System Response Testing of HEAF Kevex 130kV Microfocus Source and Thales Flashscan Panel
I. Step-wedge Measurements

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1 Introduction

In the Small Sample DR Testing series, a few questions have arisen when comparing modeled results to experimental data. It is necessary to evaluate these questions in order to validate the modeling assumptions and to ensure the validity of the test procedure in the Small Sample DR Testing.

Open Questions

1. The decay time of the scintillator elements is unknown.
2. The thickness of the Beryllium window on the source is unknown.
3. The residual effects of beam angle and scattering within the detector assembly are unknown.
4. The spectral response of the scintillator and digitizing panel are not known.
5. The spectral content of the source is unknown.

Item 1 will be addressed in separate tests by measuring the output of the panel at various intervals after the source has stopped illuminating the panel.

Item 2 will be determined by finding the manufacturer specifications.

Item 3 will be addressed in separate tests.

We are cannot easily address items 4 and 5 independently. Measuring the spectral responsivity of the detector directly would require the use of a calibrated reference source, which we lack. Similarly, measuring the spectral content of the source requires spectrally and spatially calibrated detectors, which we also lack. However, we can address the combination of items 1 and 2 to deduce the *product* of source intensity times detector response. By measuring the X-ray transmittance of samples of known thickness, material composition and density (step wedges), we can infer the desired product and so validate and improve computer models of our system.

2 Spectral Response of the Source and Detector

An assumed source spectrum and panel response has been modeled. In order to examine the predicted response versus the observed response over various frequencies, step wedges of various materials will be used.

2.1 Step Wedges

The step wedges used in this study are in various shapes and made from various materials. The table below lists the approximate properties of the step wedges, along with an identifier name for the step wedge. Units are inches in the table.

Table 1 Dimensions of the step wedges

Step	Thickness Polyethylene	Thickness Acrylic	Thickness Lucite	Thickness Al_1	Thickness Al_2	Thickness Iron
1	0.112	0.058	0.237	0.04	0.126	0.075
2	0.192	0.116	0.474	0.08	0.253	0.15
3	0.332	0.174	0.712	0.115	0.38	0.225
4	0.472	0.232	0.948	0.155	0.506	0.3
5	0.608	0.29		0.195	0.631	0.375
6	0.744	0.232		0.23	0.755	0.45
7	0.87	0.116		0.27	0.879	
8	1.002	0.058		0.31	1.004	
9	1.131			0.35		
10	1.259			0.39		
11	1.383			0.425		
12	1.509			0.465		
13	1.632			0.505		
14	1.758			0.545		
15	1.883			0.585		
16	2.003			0.625		
17				0.66		
18				0.7		
19				0.74		
20				0.775		
	Nom Interval	Nom Interval	Nom Interval	Nom Interval	Nom Interval	Nom Interval
	0.126	0.033	0.237	0.039	0.125	0.075
	Width	Width	Width	Width	Width	Width
	4.001	2.55	2.233	0.729	2.254	3.02
	Length	Length	Length	Length	Length	Length
	8.011	6.9	4.045	5.899	8.028	5.996
	nom step width					
	0.500688	0.8625	1.01125	0.29495	1.0035	1

