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Test Report

Determination of Attenuation Properties of Materials using Diagnostic X-Radiation

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: MMC DJM

Signed: 
Name: G A Bass

(Authorised signatory)
on behalf of NPLML

CONDITIONS:

Distance from x-ray tube to target sample: 1.8m
Ionisation chamber used: 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

X-ray Tube Voltage **kV**	**Added filtration** **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:

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

where $\dot{K}_0$ = 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 10^5.

The Lead equivalent value $\boldsymbol{\delta_{NBG}}$ 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 ±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

1. 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

RESULTS:

Table II
Corning Lens 4B 65d 0.75mm LE,
sample #341, 0.75mm nominal Lead equivalent

kV	F_{NBG}	δ_{NBG} mm	PASS/FAIL†
150	48.6	0.7650	PASS

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

kV	F_{NBG}	δ_{NBG} mm	PASS/FAIL†
150	36.0	0.6781	PASS

Table IV
Protech Faceshield 0.12 LE,
sample #343, 0.12mm nominal Lead equivalent

kV	F_{NBG}	δ_{NBG} mm	PASS/FAIL†
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:

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