the apron should be labelled as follows:

XYZ(1) H(2) Pb0,35(3)/100(4) LM(5) IEC 61331- 3:1998(6)

- (1) name of/trade mark of manufacturer or supplier;
- (2) for heavy protective apron;
- (3) attenuation equivalent;
- (4) X-ray tube voltage (and filtration);
- (5) standard size (large medium);
- (6) year of production of the standard.

If different, the value of back and front section stated on label.

It is recommended that both the design and 'lead equivalent' of an apron is suitable for its intended use. It is recommended that regular testing for defects in aprons be included as part of the quality assurance program for an X-ray department.