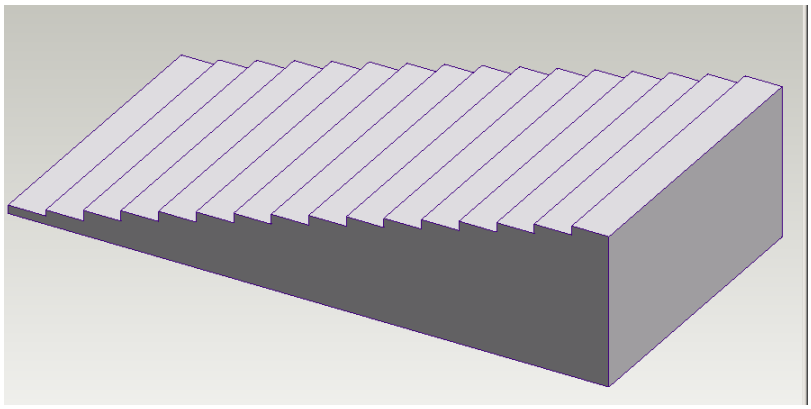


Figure 1 Isometric sketch of the Polyethylene step wedge

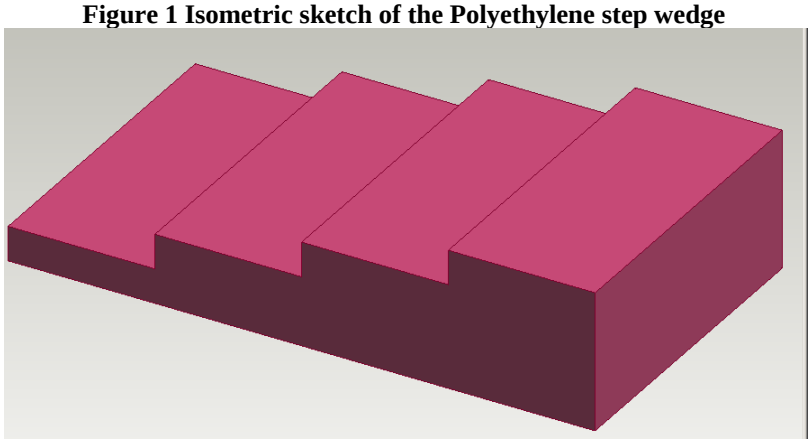


Figure 2 Isometric sketch of the Lucite step wedge

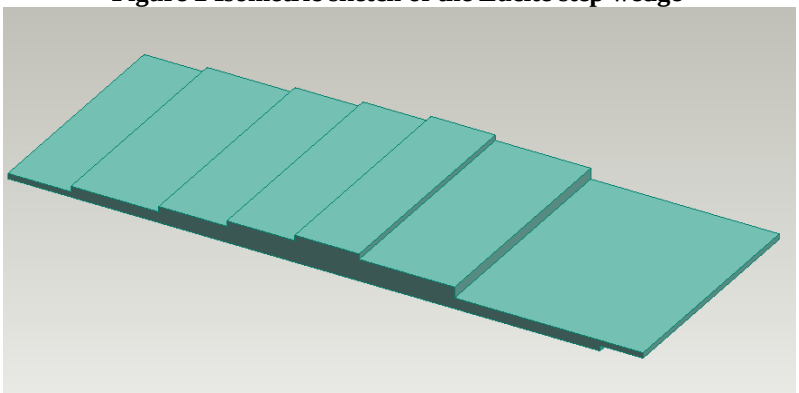


Figure 3 Isometric sketch of the Acrylic Step Wedge

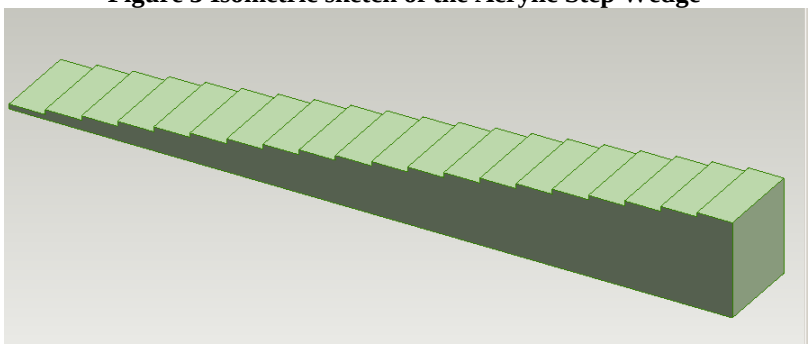


Figure 4 Isometric sketch of the Al_1 step wedge

