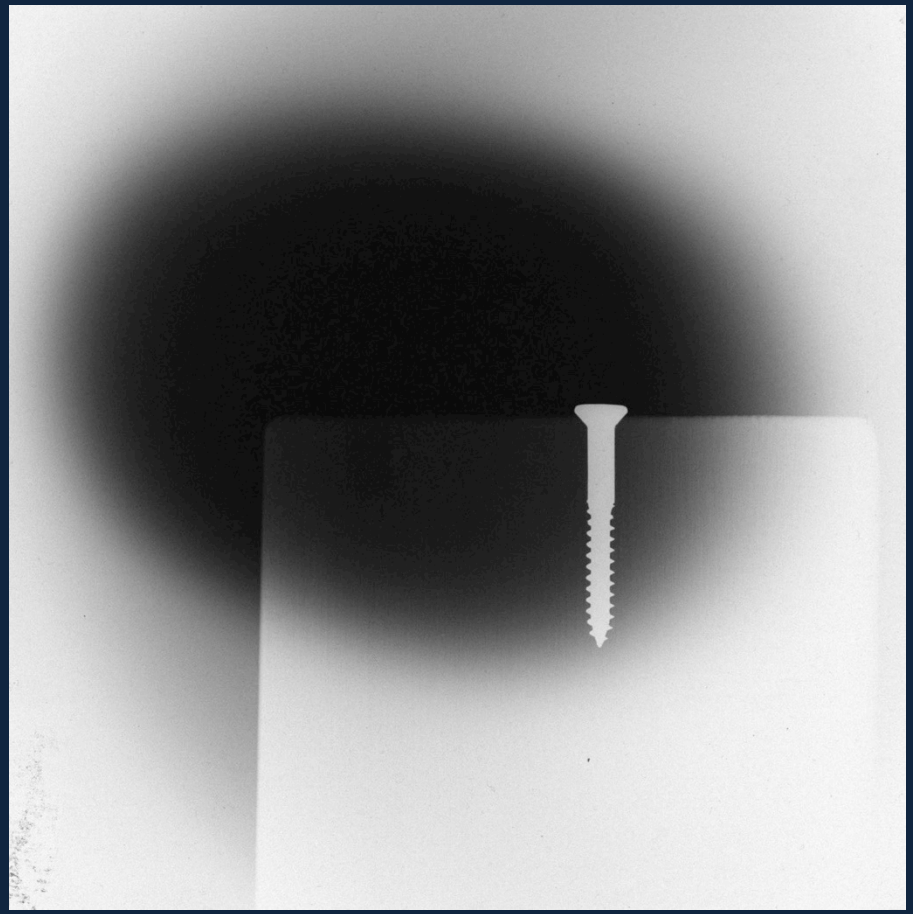
Using Portable XRF Analyzers for X-ray Radiography

Ashley Jehle - Yale University Art Gallery
Renée Stein - Carlos Museum, Emory University
Maureen Graves - Grady Memorial Hospital
John Malko - Emory University

AIC-CAC Annual Meeting, Montreal
May 16, 2016

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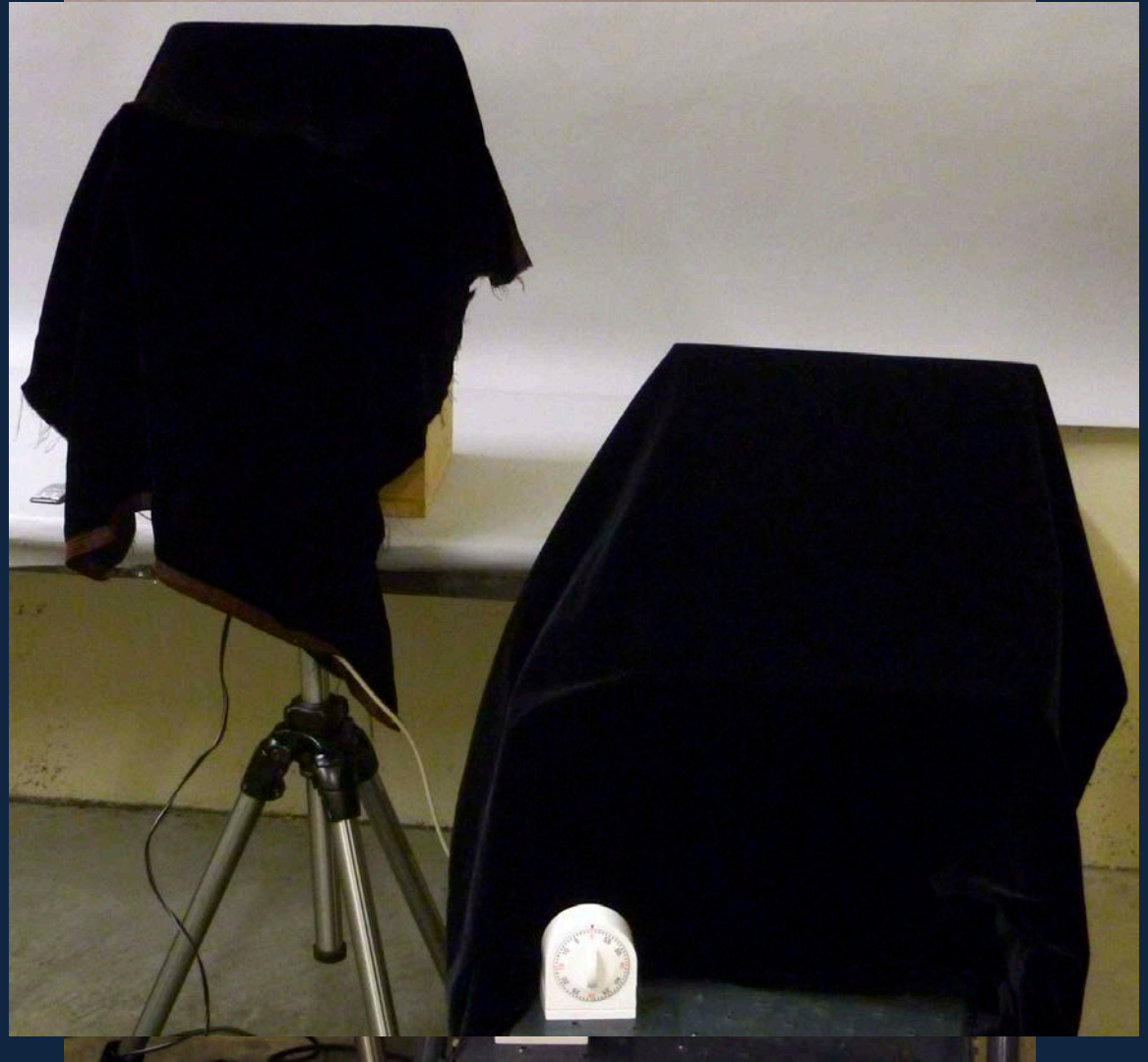
Equipment:

