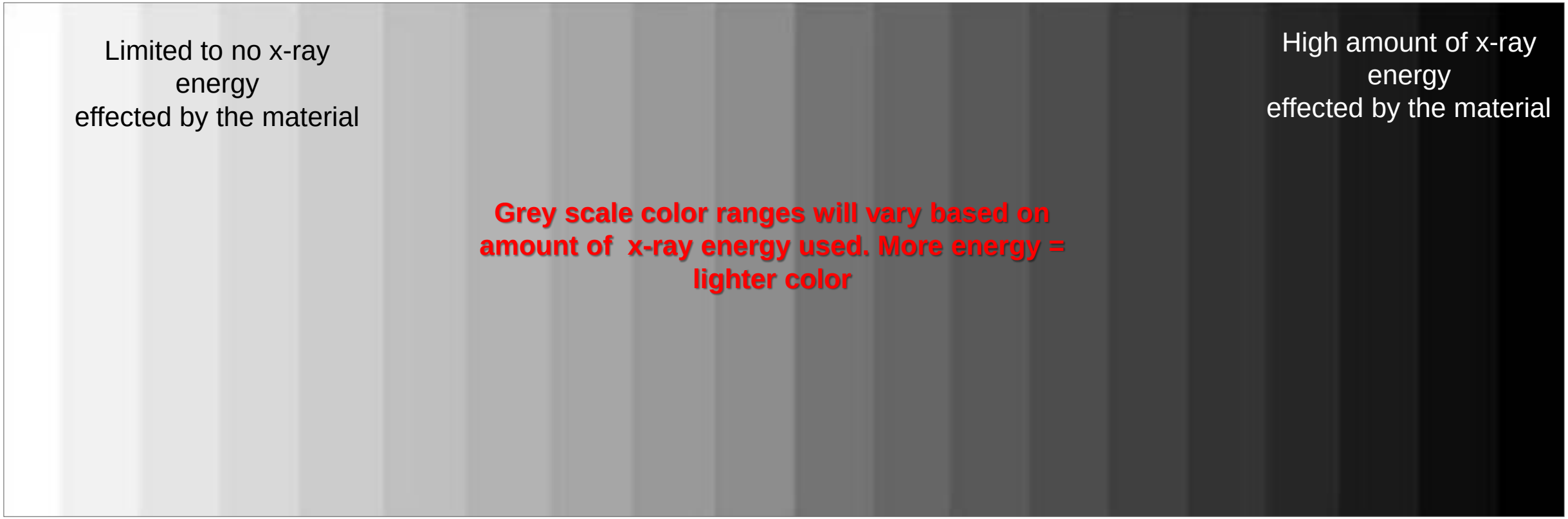
VC security

by VisiConsult

EOD Portable X-ray Enhancements using Dual Energy Imaging

What are we using now?

Grey Scale Imaging

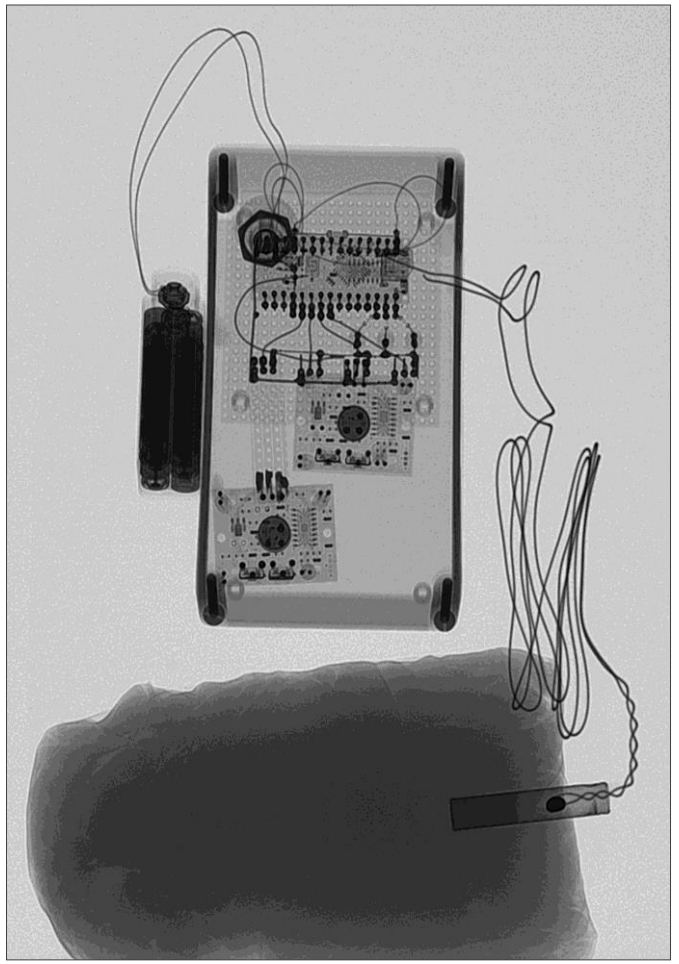


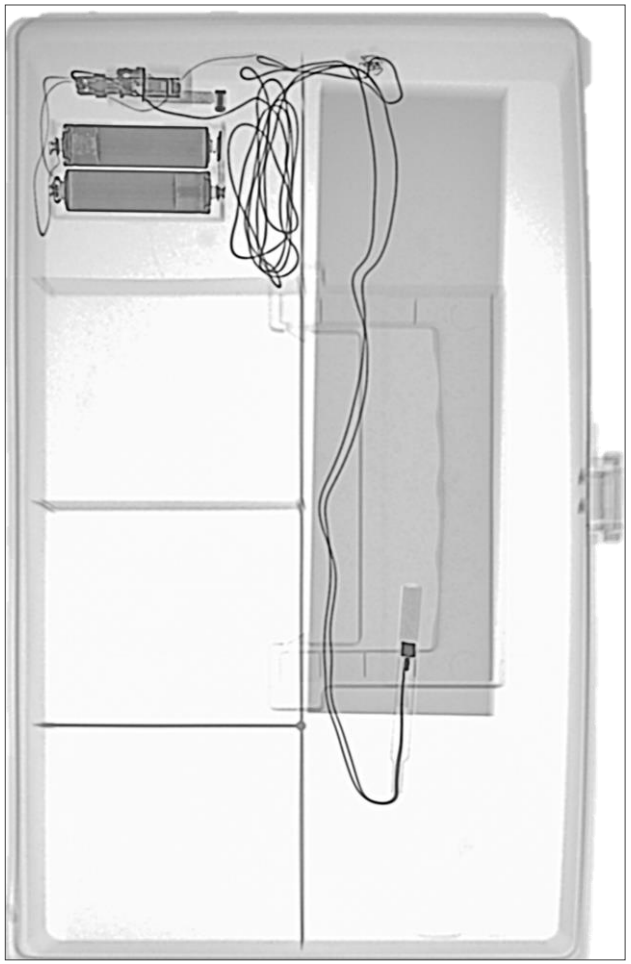
Lower density or lower thickness of the material

Higher density or higher thickness of the material

Grey Scale Imaging

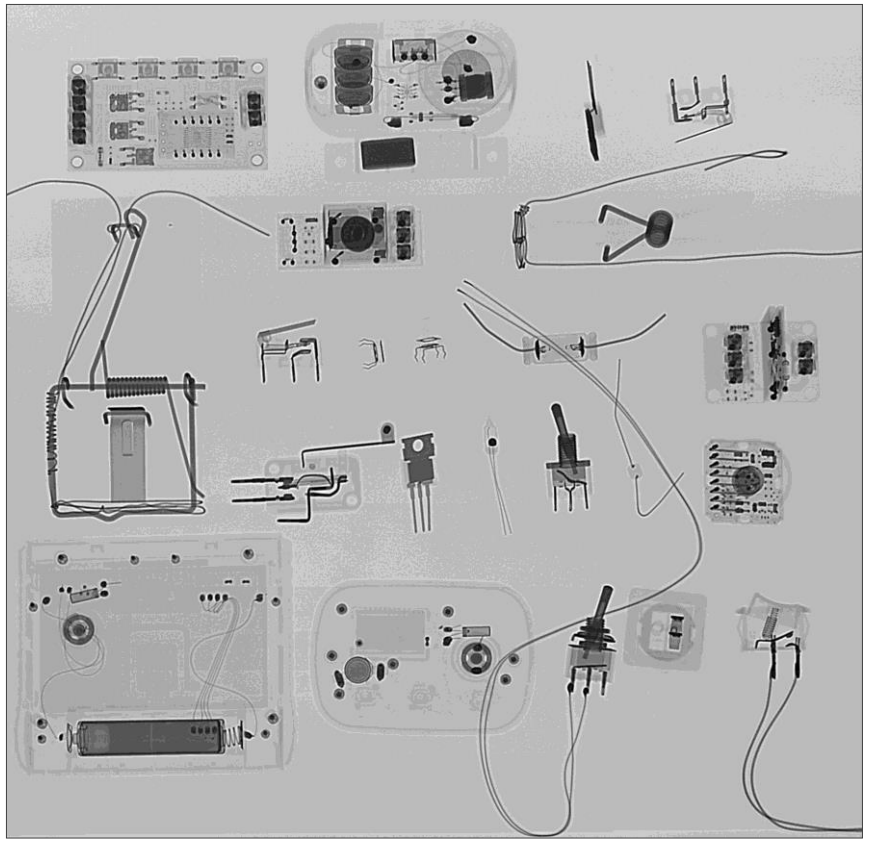
- Standard EOD method of viewing images
- Provides visual *SHAPE* recognition capability
- Single energy x-ray measurement
- Darker the item the more dense the item

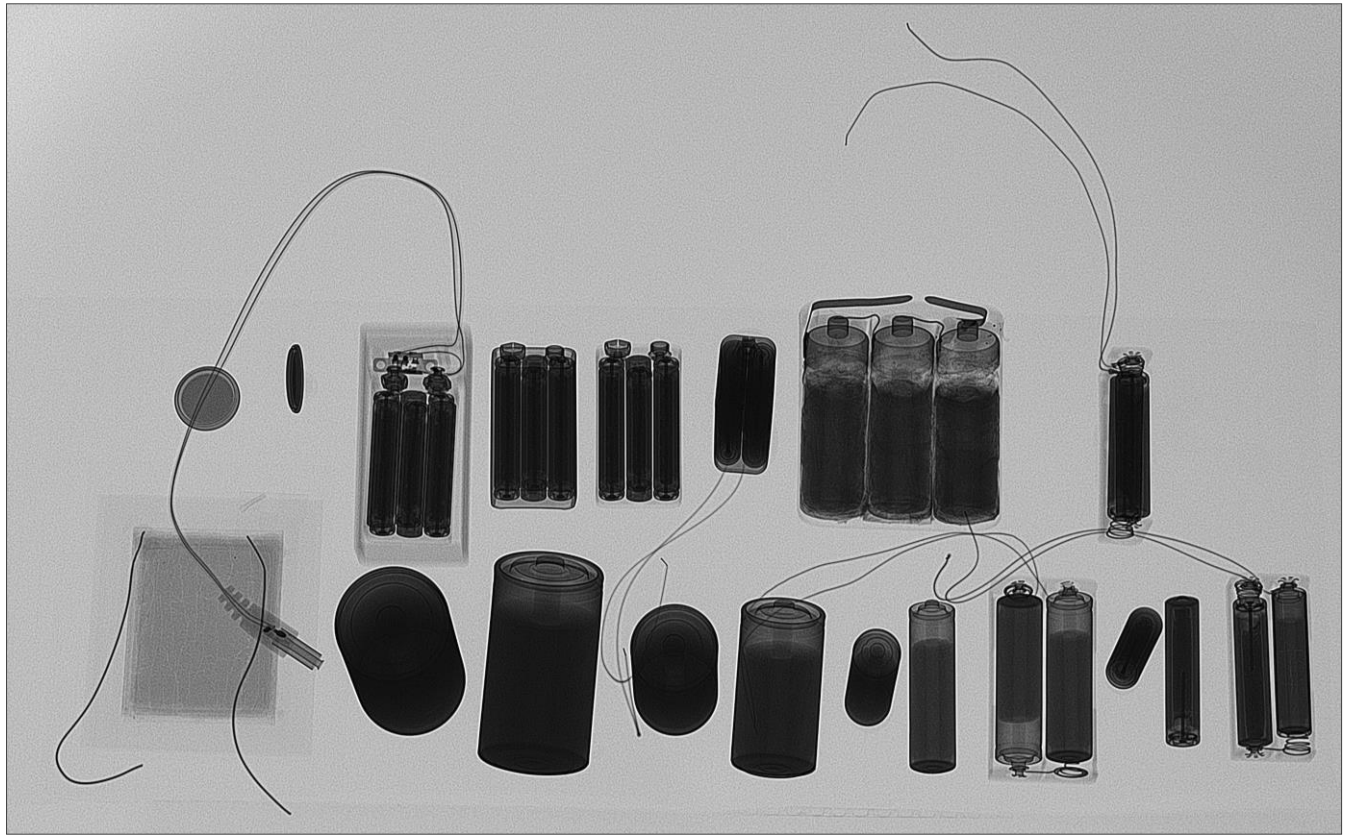




Grey Scale Imaging

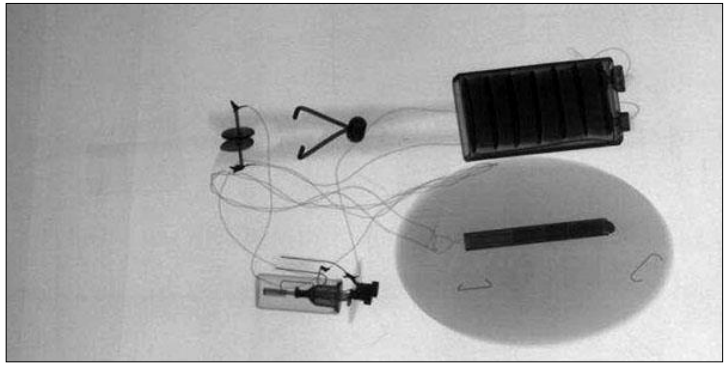
The ONLY information that grey scale imaging provides to the bomb technician is the ability to identify shapes