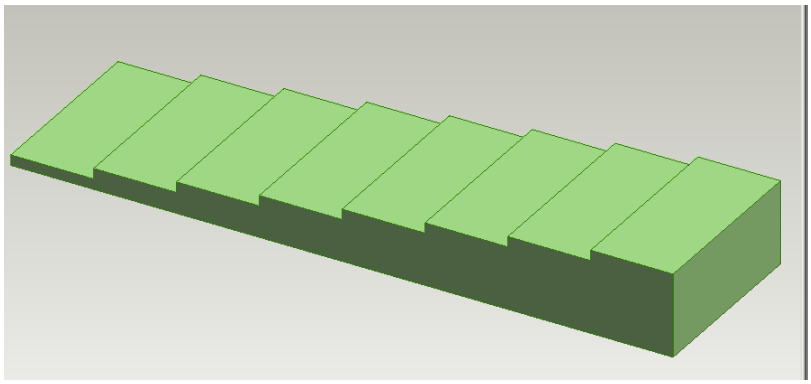


Figure 5 Isometric sketch of the Al_2 step wedge

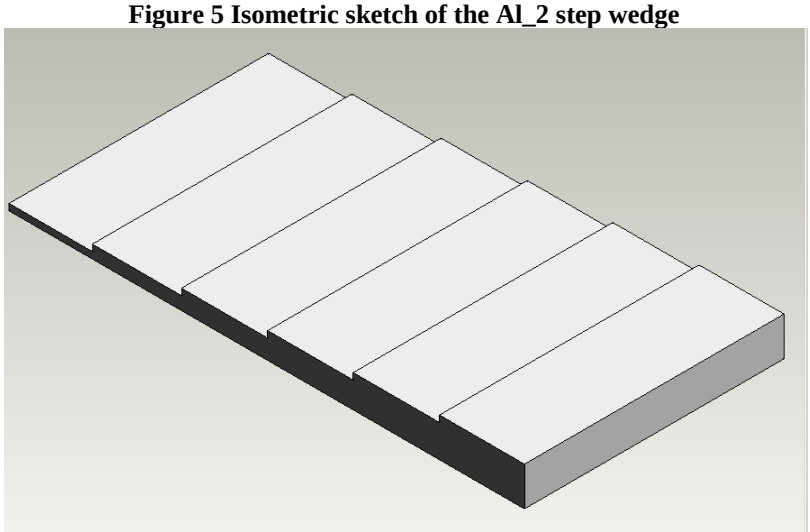


Figure 6 Isometric Sketch of the Iron step wedge

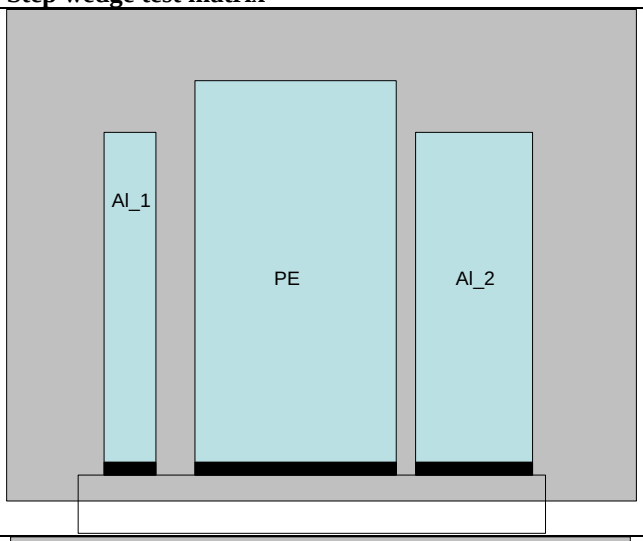
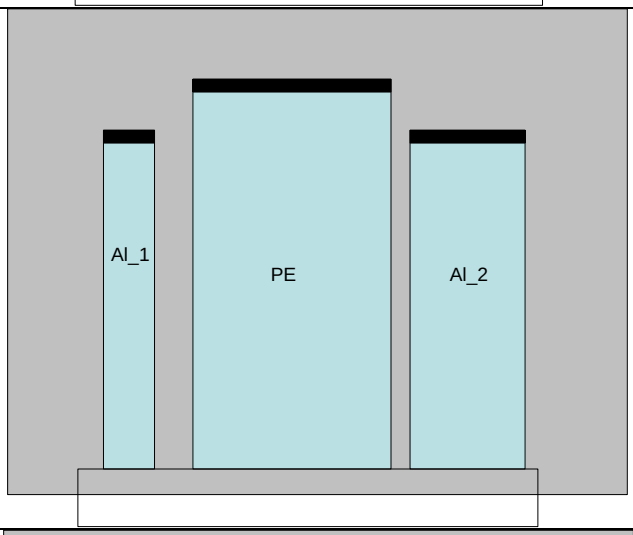
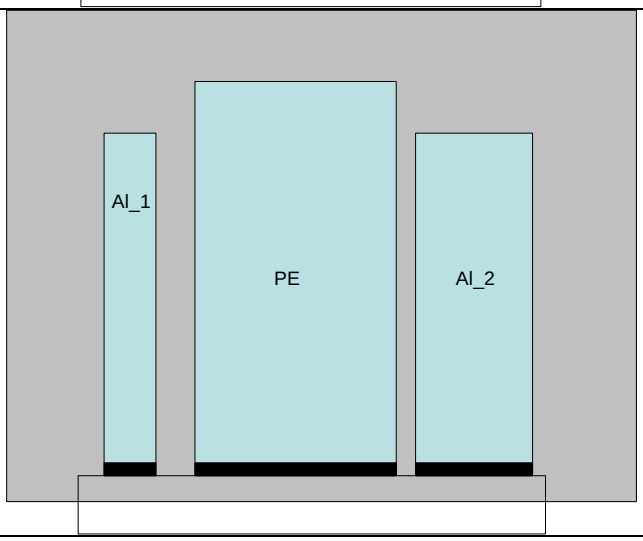
2.2 Tests to be performed with the step wedges