- Handheld XRF
- Tripod
- Computer
- Film
- Film developing chemicals
- Intensifying screen (optional)



Bruker AXS Handheld Inc. Tube Settings / Monitor

Version:1.2.21

Comm Port # 6 | High Speed Comms | Times 2 | Extended Actuals | Open XRay Comm Port | HandShake | Load from file | Save settings

High Voltage Settings	Filament Current Settings	High Voltage ADC Presets		Anode Current ADC Presets		Anode Current Scaler	Pulse Length	Filter
105	233	15	kV	28	µA		200	2
233	229	45	kV	30	µA		200	1
254	234	45	kV	37	µA		200	3
221	236	40	kV	40	µA		200	4
103	230	15	kV	25	µA		200	2
169	215	40	kV	12.2	µA		200	1
169	215	40	kV	12.2	µA		200	1

Skip reread | PC Trigger

Pulse Length 200 | Auto Mode | Pulse Period 254 | Tube Enabled

Re-Read Settings | Update Settings | Start | Update Actuals | Monitoring Actuals

Log Data to File: | Start Logging

Script File: | Start Script

Firmware to Upload: | Upload Firmware

Bytes Sent:

Reset Settings DB

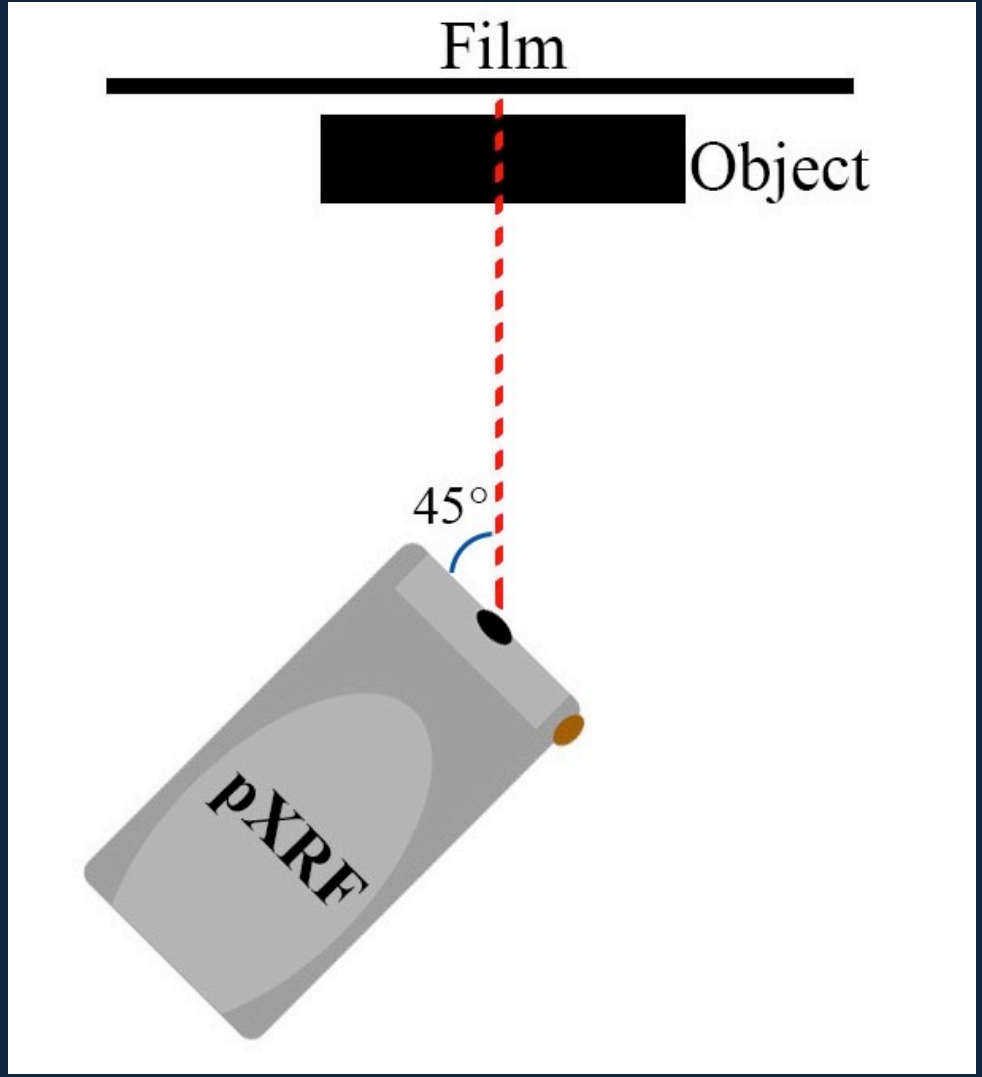
ADC/DAC Version: 8. 77.z | Filter Error: 10