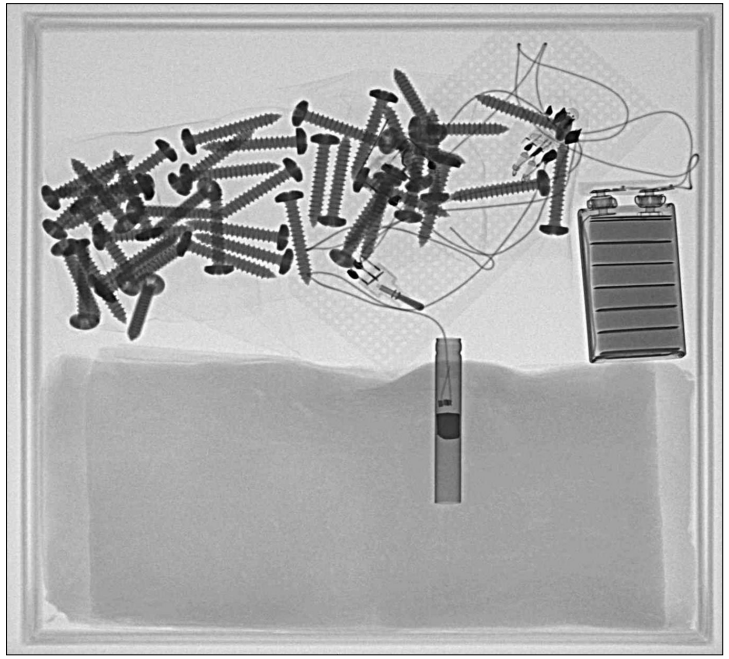


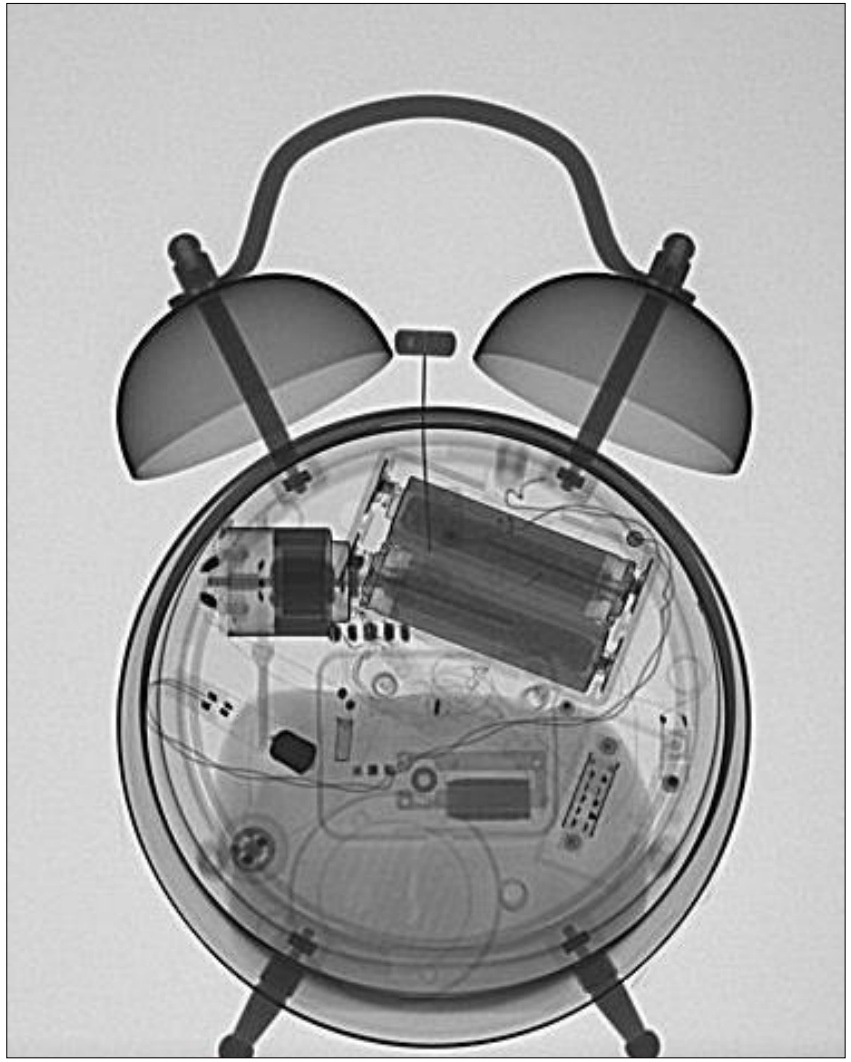


What are the drawbacks of single energy imaging for EOD?

Drawbacks (Inaccurate Examples)

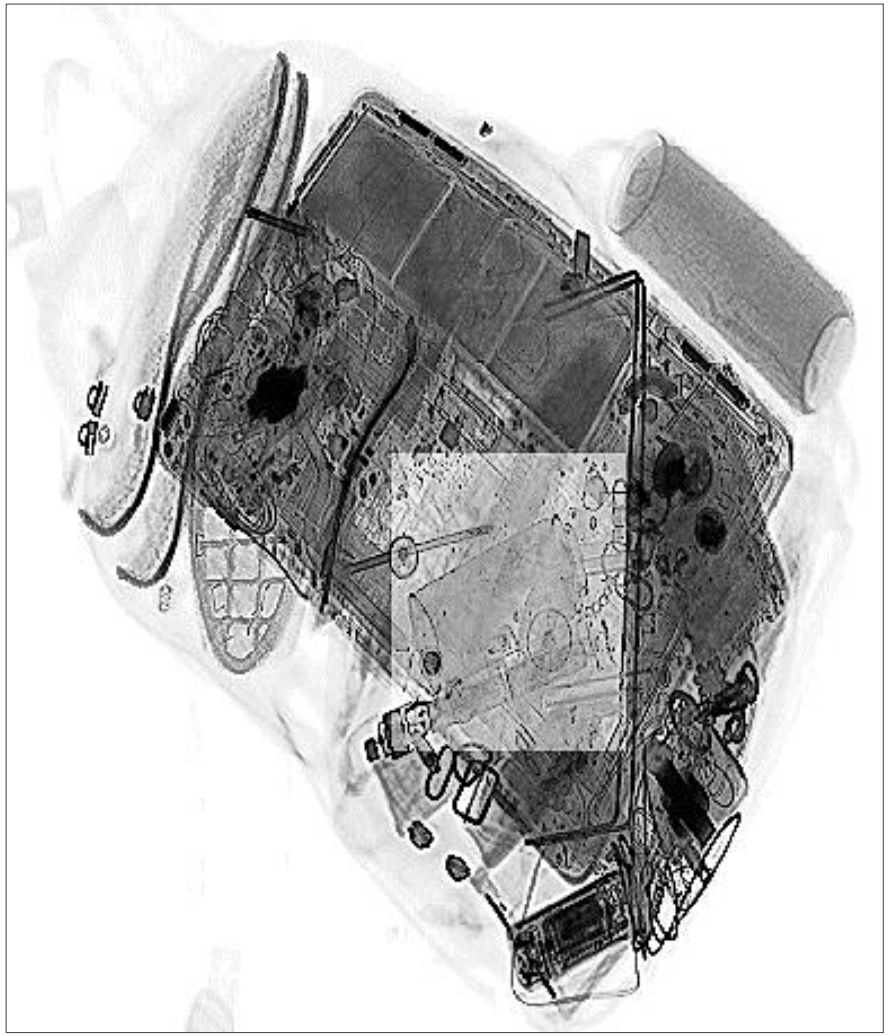






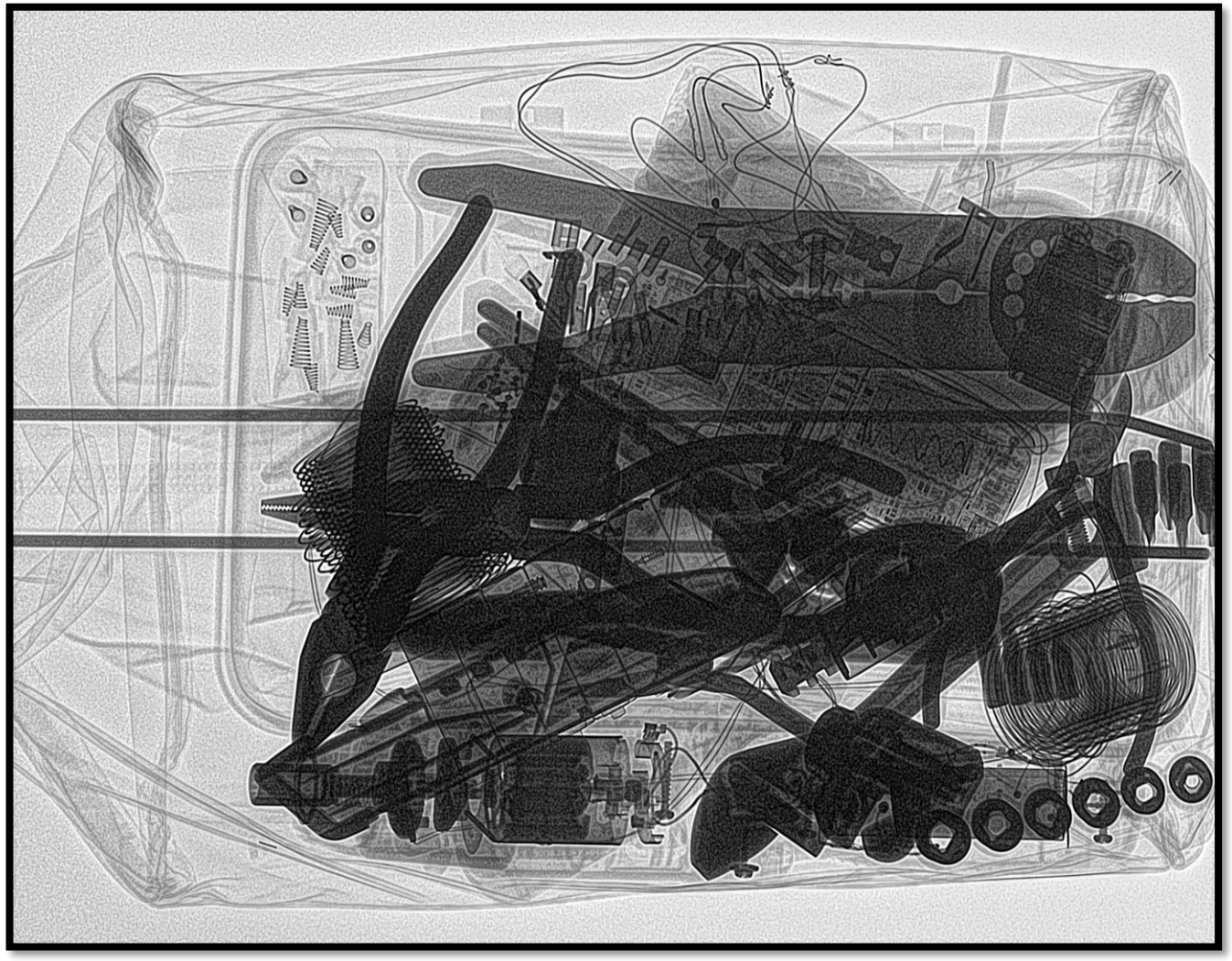
Hypothetical Scenario: Airport security screening bags at a checkpoint think they have found a bomb. Who do they call?