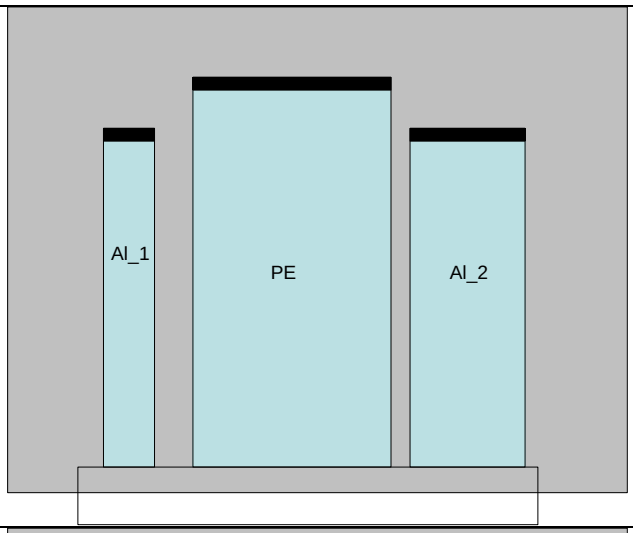
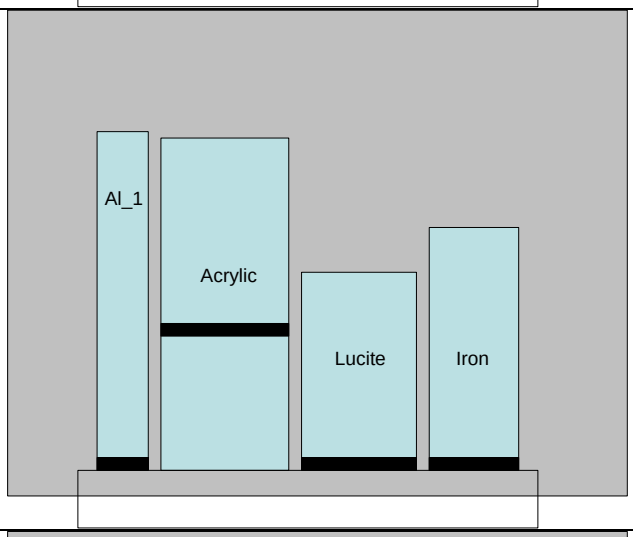
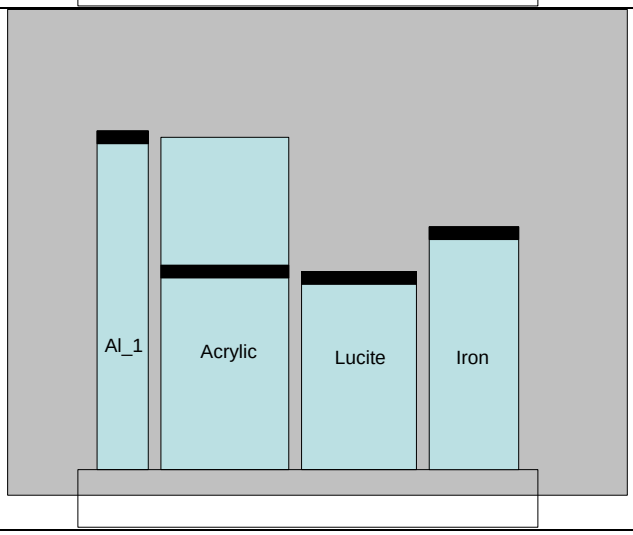
There are several effects that impact the observed and predicted measurements of the X-Ray system. Of these effects, we seek to explore positional dependence of the measurements, and also spectral dependencies. The size of the imaged object will also effect the measurements as scattering from external objects or scattering within the detector may be observed.

