



Institut für Strahlenschutz und Dosimetrie

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(Ablage 53)

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Innsbruck, 27.03.2019

TEST REPORT – measurement of the ATTENUATION EQUIVALENT

PPb 05/2019

Measurement of the ATTENUATION EQUIVALENT of radiation protection materials according to IEC 61331-1 (2014) in the modified broad beam geometry	
Client	Bar-Ray Products, Inc.
Address of the client	Bar-Ray Products, Inc. 90 E. Lakeview Drive Littlestown, Pennsylvania 17340 USA
Order date / number	26.02.2019 / IS-1314-1/2019

Copies / number	two / nr. 2
Number of pages	- 4 pages -
Attachment: number / total number of pages	--

every exemplar of the report consists
of numbered pages

All results of this test-report are only valid for the submitted test samples!

1. Order:

Measurement of the LEAD EQUIVALENT of radiation protection materials in the modified broad beam geometry.

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1. Order:

Measurement of the LEAD EQUIVALENT of radiation protection materials in the modified broad beam geometry.

2. Description of the test sample:

The test samples are nine material samples of radiation protection material. The description of the samples follows in the table of chapter 5.

The ATTENUATION RATIO and the LEAD EQUIVALENT was determined according to the Email from Helen Johnston from 7th February 2019. All material samples are quadratic with a side length of 10,0 cm.

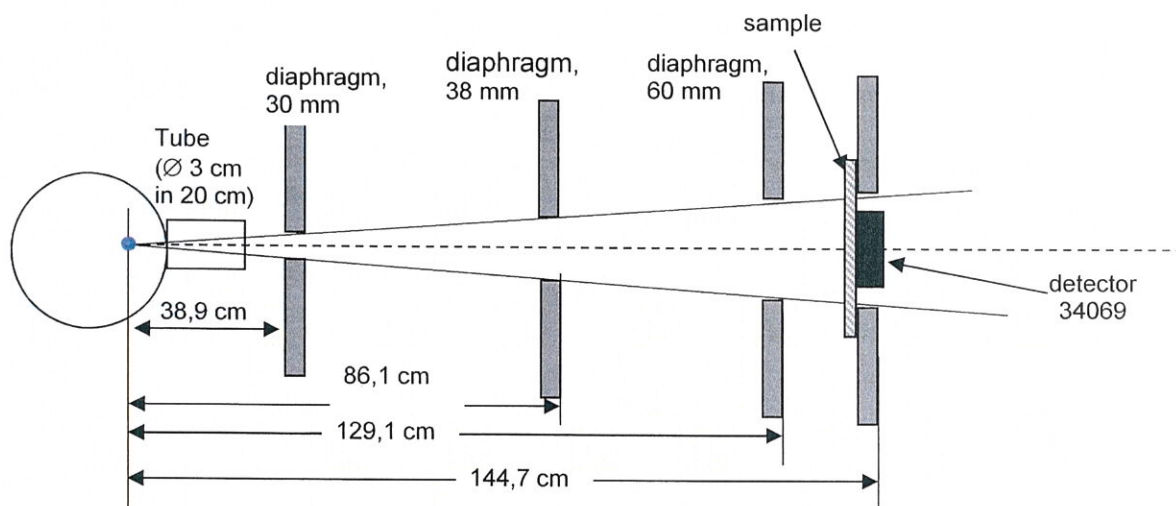
3. Description of the measuring arrangement:

3.1 Applied testing method

The LEAD EQUIVALENT was determined in the modified broad beam geometry according to:

Heinrich Eder, Helmut Schlattl: IEC 61331-1: A new setup for testing lead free X-ray protective clothing, Physica Medica 45 (2018) 6–11.