Real x-ray interpretation problem

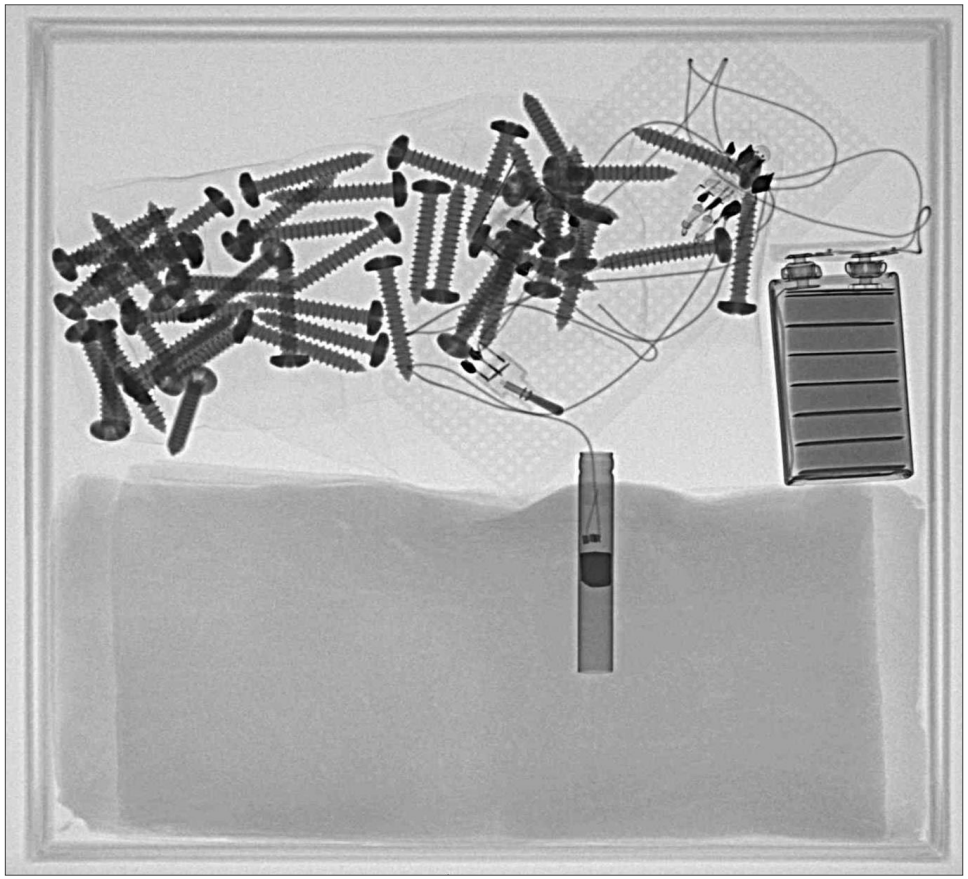


Can you solve this problem?

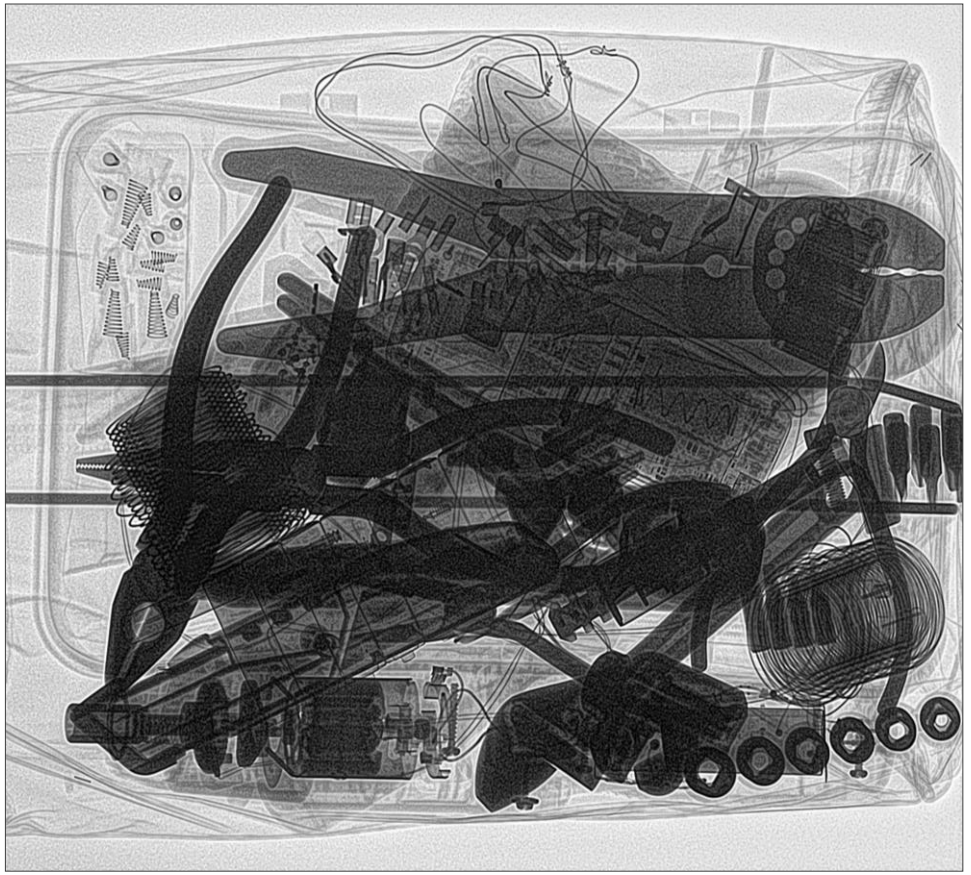
- Where is the IED?
- Where is each IED component?
- How would I render this safe?
- Where is the explosive and detonator?



Can you solve this problem?



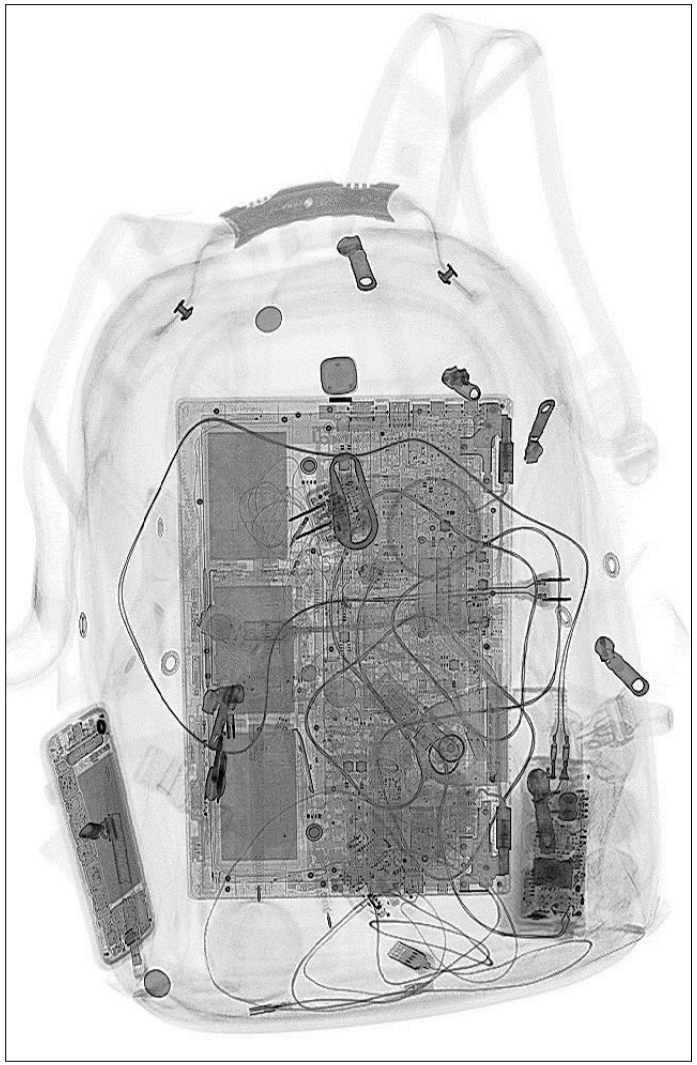
Grey Scale works great



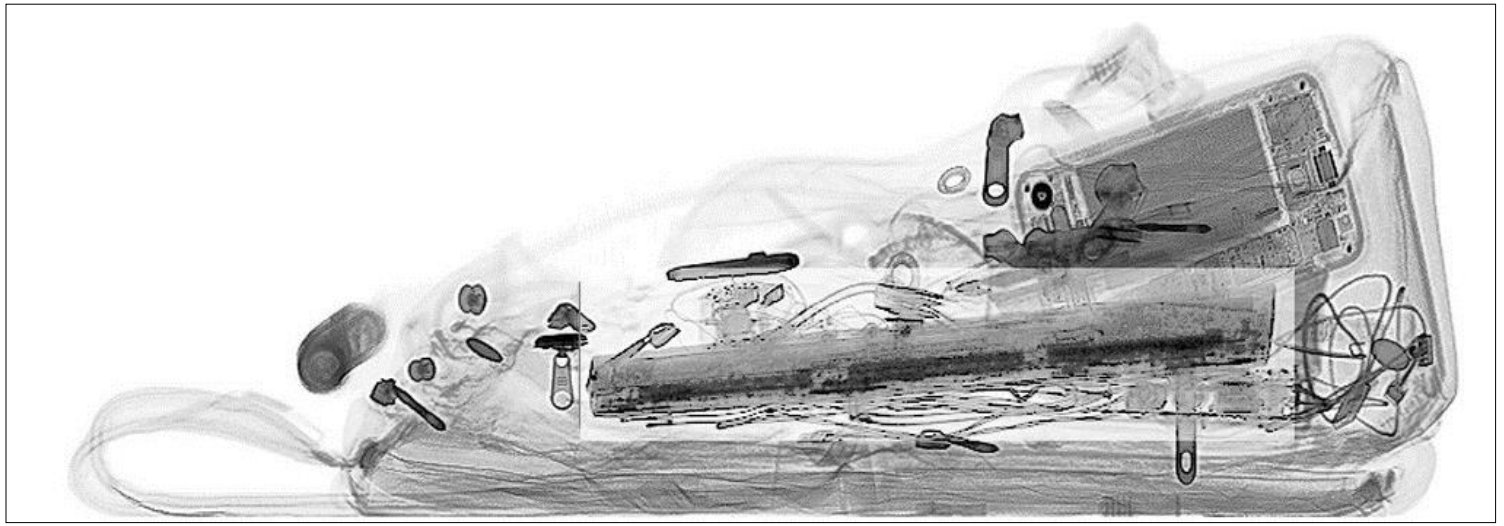
Grey Scale not so great

So why is EOD still just using single energy imaging?

Why are airports not using grey scale?



Do they know something that EOD does not know?



