Midland lead Information for Customers

Does machine cast lead meet the British standards? Yes!

A study undertaken by an Independent RPA has confirmed that apart from cost advantages, machine cast lead has no discernible differences from rolled lead and affords reliable precise attenuation of X-rays as predicted by the British Standard 3.BS 4094 part 1 and BS 4094 part 2 and other standards.

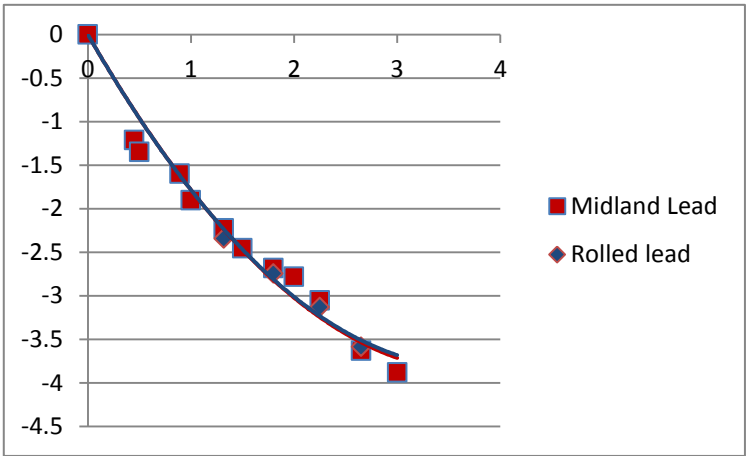
Summary of findings

- Lead produced from the Machine cast manufacture or the rolled lead manufacture process is equally suitable for use in new X-ray Installations.
- Precision measurements on Machine cast lead shows that the stopping power of the lead does not vary over the shielding by a significant factor.
- X-radiographs do not show any significant defects such as air pockets.
- Studies comparing rolled lead and Machine cast lead found that for a given thickness of lead, there was no difference in shielding quality (see below).

The graph below compares the shielding quality of rolled lead and machine cast lead, most clearly. Such data is used by Radiation Protection Advisers and engineers constructing X-ray treatment rooms and surgeries to reduce the exposure of staff and patients waiting for treatment to the acceptable levels.

The graph plots the degree of attenuation on the vertical axis against the thickness of lead required to produce that attenuation. Attenuation is given on the vertical axis and the thickness of lead to achieve this on the horizontal axis. The red squares plot the results using machine cast lead from Midland Lead Manufacturers Ltd and the blue diamonds plot the results using the rolled lead technique of manufacture.

Thickness of lead (mm)



Log (10)

Transmission

(Data from an X-ray apparatus run at 100kVp)

The plot lines are so close that it is difficult to distinguish them!. This shows that machine cast lead can be made with good precision, *

We would recommend that an Radiation Protection Adviser with a current Certificate of Competence (as recognized by the HSE) is appointed and consulted to advise on plans to install new X-ray facilities. The following advice is given as a guide only.

Shielding has two main functions:

1) To contain the controlled area so that dose rates do not exceed 7.5μSV per hour at the perimeter.

2) To reduce the dose rate for members of the public to the dose restrain of 0.3 mSv per year for the Time Averaged Dose Rate over 2000 hours (TADR2000)

The RPA will firstly calculate the attenuation required to reduce the dose rate to <7.5 μSV per hour for the purposes of 1) above.

Similarly, the RPA will calculate the attenuation needed to reduce dose rate to members of the public. It is good practice to calculate the number of exposures per week and take account of the occupancy of the space affected by X-ray scatter.

The lead equivalence required can be then calculated by accepted standards such as the British Standard 3.BS 4094 part 1 and BS 4094 part 2 or the calculation protocol provided in the BIR/IPEM working party entitled "Radiation Shielding for Diagnostic X-rays" (BIR 2000), for example.

A useful concept is the Ten Value Thickness (TVT) this is the lead thickness that would reduce the exposure to $1/10^{th}$ of the unattenuated dose. If another layer of lead with the same thickness is added, for shielding, then the exposure would be reduce to $1/100^{th}$ of the unattenuated dose, for three TVT layers this would reduce exposure to $1/1000^{th}$ etc. Similarly, a Half Value Layer (HVT) will reduce exposure to $1/2^{th}$ of the unattenuated exposure and two HVT's will reduce the exposure to ¼th of the unattenuated exposure.

* The precision can be shown by the calculation of the percentage standard deviation for measurements of the dose rate attenuation at ten different positions on the same lead sheet. This was found to be 0.73% which is very low and therefore of high precision.

N C Higbee BSc MSC CRadP MSRP 22nd August 2012

About the Radiation Protection Adviser

Niall Higbee, BSc MSC CRadP MSRP

Niall is the MD and Principal RPA of RPA PLUS

http://www.radiationprotectionadviser.co.uk

Niall is a chartered radiation protection professional with a current certificate of competence from RPA2000 recognised by the HSE and a Certificate of Recognition to act as a Radioactive Waste Adviser.

After obtaining an MSc in radiation science, Niall went on to become a production scientist, manufacturing radio-pharmaceuticals. At Oxford University, he was an RPA with wide areas of responsibility including unsealed and sealed sources, accelerators and X-ray apparatus. In an operation with over 50 departments, he reorganised and developed training programmes for radiation workers and Radiation Protection Supervisors (RPSs). Niall served on the Executive of The Association of University Radiation Protection Officers and was the joint local organiser for their successful 2-day conference at Oxford. Overall, he has thirty years experience in R+D and radiation protection management.

Niall has experience of advising dentists, vets, companies and Universities about their X-rays sets and shielding requirements. He also has advised on the shielding requirements for large enclosures and labyrinths using X-rays and gamma emitting radiations. He is also has experience of calibrating instruments and the critical examination and acceptance testing of new apparatus.

Niall founded RPA Plus as he realised the need for better customer based services to match the different needs of customers.