NATIONAL PHYSICAL LABORATORY



Teddington Middlesex UK TW11 0LW Telephone +44 20 8977 3222 NPL Management Ltd – Registered in England and Wales No 2937881

Test Report

Determination of Attenuation Properties of Materials using Diagnostic X-Radiation The measurement results in this report are traceable to the SI system of units, to units of measurement realised at the National Physical Laboratory or other

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FOR:	Protech Leaded Eyewear Inc.DBA Protech Medical 1360 N Killian Dr.Unit#2 Lake Park, FL 33403 United States
DESCRIPTION:	Determination of Attenuation properties of various material according to BS EN 61331-1:2014 in the Narrow Beam Geometry using the Report and short guidelines for testing laboratories (L. Büermann, 2016 ¹)
DATE OF MEASUREMENTS:	17 – 18 August 2023

Reference: 2023070331-1 Date of Issue: 13 September 2023 Checked by: MM

Signed: Name: G A Bass Page 1 of 3 (Authorised signatory) on behalf of NPLML

NATIONAL PHYSICAL LABORATORY

Continuation Sheet

CONDITIONS:

Distance from x-ray tube to target sample: Ionisation chamber used: 1.8m PTW TW34069-2.5 s/n 000231

All equipment associated with the measurements performed in this report has direct traceability to UK national standards or UKAS accredited calibration facilities.

Table I

61331-1:2014 X-ray beam qualities		
<u>X-ray Tube Voltage</u>	Added filtration	
kV	mmAl*	
50 - 150	2.2	

*The inherent filtration of the x-ray tube was determined to be 0.3mmAl equivalent (according to ISO 4037-1:1996), giving a total filtration of 2.5mmAl

 F_{NBG} is the attenuation ratio in the Narrow beam geometry, given by:

$$\boldsymbol{F}_{\boldsymbol{NBG}} = \frac{\dot{K}_0 - \dot{K}_B}{\dot{K}_1 - \dot{K}_B}$$

where $\dot{K}_0 = \text{Air Kerma Rate without the test object in the beam}$

 \dot{K}_1 = Air Kerma Rate with the test object in the beam

 \dot{K}_B = Background Air Kerma Rate with the test object replaced by a sheet of material with an attenuation ratio greater than 10⁵.

The Lead equivalent value δ_{NBG} in mm using the Narrow Beam Geometry is obtained by fits to the attenuation curves F_{NBG} of Lead foils of known thicknesses and of at least 99.995% purity.

UNCERTAINTIES

The uncertainty in the Lead equivalence value δ_{NBG} is $\pm 5\%$. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

REFERENCES

 I. Technical report: Determination of lead equivalent values according to IEC 61331:2014 – Report and short guidelines for testing Laboratories, *L. Büermann*, Journal of Instrumentation, Volume 11, September 2016

 Reference:
 2023070331-1

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Page 2 of 3

NATIONAL PHYSICAL LABORATORY

Continuation Sheet

RESULTS:

 $\begin{tabular}{|c|c|c|c|c|c|} \hline Corning Lens 4B 65d 0.75mm LE, \\ sample \#341, 0.75mm nominal Lead equivalent \\ \hline \hline \underline{kV} & $\underline{F_{NBG}}$ & $\underline{\delta_{NBG}}$ & $\underline{PASS/FAIL}^{+}$ \\ \hline mm & 150 & 48.6 & 0.7650 & $PASS$ \\ \hline \end{tabular}$

Table II

Τ	abl	le II	[
	4D	651	Δ	50

Protech Lens 4B 65d 0.50mm LE, sample #342, 0.50mm nominal Lead equivalent

kV	<u>F</u>_{NBG}	<u>δ_{NBG}</u>	PASS/FAIL†
		mm	
150	36.0	0.6781	PASS

Table IV						
Protech Faceshield 0.12 LE,						
sample #343, 0.12mm nominal Lead equivalent						
<u>kV</u>	<u>F_{NBG}</u>	<u>δ_{NBG}</u>	PASS/FAIL†			
		mm				
120	4.88	0.1650	PASS			

†Determination of the lead equivalent class for a specified range of radiation qualities according to IEC 61331-1 clause 5.5.

Clause 5.5.3 of IEC 61331-1:2014 states that a relative standard uncertainty of 7% be taken into account in the decision of conformity in assigning the class of the Lead equivalent thickness to the material under test. If t_{Pb} is the standard Lead equivalent thickness class (0.25mm, 0.35mm, 0.5mm or 1mm) and δ_{NGB} is the Lead equivalence of the material under test, the condition can be written as:

 $\delta_{NBG} \ge 0.93 t_{Pb}$

 Reference:
 2023070331-1

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Page 3 of 3