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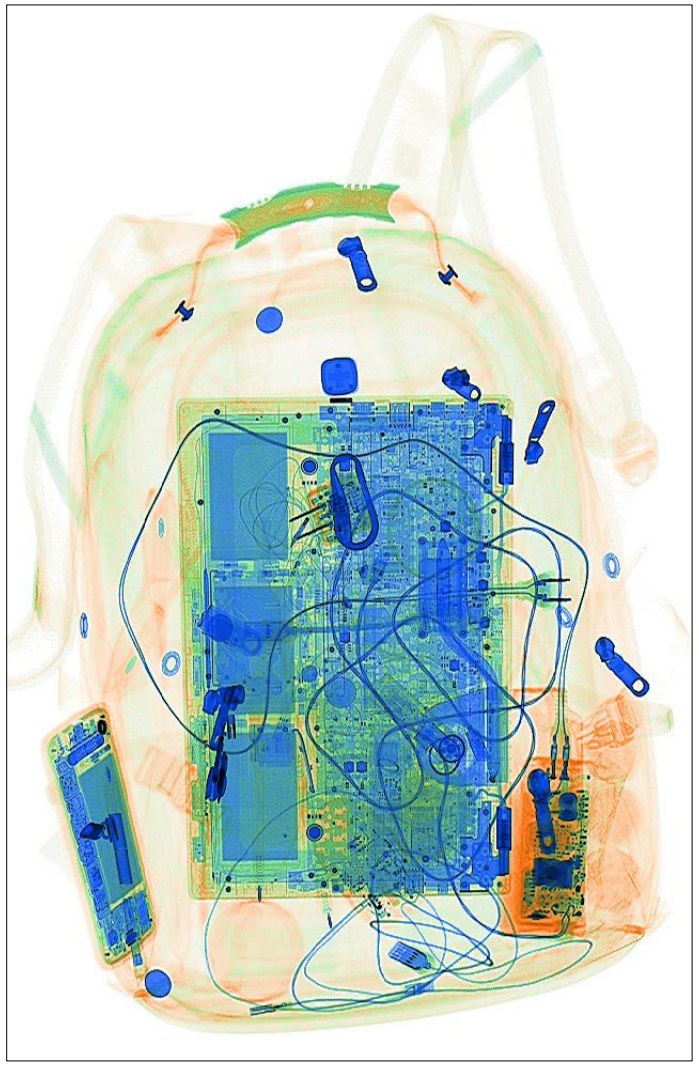
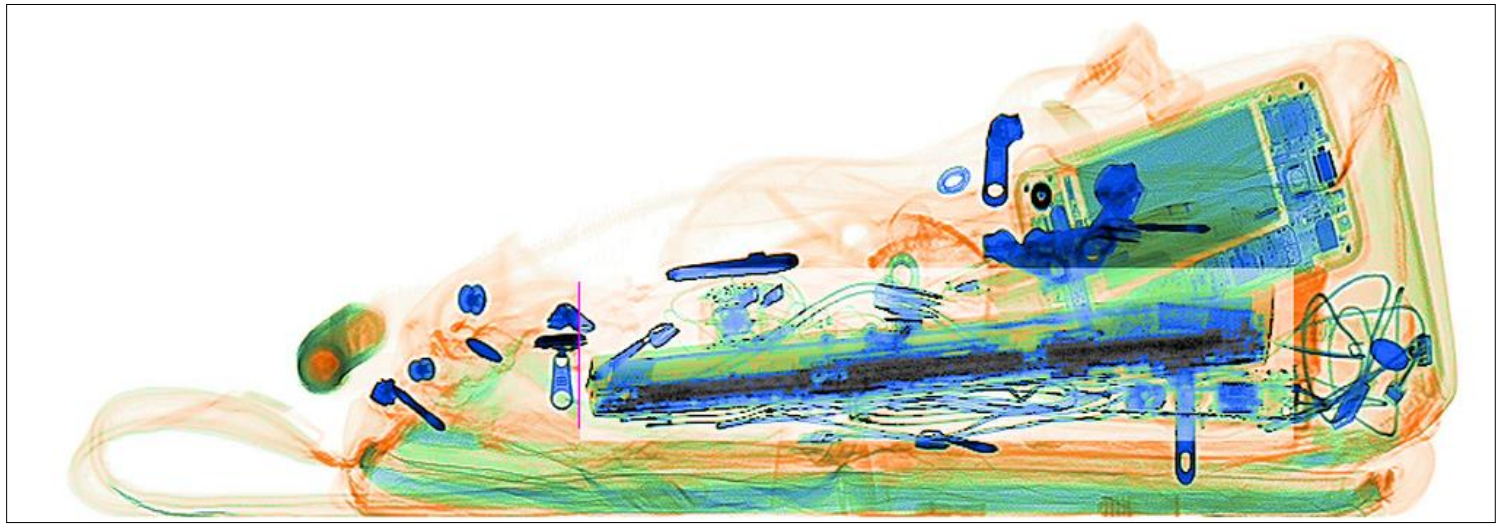
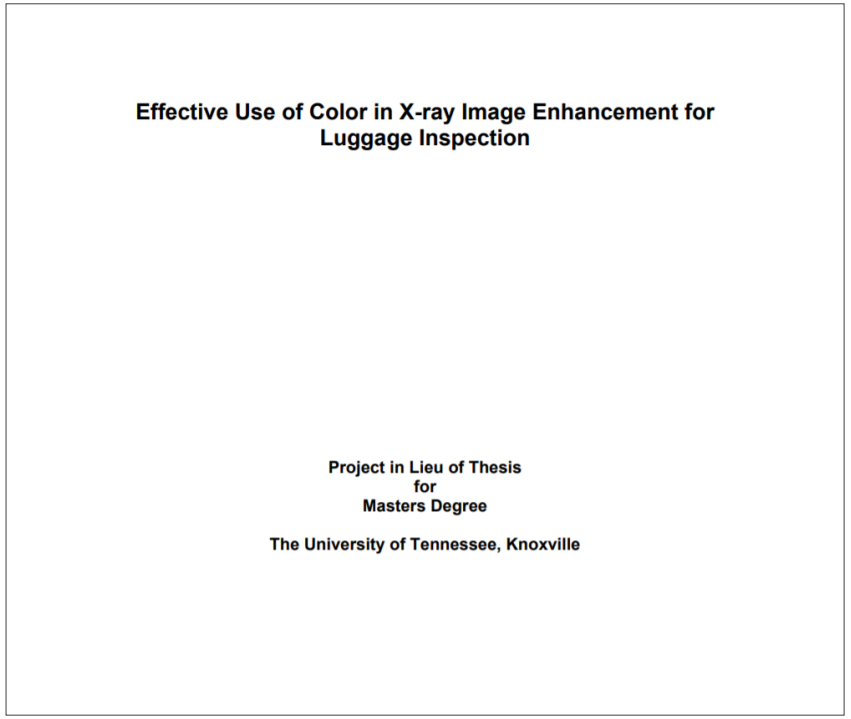


Aviation Security has done study after study after study on an X-ray operators ability to identify threats with grey scale vs dual energy imaging.

What could EOD find out if they would do the same?

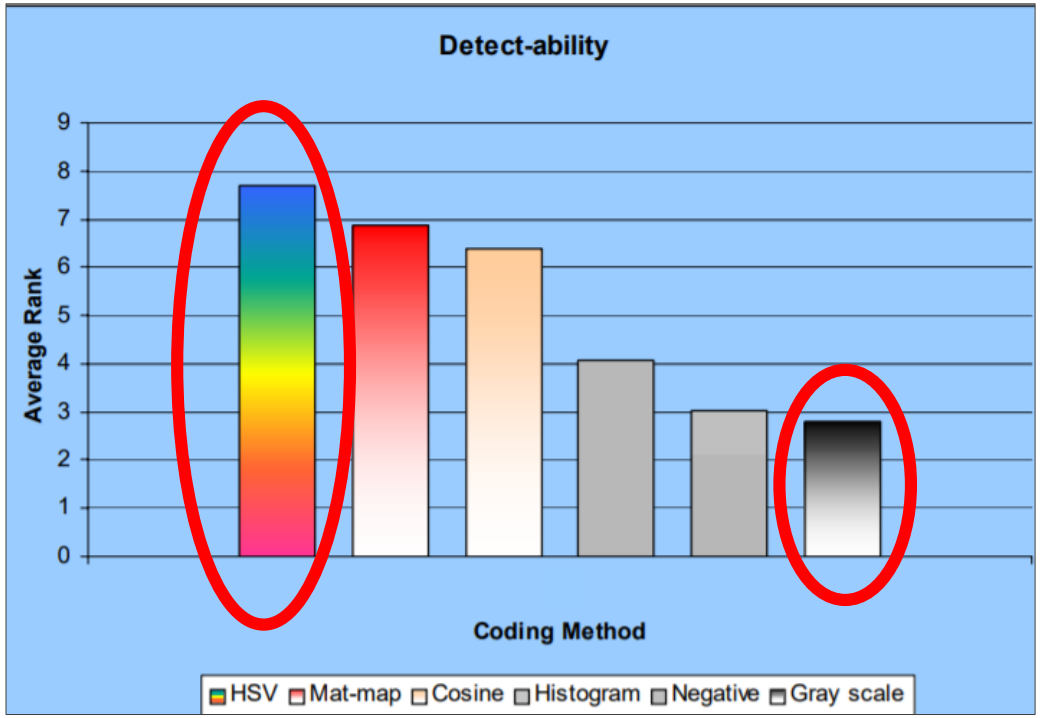


Why are airports not using grey scale?


Effective Use of Color in X-ray Image Enhancement for Luggage Inspection

Project in Lieu of Thesis
for
Masters Degree

The University of Tennessee, Knoxville



https://pdfs.semanticscholar.org/e778/b621e2175398d84726cc72884abbb7944722.pdf

Conclusion

From the survey results, color has been shown superior to grey scale for effective information processing time and for memory performance. The ability to detect and identify details from the image is inherently increased by using color.

Why are airports not using grey scale?

X-ray Imagery: Enhancing the Value of the Pixels

Article (PDF Available) · October 2005 *with* 466 Reads

Cite this publication

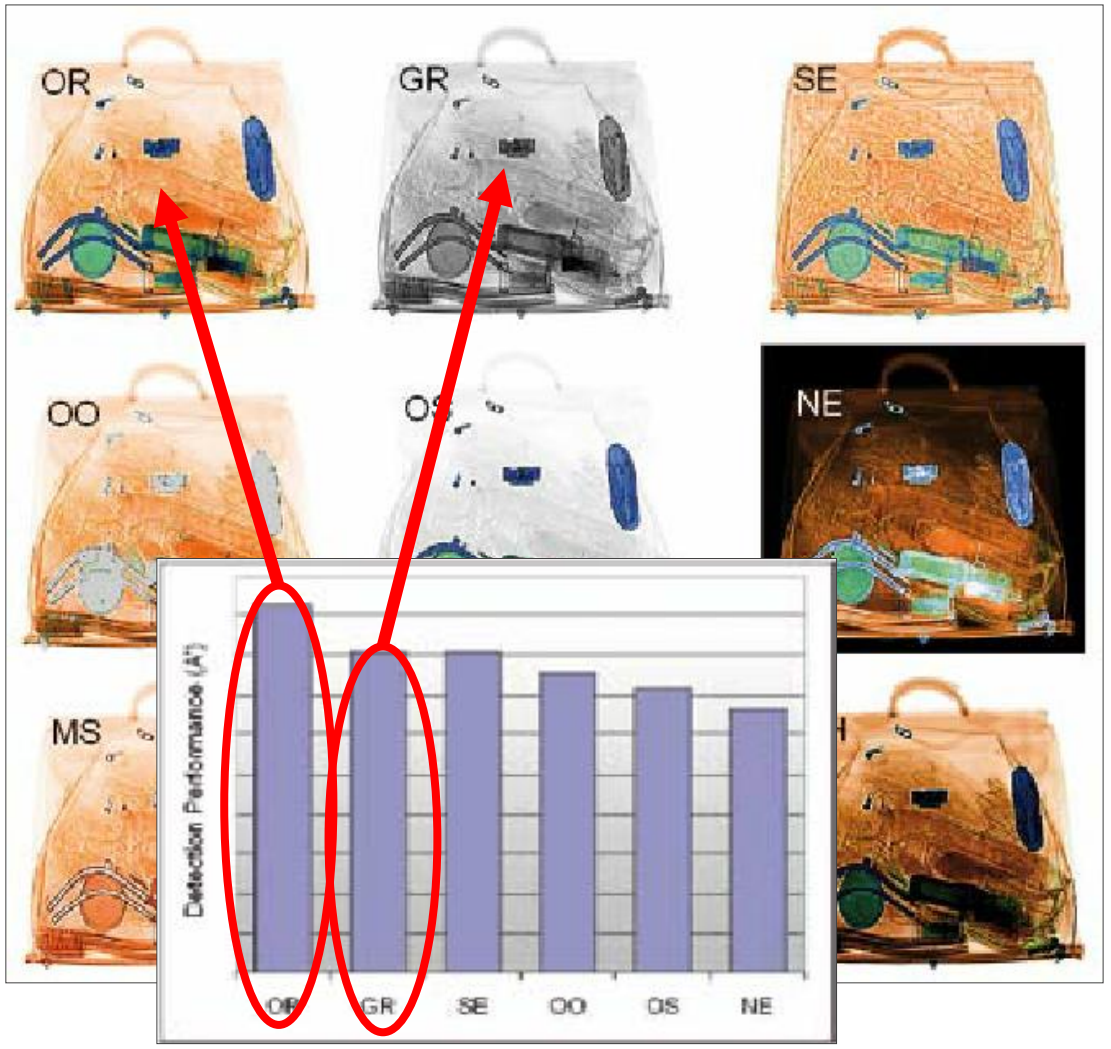
Adrian Schwaninger
28.2 · University of Applied Sciences and Arts Northwester...

Abstract

Whilst huge strides have been made in the enhancement of X-ray technology, how can we best benefit from the better imagery provided to us and use the data provided us by the X-ray monitors pixels to its best advantage? Adrian Schwaninger casts an eye on the relationship between operator and machine.

https://www.researchgate.net/publication/238393928_X-ray_Imagery_Enhancing_the_Value_of_the_Pixels

IED detection performance was best when images were displayed without image enhancements. Performance ***decreased*** when images were presented in grey scale.