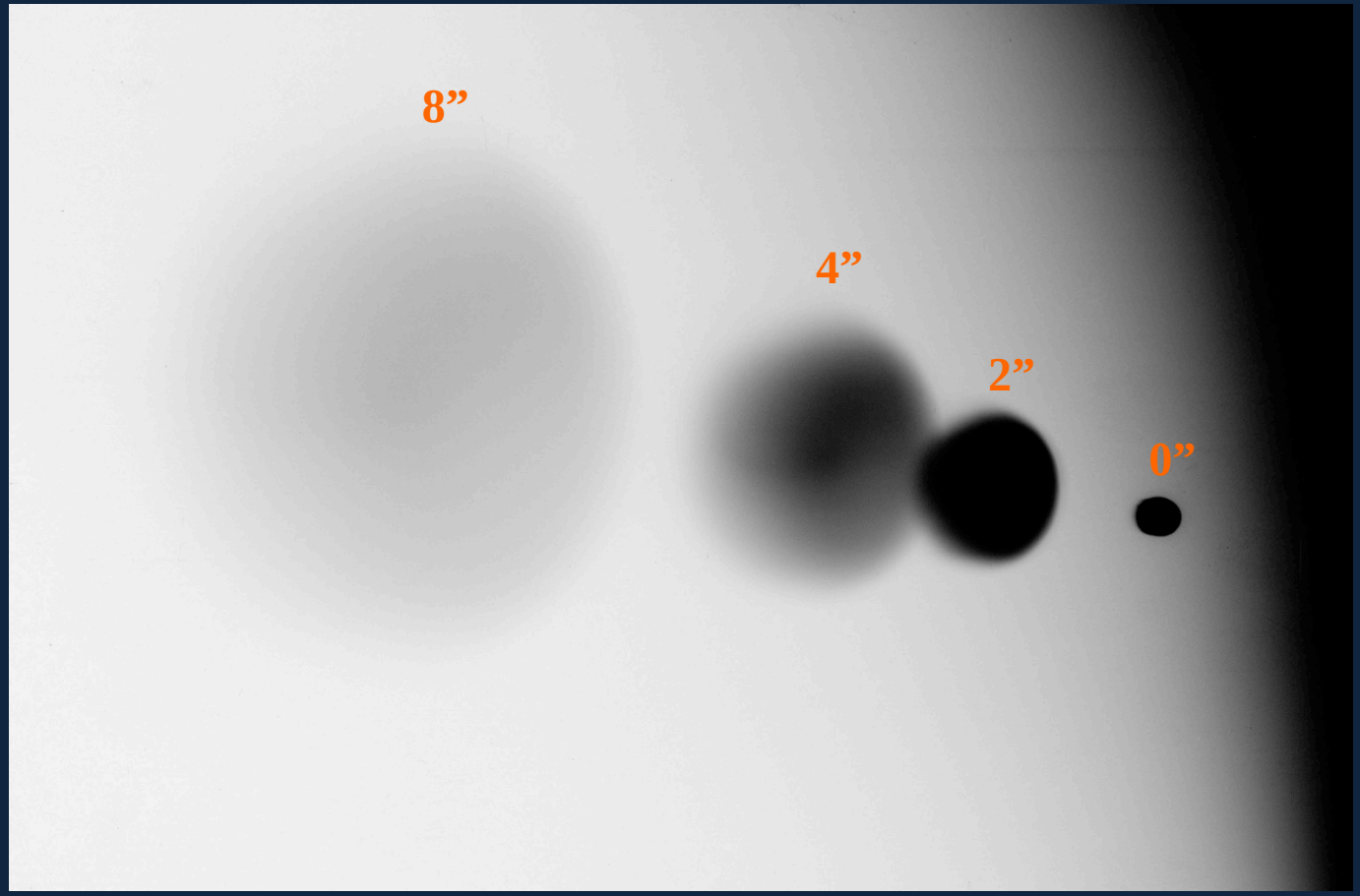
Actual HV (kV)	40.15
Actual HVG DAC	191
HVG Current (mA)	296
Anode Current (µA)	24.90
Actual FG DAC	227
FG Current (mA)	144
Anode diode	8
Cathode diode	4095
Input Voltage	14.5
Input Current	207
Pulse Length	200
Temp.	27.9
Filter	7
Flux	2
IR LED	3755
Vacuum	759