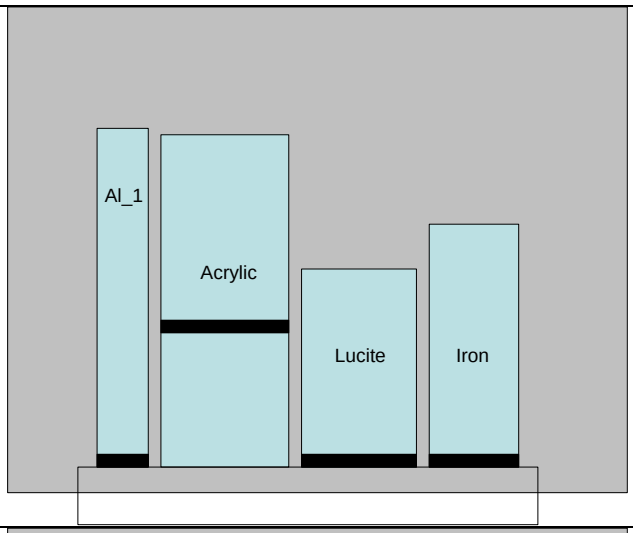
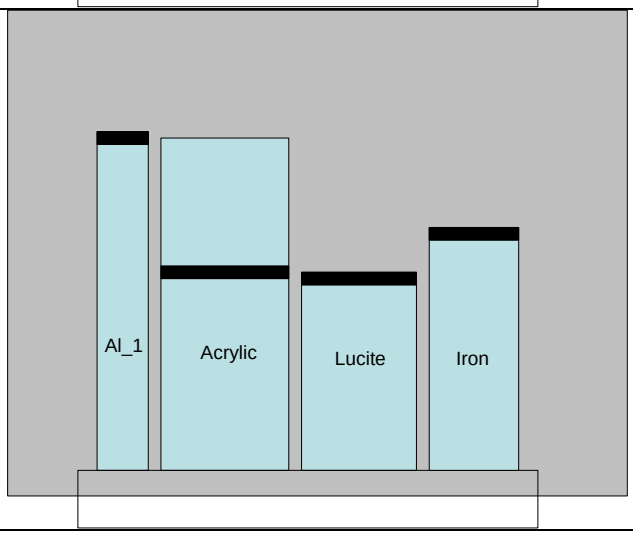
The source is not collimated in our observation system, resulting in the potential for scattering to be observed.

The test matrix will be as follows, with the transparent box representing a piece of 0.5lb/ft^3 expanded polystyrene to hold the wedges in place. The black bars represent the thickest part of the step wedge. The grey box represents the detector panel. The view is the view from the source towards the panel. Measurement will be collected with the Kevex microfocus source biased at each of two settings: 100kV and 130kV.

Table 2 Step wedge test matrix

Test Name: Wedge1a_130kv Energy Level: 130kV Filter: None	
Test Name: Wedge1b_130kv Energy Level: 130kV Filter: None	
Test Name: Wedge1a_100kv Energy Level: 100kV Filter: None	

Test Name: Wedge1b_100kv Energy Level: 100kV Filter: None	
Test Name: Wedge2a_130kv Energy Level: 130kV Filter: None	
Test Name: Wedge2b_130kv Energy Level: 130kV Filter: None	

Test Name: Wedge2a_100kv Energy Level: 100kV Filter: None	
Test Name: Wedge2b_100kv Energy Level: 100kV Filter: None