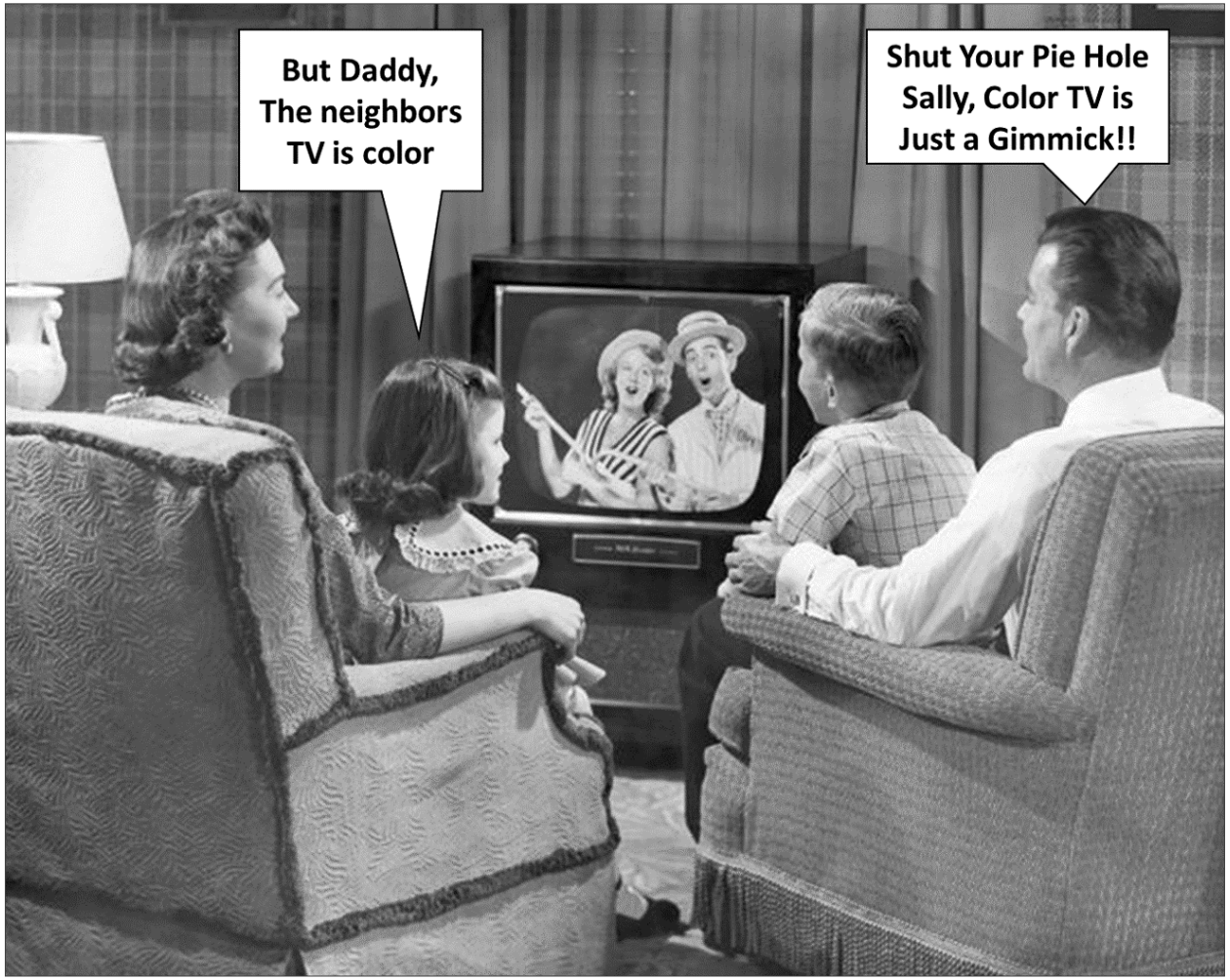
But we have always done it this way …

I live in a bubble …

Many EOD and portable X-ray manufacturers still think that dual energy imaging is a gimmick and don‘t understand how it can be an enhancement over grey scale.

It is also not easy to do with pulsed generators and some manufacturers cannot do it.

**No studies,
no understanding,
no drive for change.**

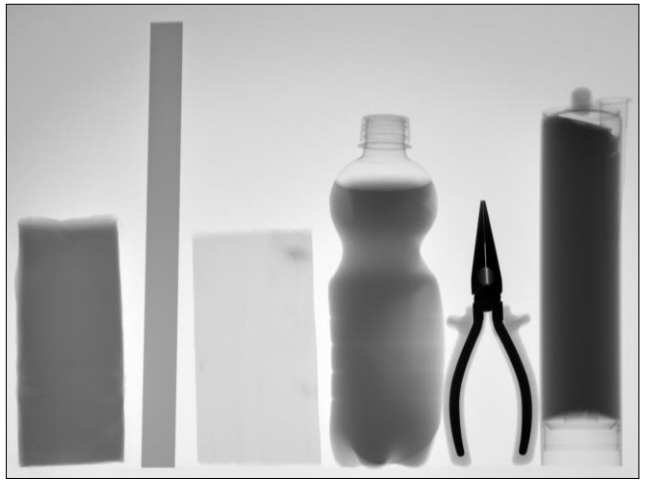


Dual Energy Imaging with EOD Portable Systems

Dual Energy Imaging

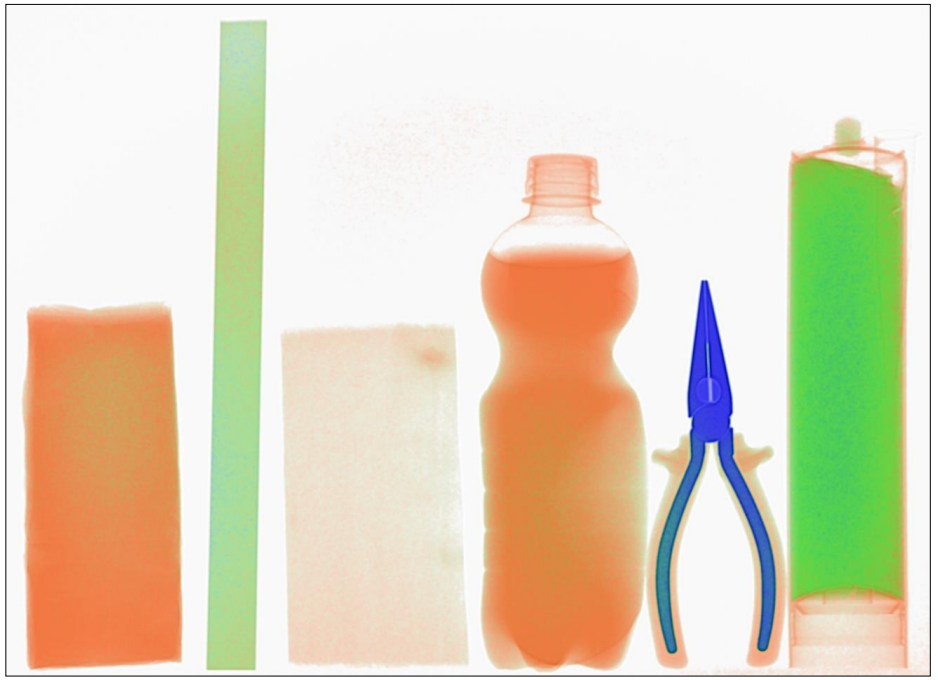
EOD x-ray systems with the required penetration capability (pulsed generators) require a dual energy (DE) module on the x-ray generator to create dual energy images

Dual Energy Module



A dual energy measurement is known as “Material Discrimination”

Provides a measurement of the average effective atomic number of the material x-rayed



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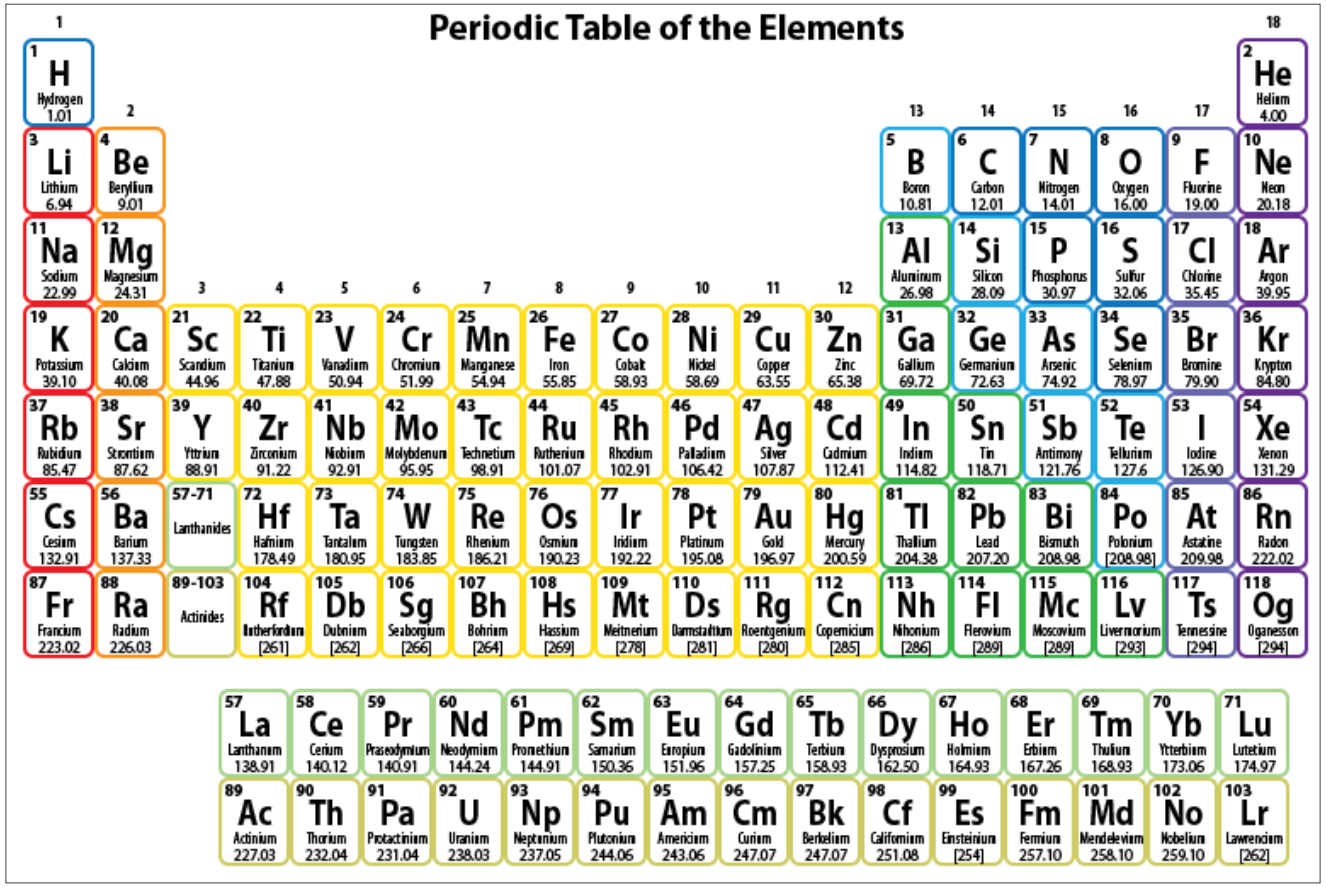
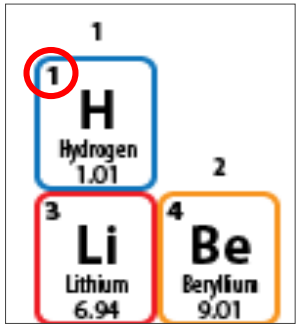
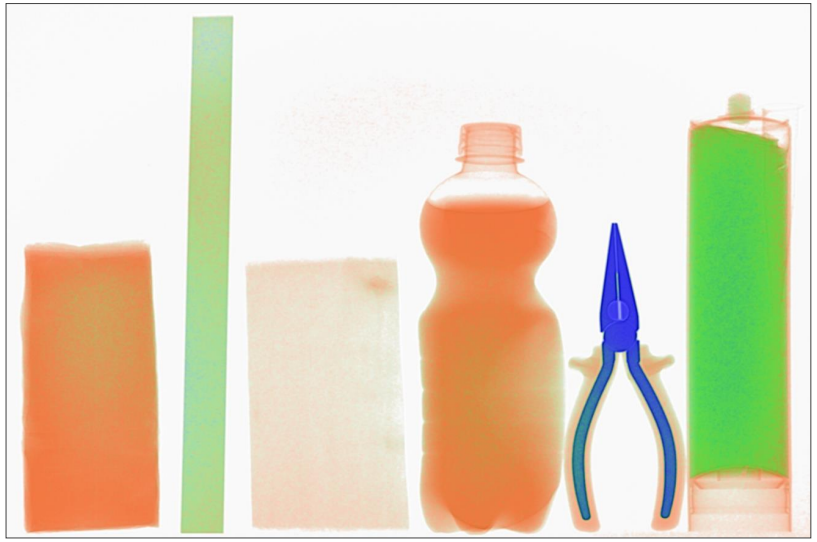