4/14/2016 4:27:52 PM

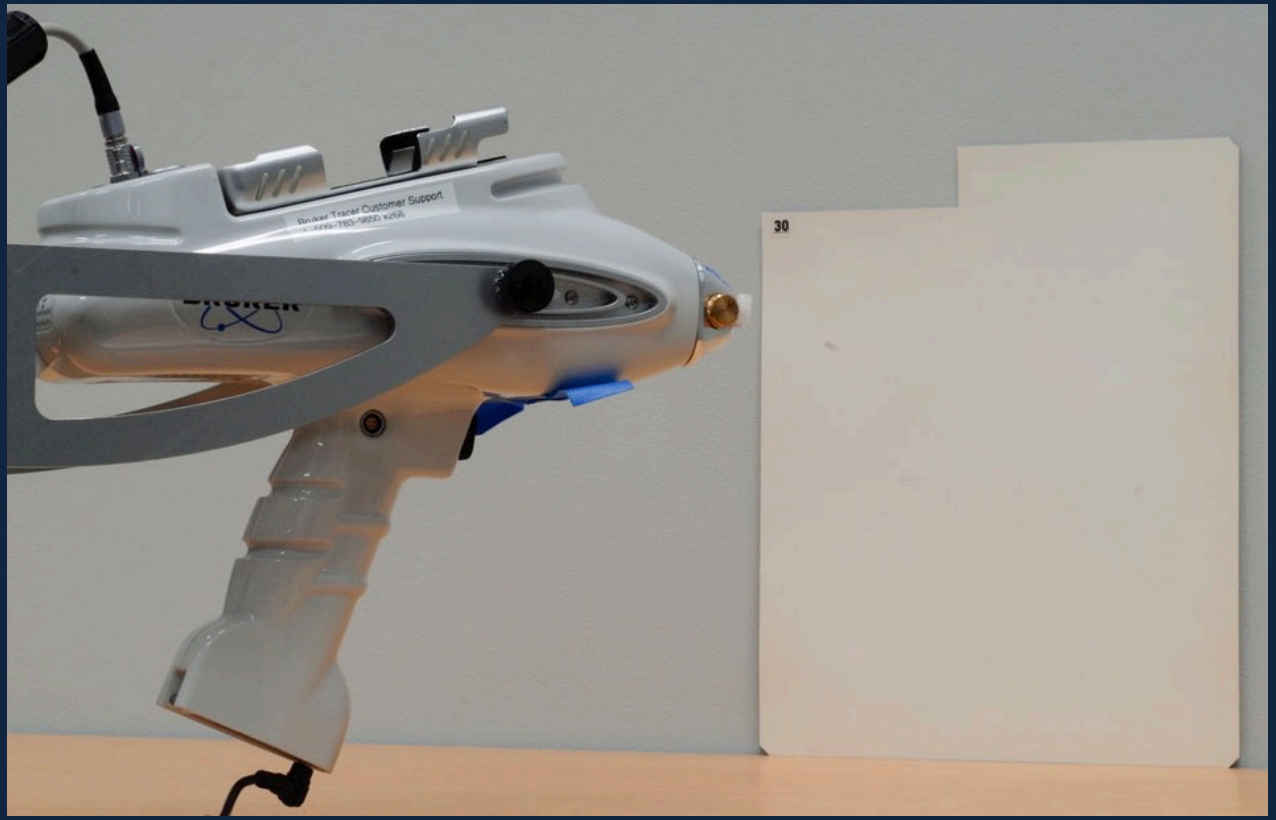
1966

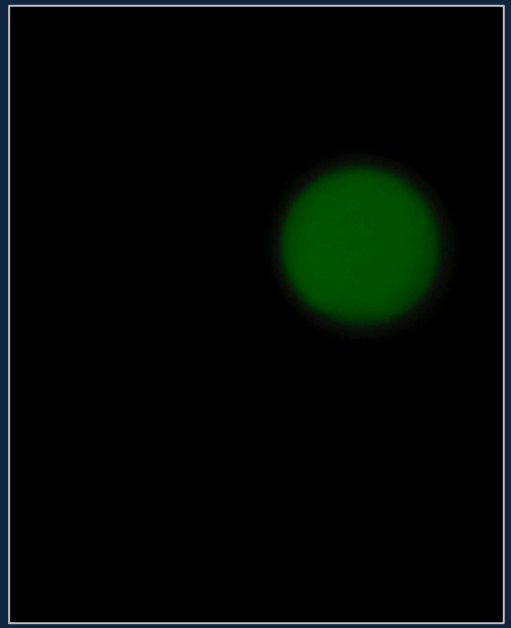
1000


Film
Object
45°
pXRF



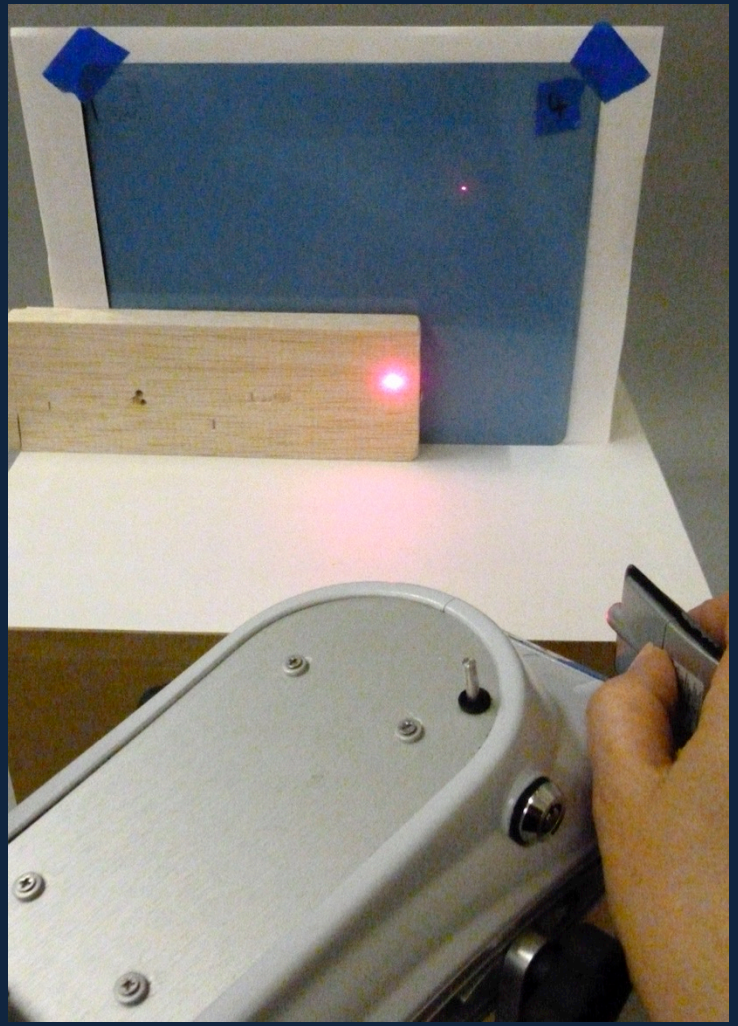
Scanned X-ray radiograph;
15 kV, 45 μA, 0, 2, 4, and 8” distances, 3 min. each