Measuring arrangement:



3.2 Measuring devices:

- Dosimeter mod. UNIDOS with detector TM34069, LNr: 97
- Lead diaphragm, LNr. 125 (thickness 6 mm, diameter of the holes are 20 mm and 38 mm)
- Set of Al-filters, LNr. 176
- Set of lead-films, LNr. 126 and LNr. 157
- Balance SARTORIUS, LNr. 84
- Tape measure, LNr. 194
- Thermometer, LNr. 49
- Barometer, LNr. 67

4. Test procedure:

- Date of measurement: 28.02.2019 and 26.03.2019
- Execution of the measurements: Dr. Thomas Schöpf
- Location of the measurements: conventional X-ray-therapy equipment, Dept. of Radiotherapy and Radiation Oncology at Innsbruck Univ. Hospital
- Kind of X-ray-equipment: X-ray equipment for therapy with HF-generator CP-225 (Fa. X-STRahl) and x-ray-tube MIR-226 (Fa. COMET) with an inherent filtration of 0,8 mm Be and an anode-angle of 30°

In accordance with the order, the ATTENUATION RATIO F and the ATTENUATION EQUIVALENT were determined with x-ray tube voltages of 60 kV, 70 kV, 90 kV, 110 kV and 150 kV. According to IEC 61331-1 a filter of 2,5 mm Al for all x-ray tube voltages were used.

With the set of lead films the attenuation curves, the so called "lead-curves", was taken up first. After measuring the attenuation due to the test sample, the corresponding "lead curve" was applied on the attenuation factor in order to determine the LEAD EQUIVALENT.

5. Results:

Results for 60 kV, 70 kV and 90 kV:

Sample	Area density (g/m ²)	F (60 kV)	mm Pb (60 kV)	F (70 kV)	mm Pb (70 kV)	F (90 kV)	mm Pb (90 kV)
Bar-Ray Products, Inc. Cost Cruncher .250	3359	45,1	0,252	25,3	0,254	11,8	0,257
Bar-Ray Products, Inc. Cost Cruncher .350	4648	106	0,347	49,5	0,349	18,9	0,353
Bar-Ray Products, Inc. Cost Cruncher .500	6747	355	0,500	126	0,504	36,1	0,508
Bar-Ray Products, Inc. Truelite .250	3408	40,9	0,242	23,5	0,244	11,1	0,246
Bar-Ray Products, Inc. Truelite .350	4508	112	0,354	51,9	0,357	19,4	0,359
Bar-Ray Products, Inc. Truelite .500	6462	362	0,502	127	0,505	36,1	0,508
Bar-Ray Products, Inc. Scatter Sentry .250	2787	40,6	0,242	24,2	0,248	11,5	0,252
Bar-Ray Products, Inc. Scatter Sentry .350	3862	99,8	0,341	50,2	0,351	19,2	0,357
Bar-Ray Products, Inc. Scatter Sentry .500	5794	427	0,525	158	0,544	42,1	0,549

Results for 110 kV and 150 kV:

Sample	Area density (g/m ²)	F (110 kV)	mm Pb (110 kV)	F (150 kV)	mm Pb (150 kV)
Bar-Ray Products, Inc. Cost Cruncher .250	3359	8,24	0,258	5,47	0,254
Bar-Ray Products, Inc. Cost Cruncher .350	4648	12,7	0,354	8,08	0,349
Bar-Ray Products, Inc. Cost Cruncher .500	6747	23,4	0,509	14,3	0,503
Bar-Ray Products, Inc. Truelite .250	3408	7,74	0,245	---	---
Bar-Ray Products, Inc. Truelite .350	4508	12,7	0,353	---	---
Bar-Ray Products, Inc. Truelite .500	6462	22,6	0,499	---	---
Bar-Ray Products, Inc. Scatter Sentry .250	2787	7,56	0,241	---	---
Bar-Ray Products, Inc. Scatter Sentry .350	3862	11,4	0,329	---	---
Bar-Ray Products, Inc. Scatter Sentry .500	5794	21,0	0,480	---	---

F attenuation ratio
mm Pb LEAD EQUIVALENT compared to pure lead foils

The total measurement uncertainty (for k = 2) are

- for the LEAD EQUIVALENT: 5%
- for the area density: 1,5%

The deputy director:



(Ing. J. Felderer)

The examiner and director:



(Dr. T. Schöpf)