0 -10= Orange

11-15= Green

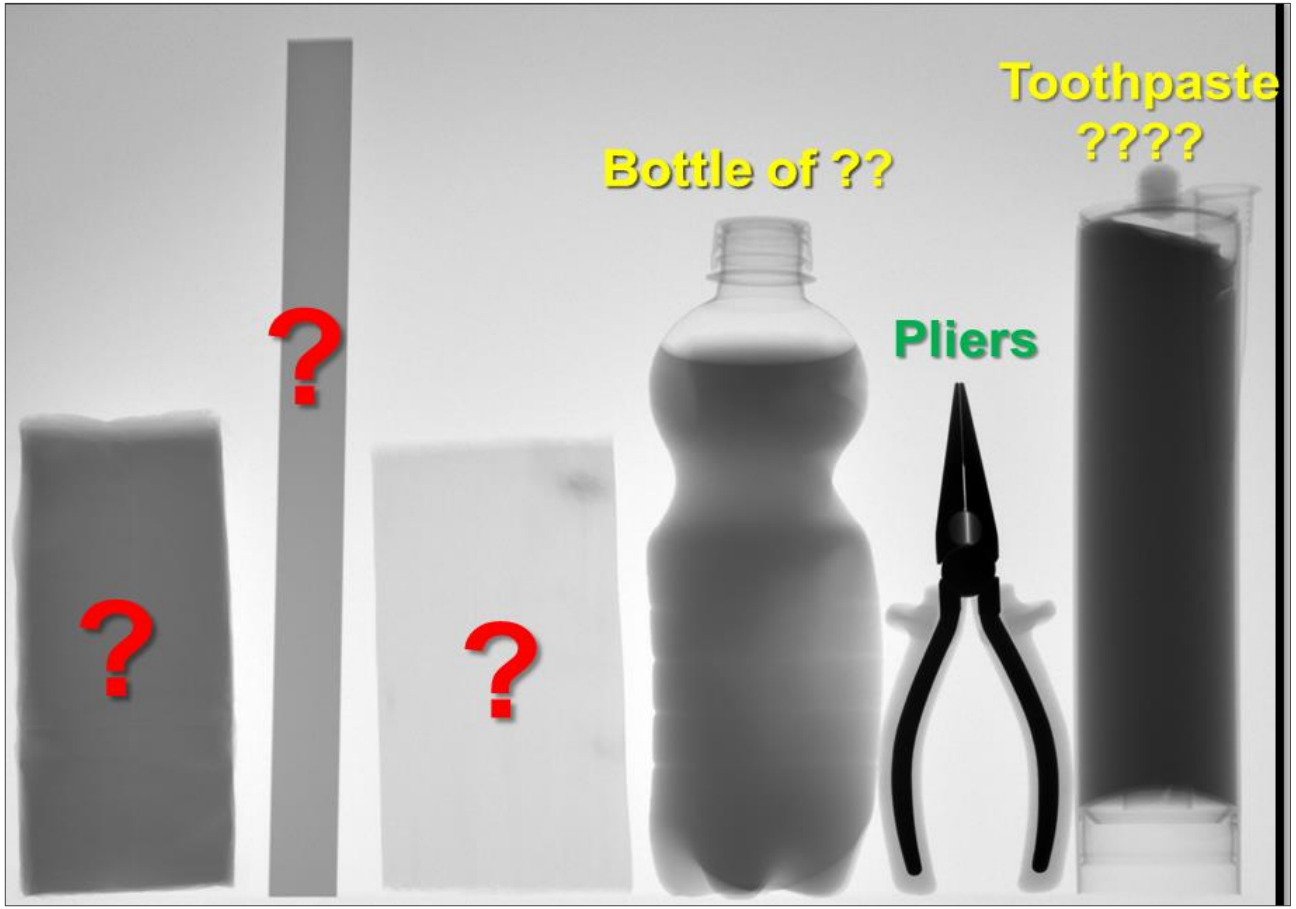
15-30= Blue



What are the advantages of Dual Energy Imaging?

Material Discrimination

In the absence of a recognizable shape material discrimination tells what the item is made out of based on its average atomic number



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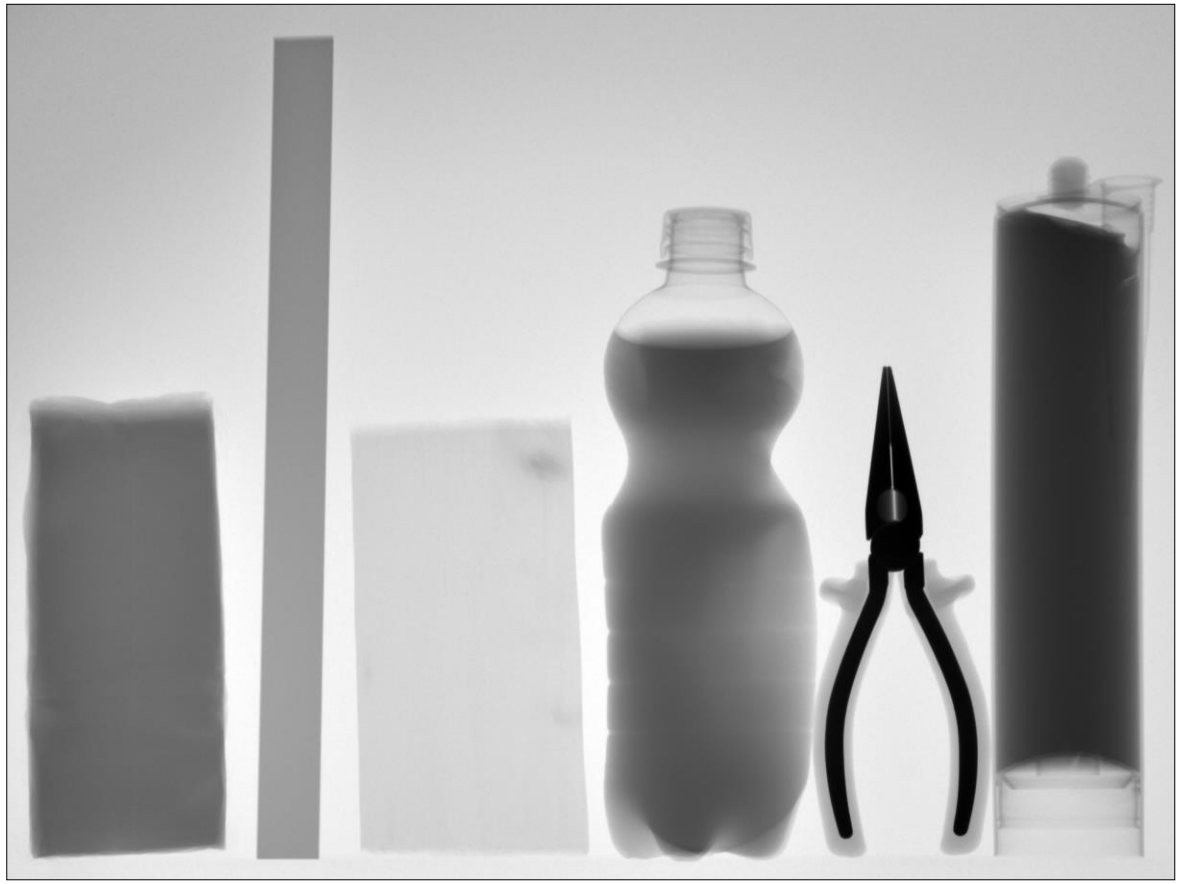
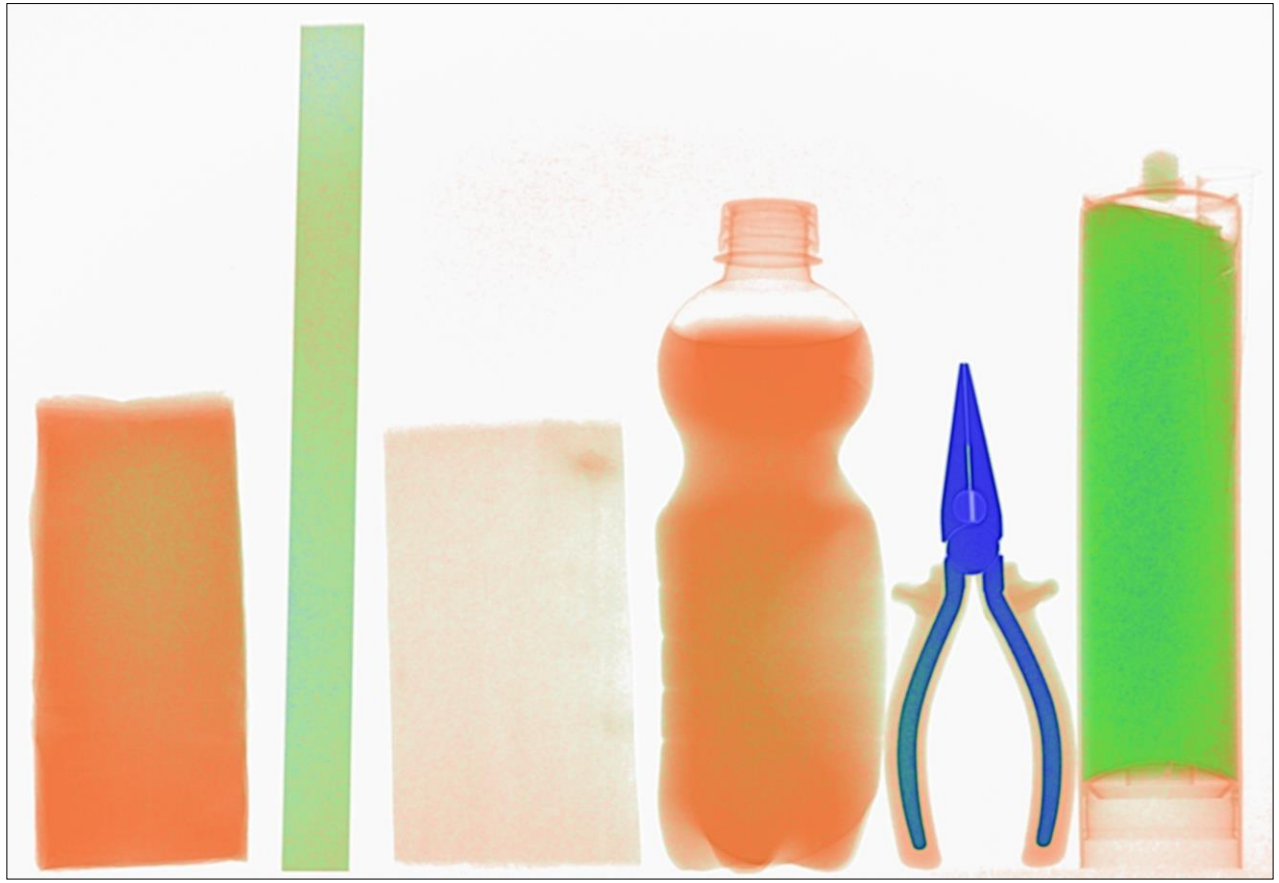
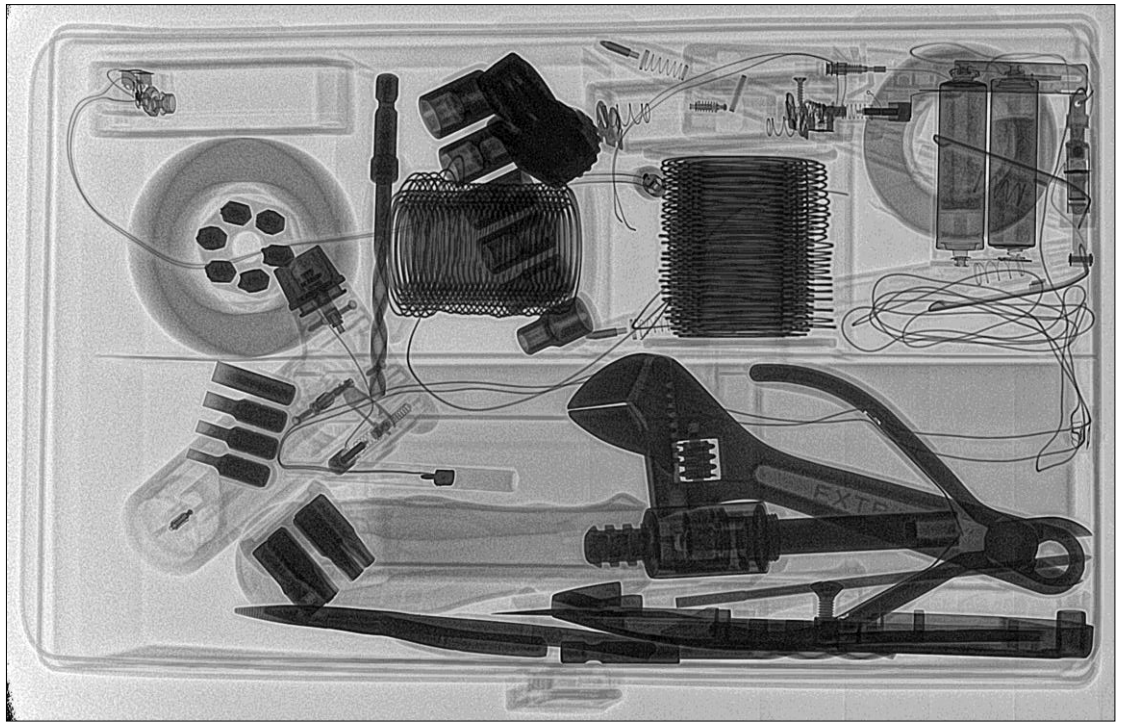
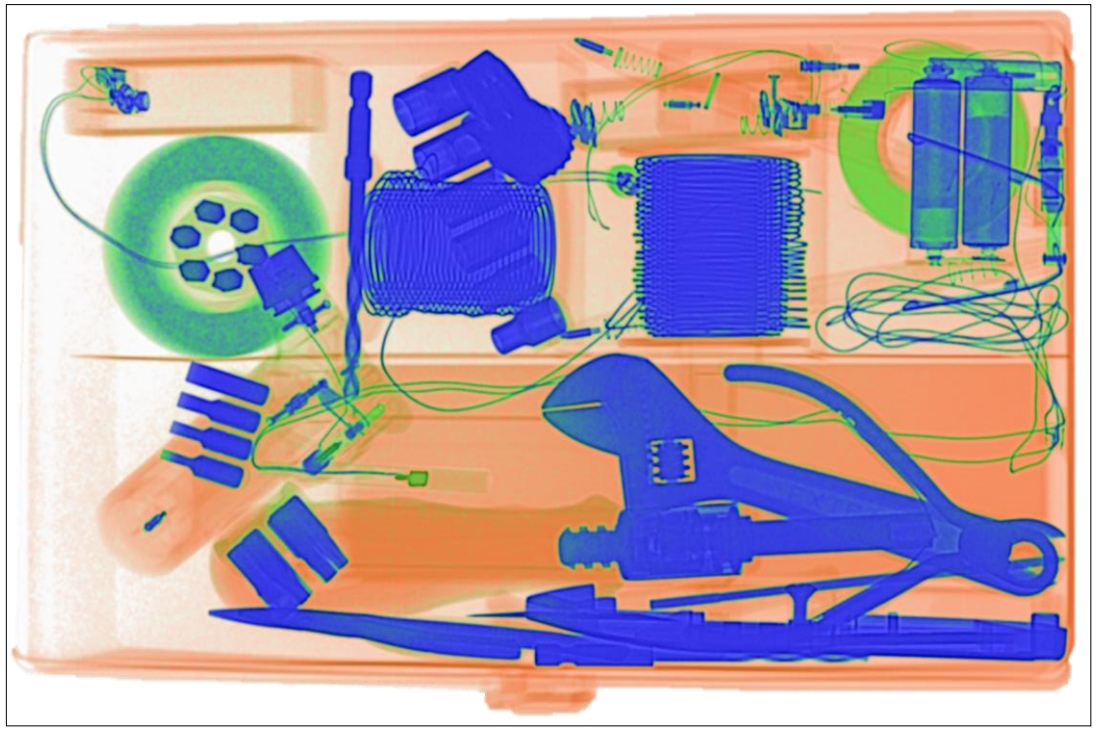