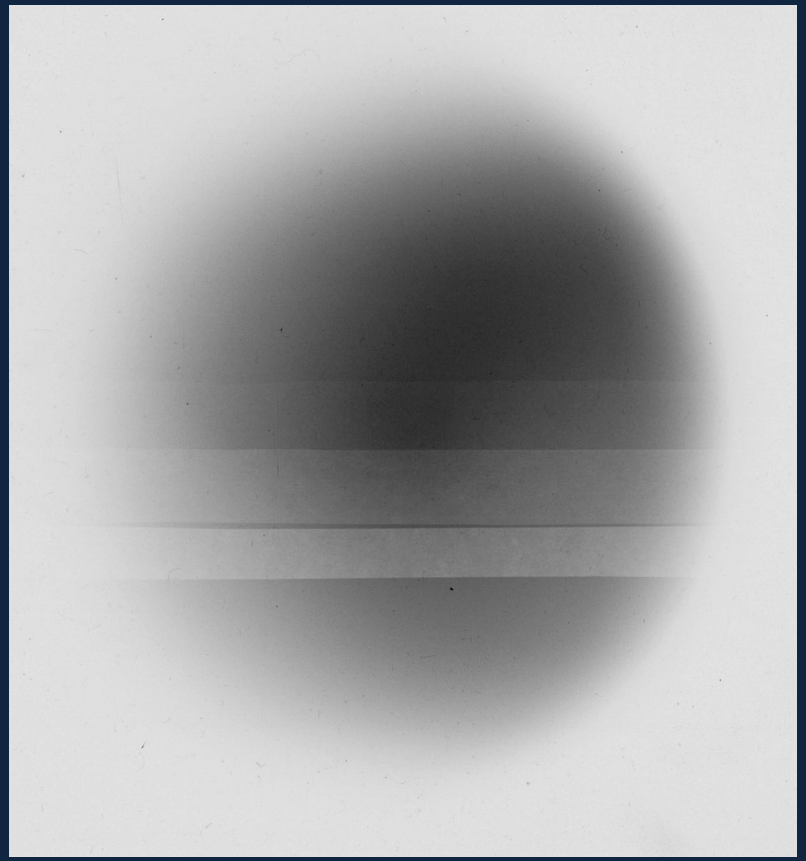


Intensifying screen exposed to X-ray beam in dark

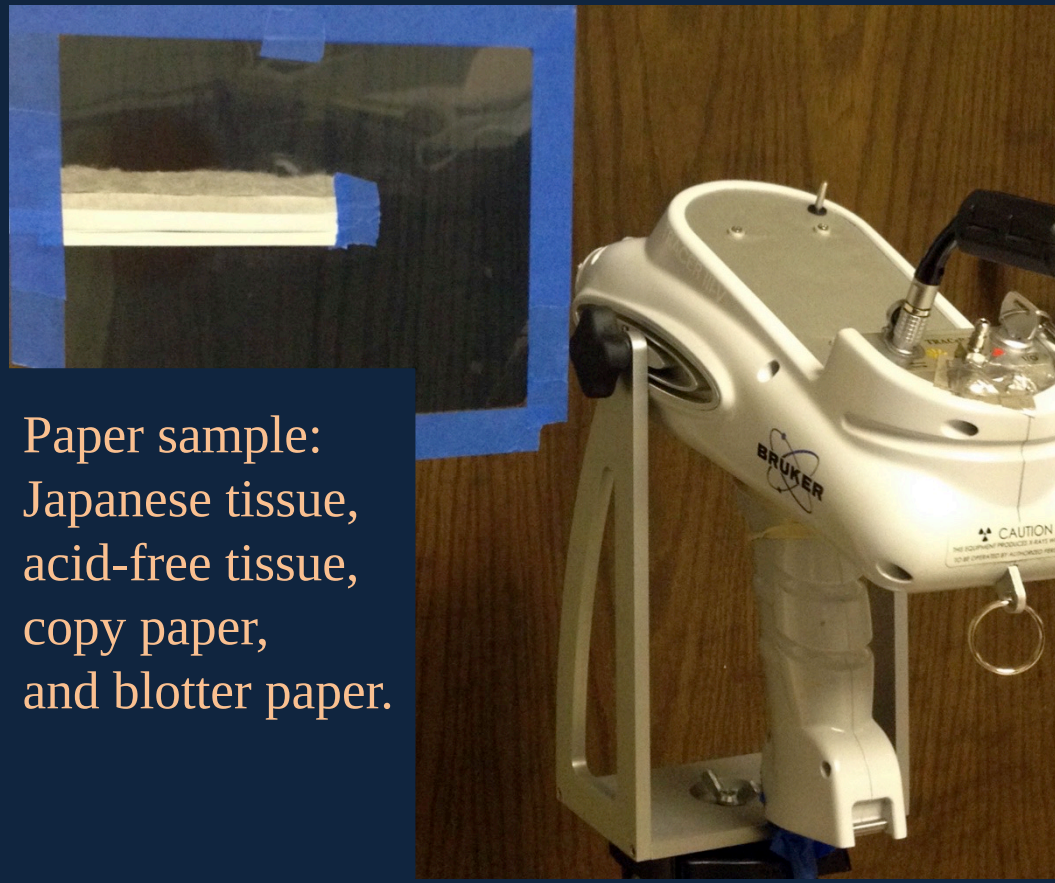
String



Laser Pointer

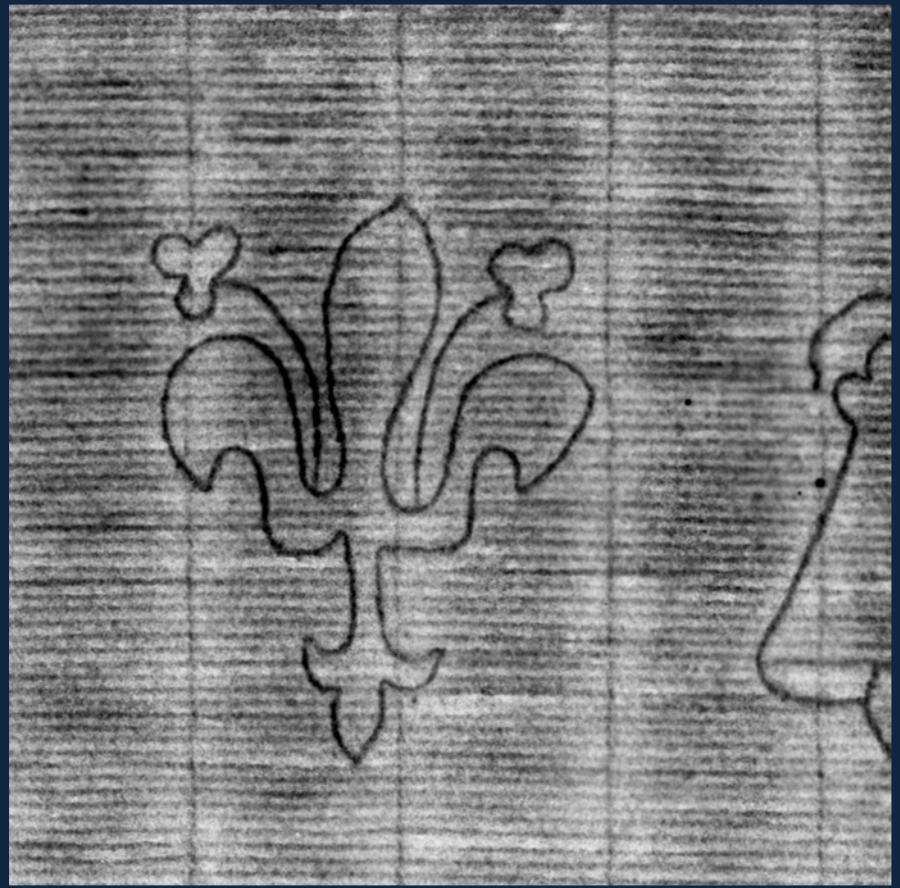


Scanned X-ray radiograph;
15 kV, 45 µA, 8” distance, 6 min.