Material Discrimination

In grey scale just because something is dark does not verify it is a metal nor can grey scale verify organic materials

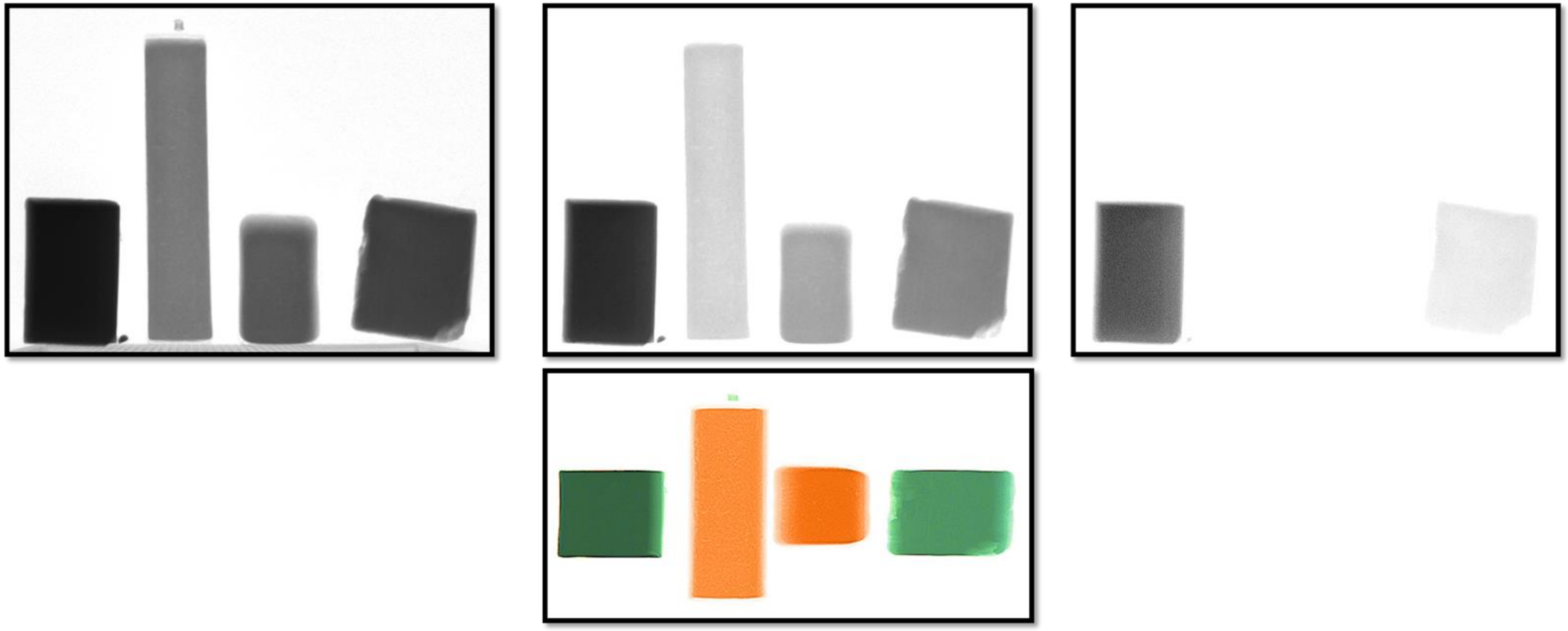




Most explosives are organic and MUST be located before doing a disruption on the package

No bleed out from high pulses

Material Discrimination no bleed out

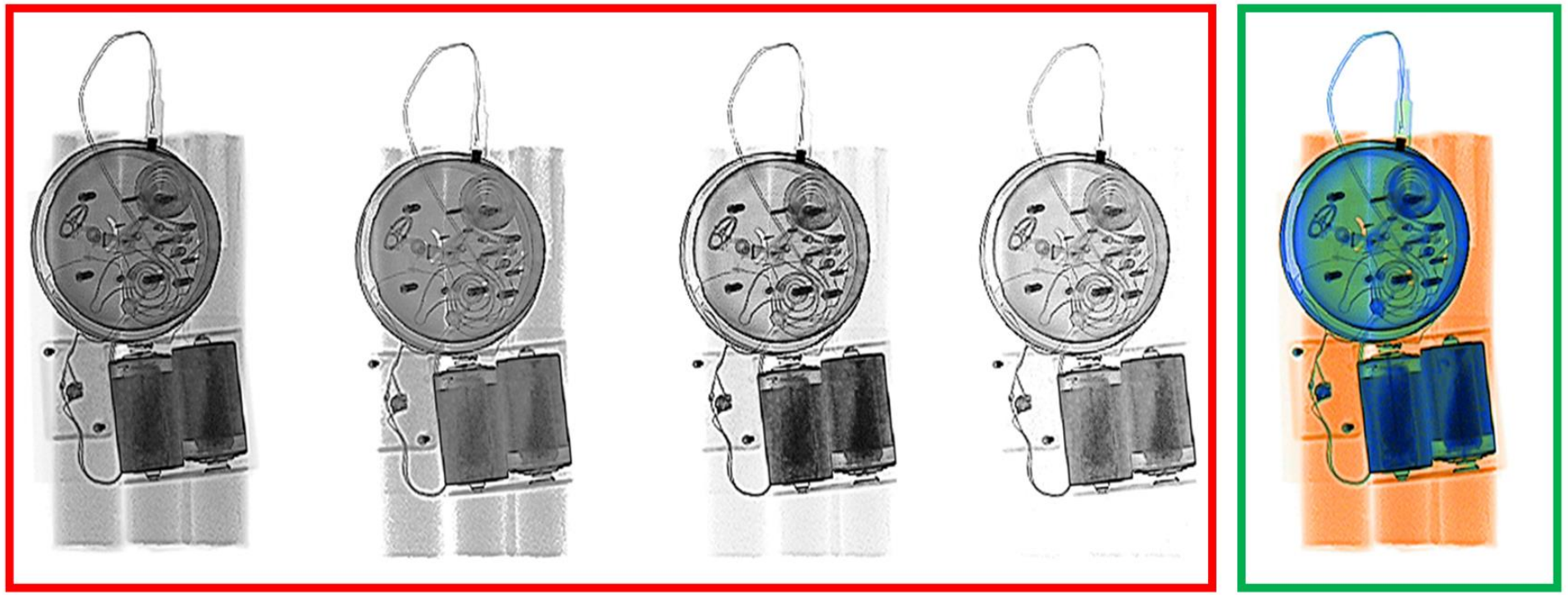


Bleed out occurs when you are using higher pulses on low density or thin materials. Dual energy imaging negates this problem

Material Discrimination no bleed out

Grey Scale Bleed out at higher pulses

Duel Energy

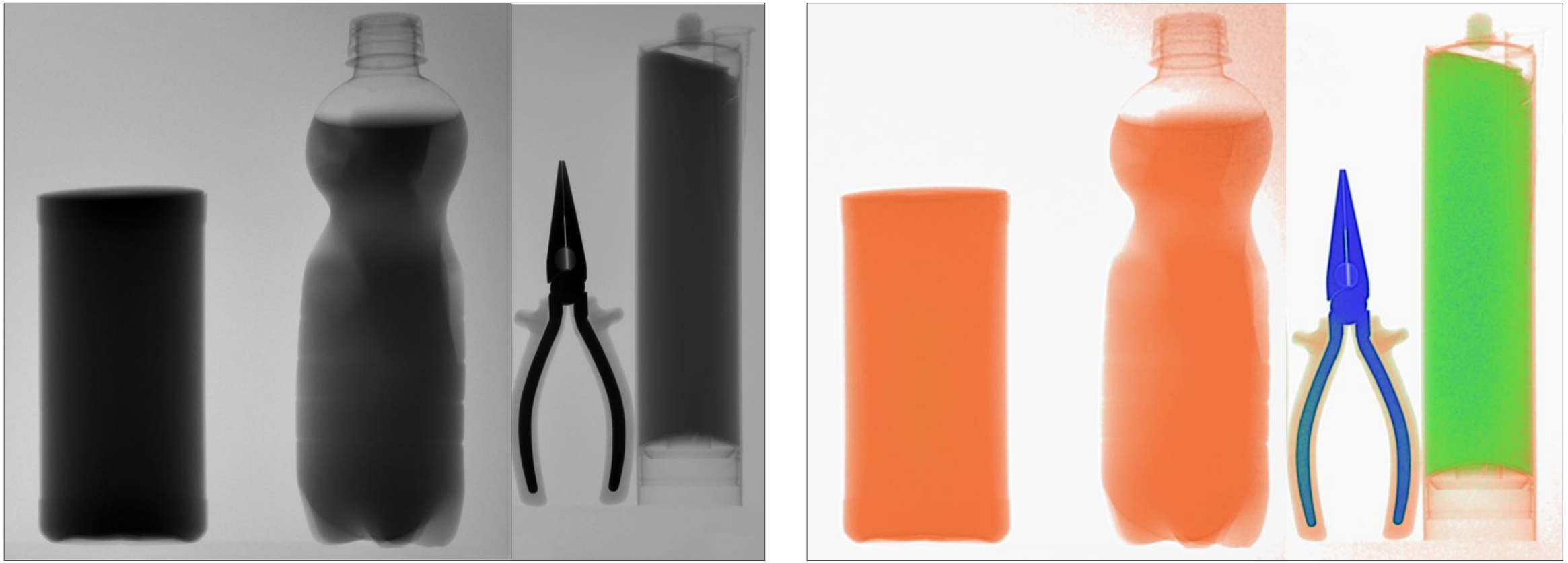


The Bomb technician MUST know the location of the exploisve material

This is extremely important when you consider that explosives would bleed out at higher pulses.