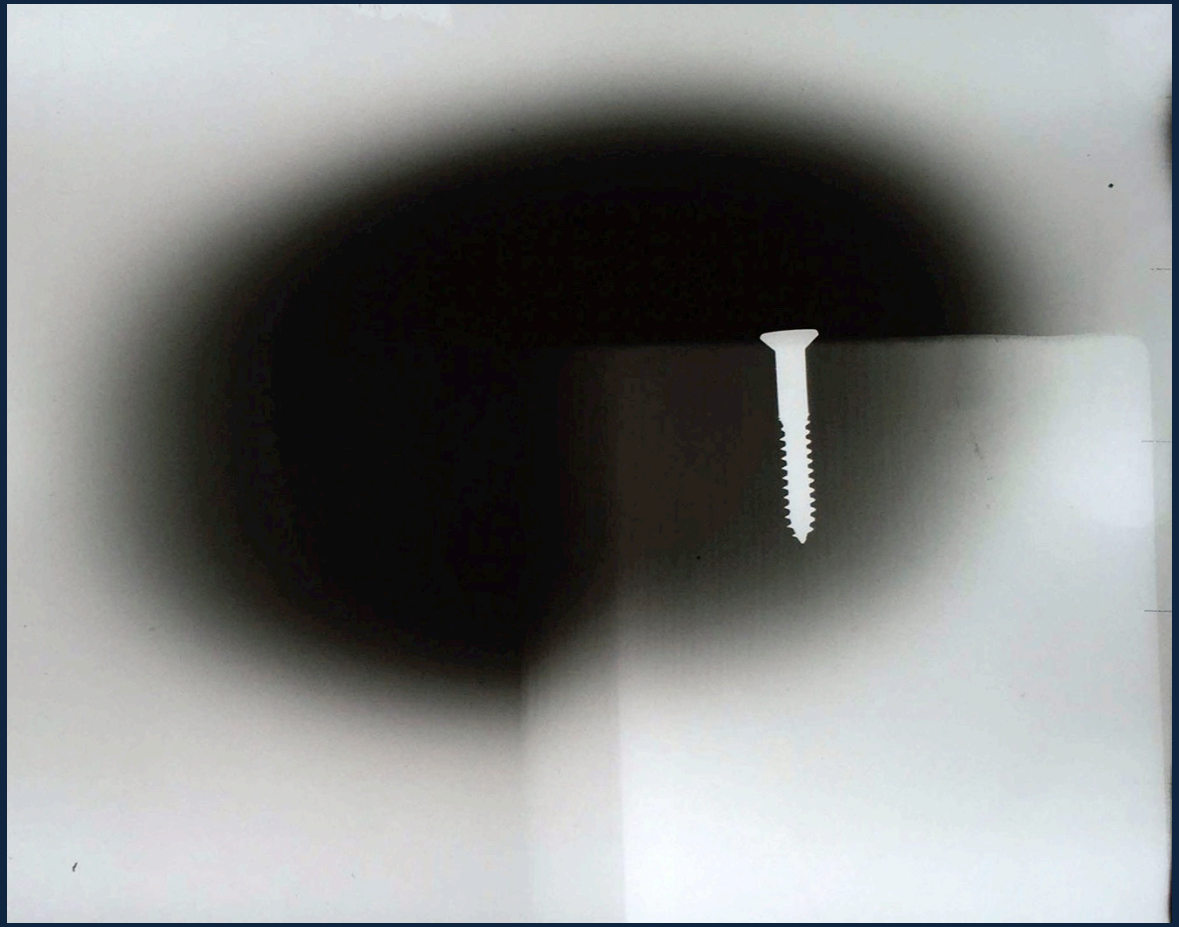
Paper sample:
Japanese tissue,
acid-free tissue,
copy paper,
and blotter paper.

Scanned X-ray radiograph;
15 kV, 45 μA, 15”, 30 min. exposure

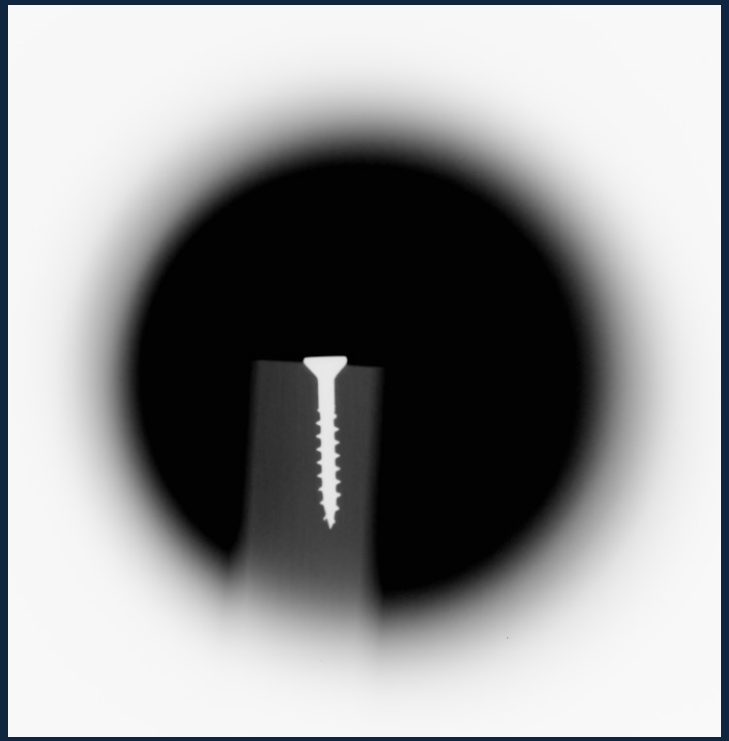


Scanned beta-radiograph;
1.75 hr. exposure

Metal screw in ¾” balsa wood plank

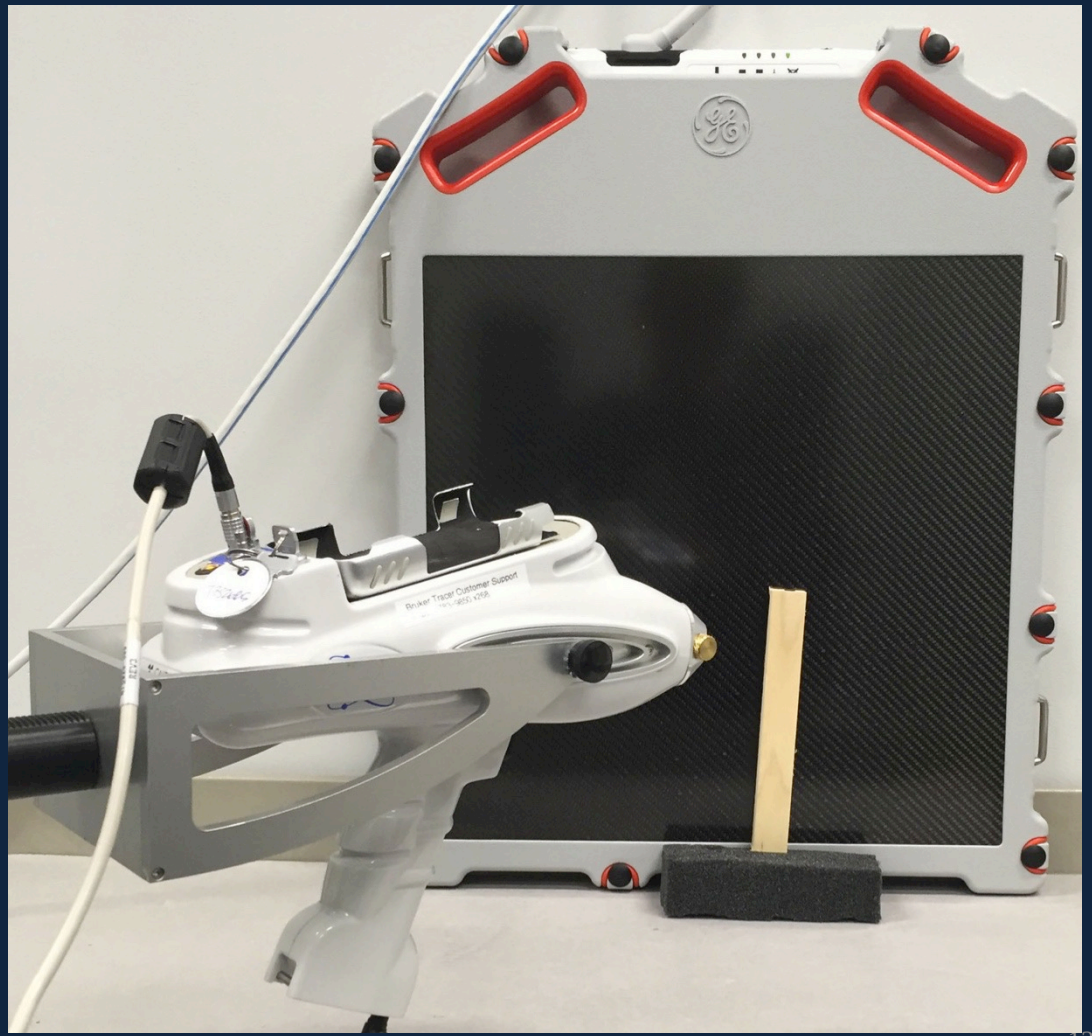


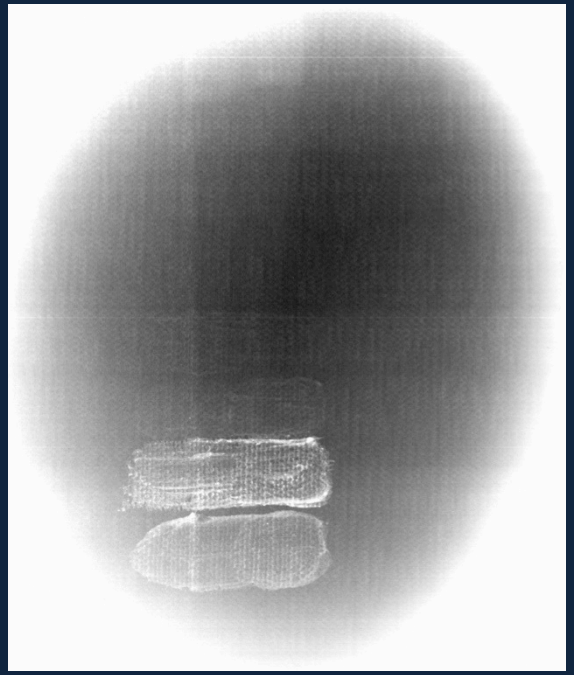
Scanned X-ray radiograph; 25 kV, 43 µA, 15”, 20 min.



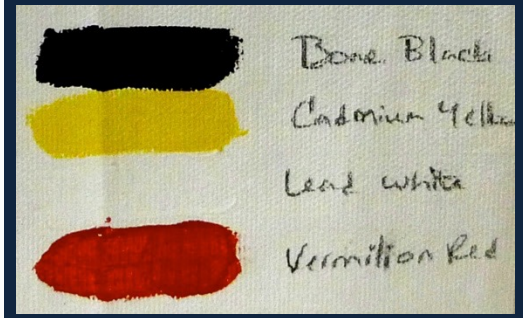
Digital X-ray radiograph;
40 kV, 37 μA, 16”, 1 min.

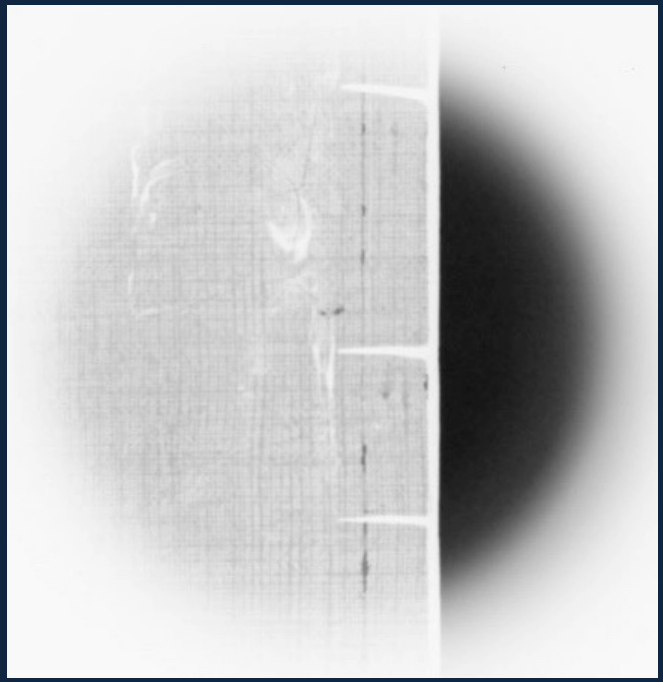
Metal screw in ¾” poplar wood



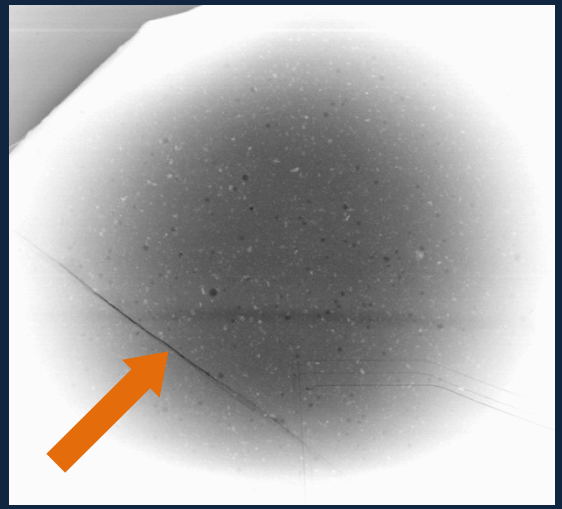


Painting sample
Scanned X-ray radiograph;
25 kV, 40 μA, 14”, 20 min.

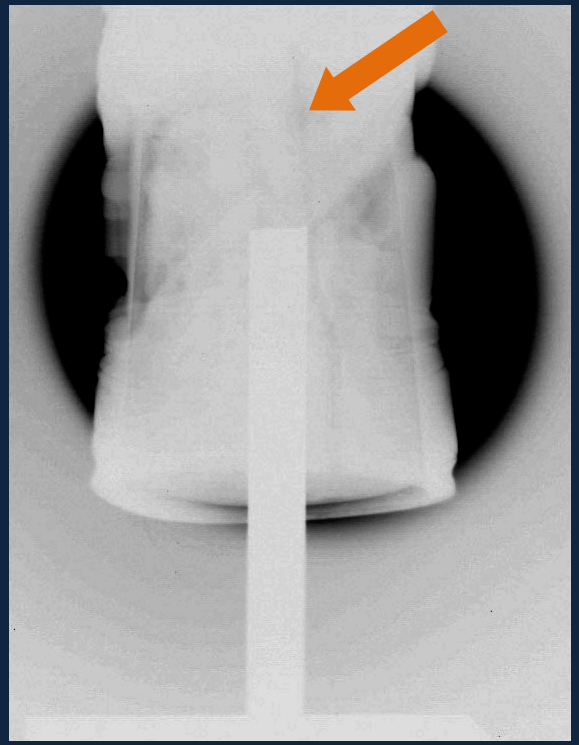




Painting edge
Digital X-ray radiograph;
30 kV, 40 μA, 12”, 1 min.



Cracked ceramic
Scanned X-ray radiograph;
40 kV, 30 μA, 14”, 30 min.



Ivory tusk with mount
Digital X-ray radiograph;
45 kV, 37 μA, 13”, 2.5 min.

Limestone with mount
Scanned X-ray radiograph;
40 kV, 30 μA, 13”, 30 min.

Dose Estimates

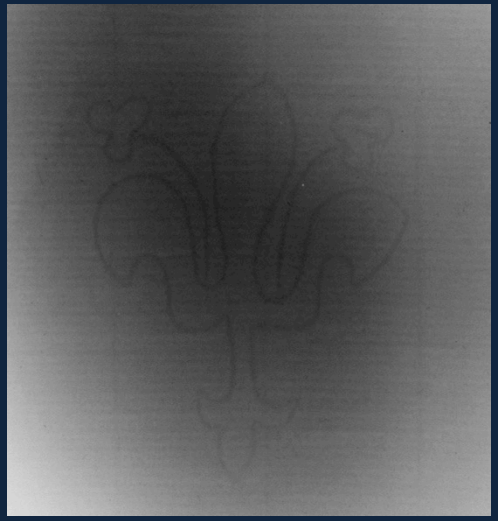
1) GMC calibrated Geiger counter: dose rate = 0.13 mrem / hr

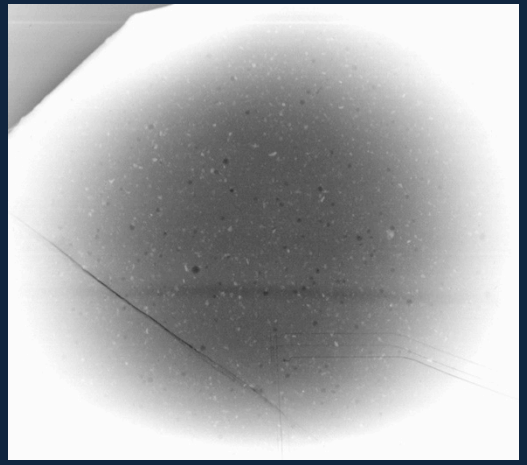
2) *Luxel*+ dosimetry badge: 1 hr exposure = "M" minimal dose (less than 1 mrem)

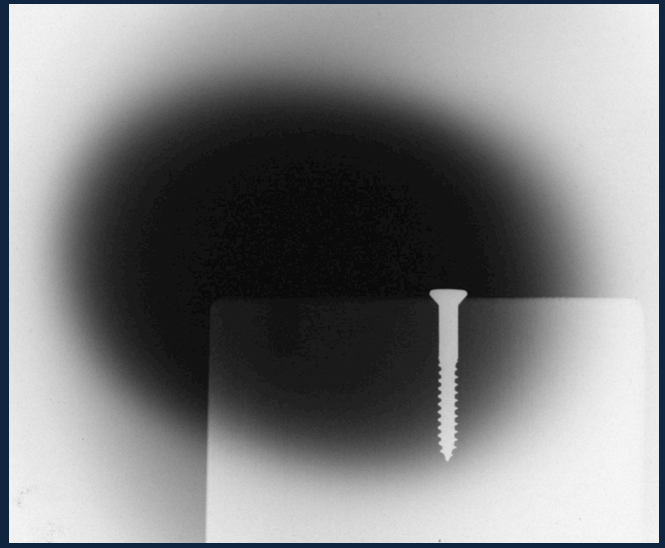
General population limits = 2 mrem / hr and 100 mrem per year

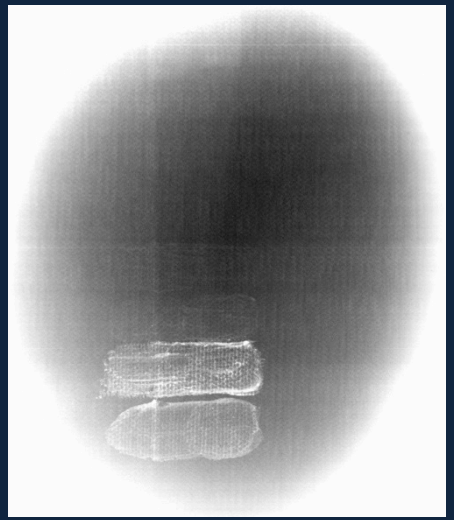
At 0.13 mrem / hr, the operator would need 770 hours of continuous of exposure to exceed limit.

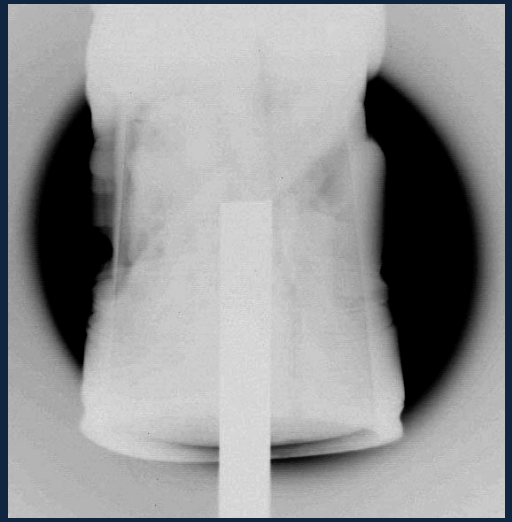
Note that 1 mrem = 3 days of living in Atlanta or 1 coast-to-coast airline flight.









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Acknowledgments

- Dawn Moore, Department of Radiology and Imaging Sciences, Emory University School of Medicine
- Carlos Museum, Emory University
- Andrew W. Mellon Foundation
- Grady Memorial Hospital
- Dr. Anikó Bezur, Technical Studies Lab, Yale University Institute for the Preservation of Cultural Heritage
- Carol Snow & Ian McClure, Conservation Department, Yale University Art Gallery
- Eric Stegmaier, Yale Center for British Art