Metal Detection

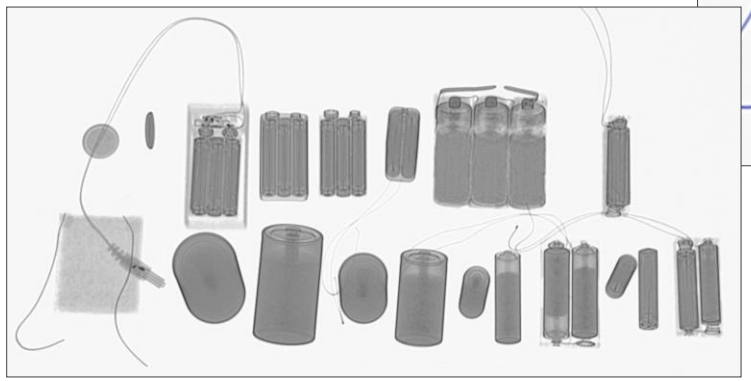
Identification of „Metals“



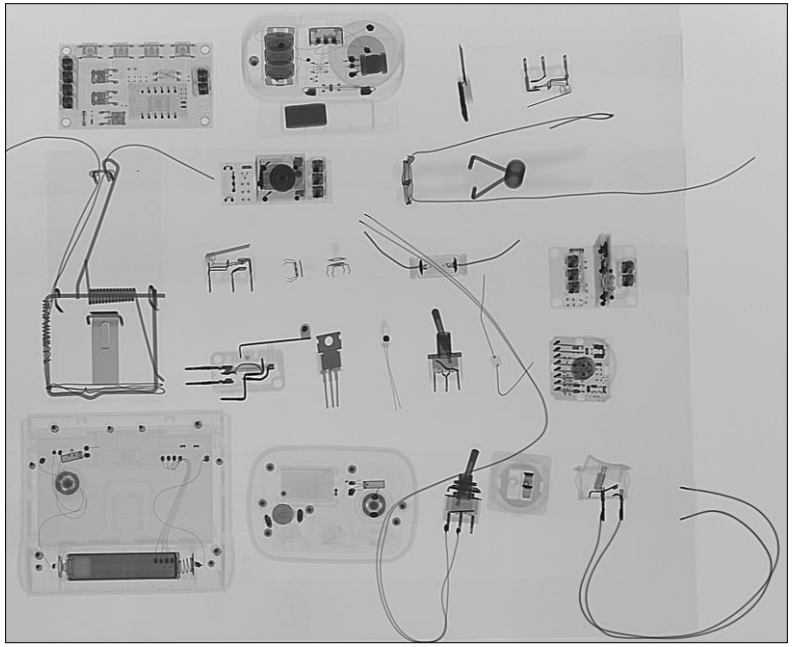
Just because it is dark in grey scale does not mean it is a metal

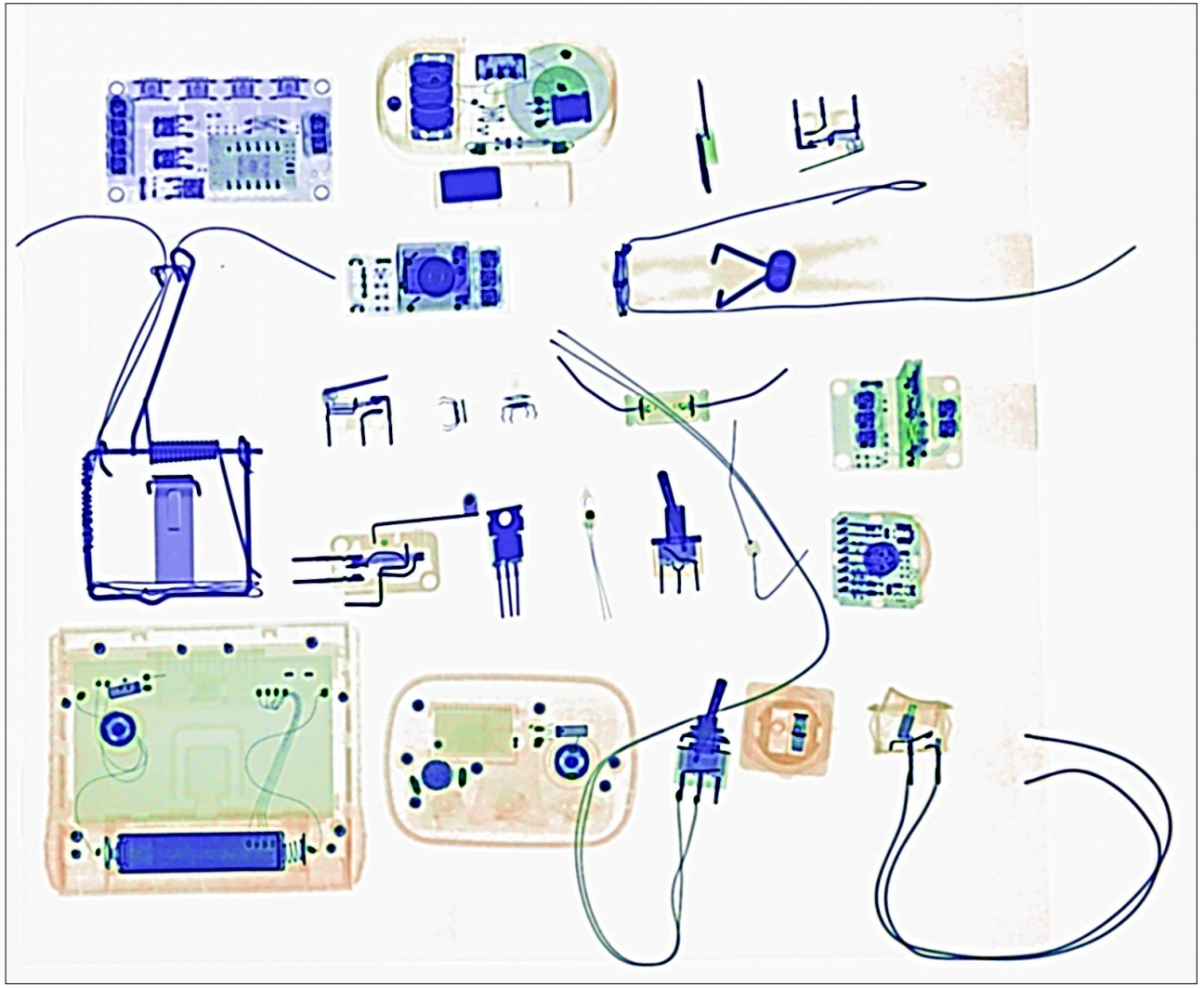
„Metals“ IED Power Sources

The majority of IED components are made from metal so being able to highlight metals is a huge benefit over grey scale



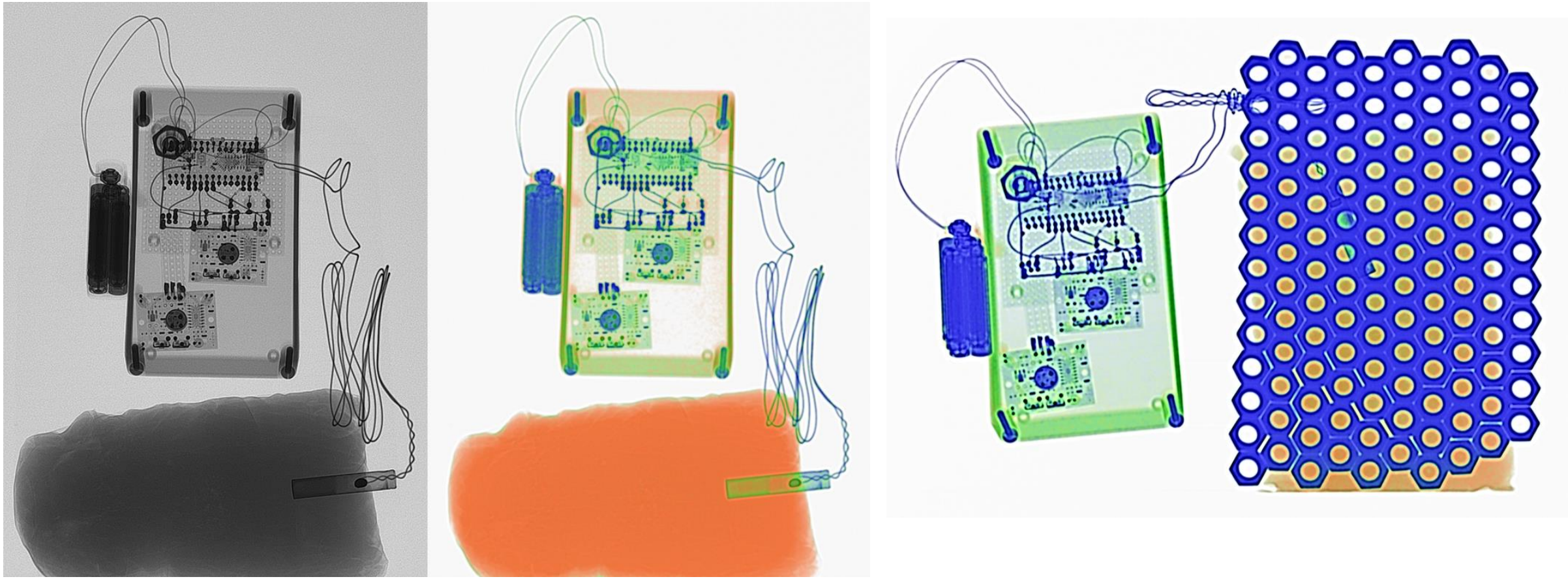
Identification of „Metals“ IED switches





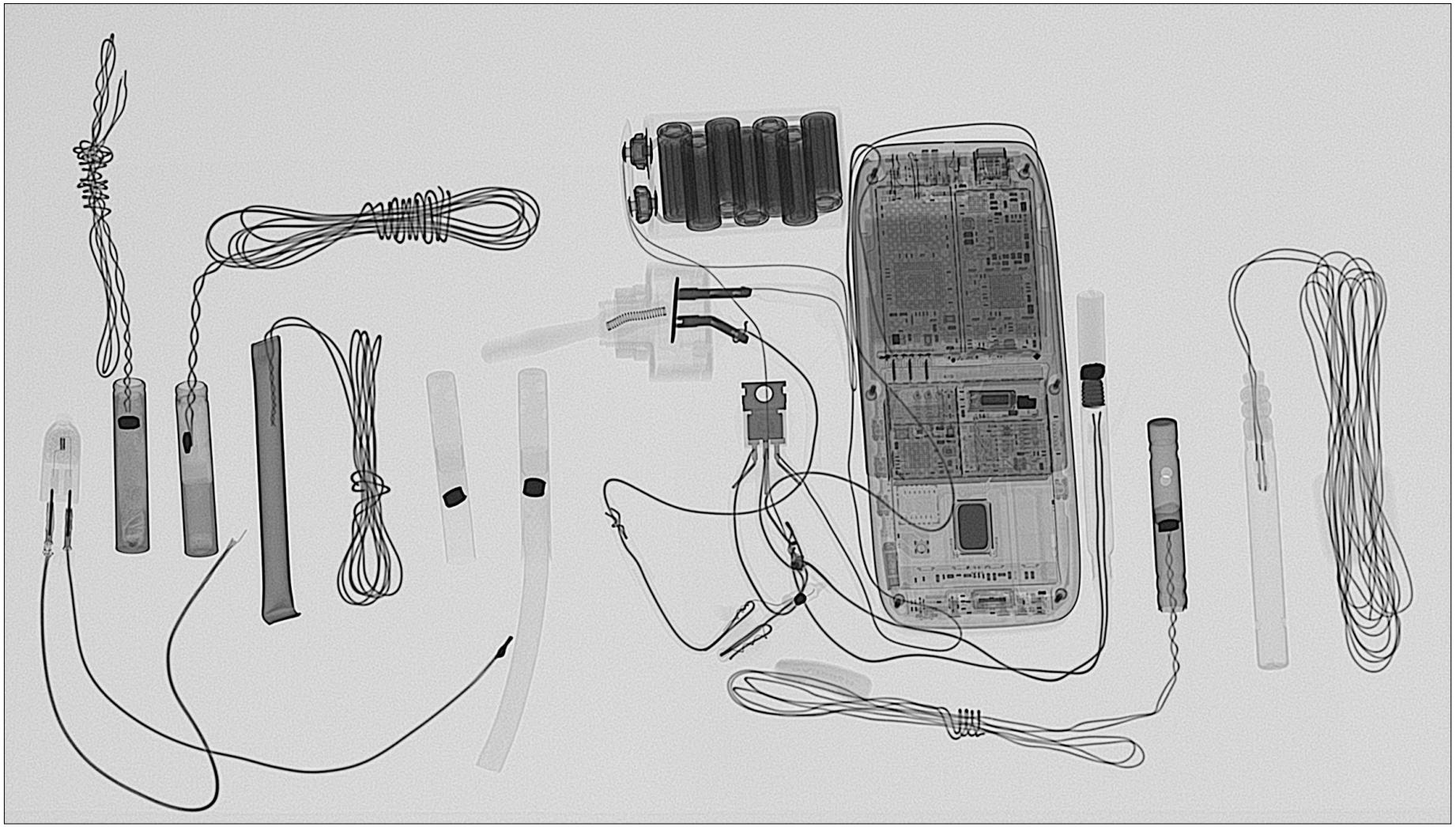
This allows you the ability to locate IED circuits in a cluttered image more accurately and or verify a item that is at a difficult angle as being made from metal

Identification of „Metals“ IED switches



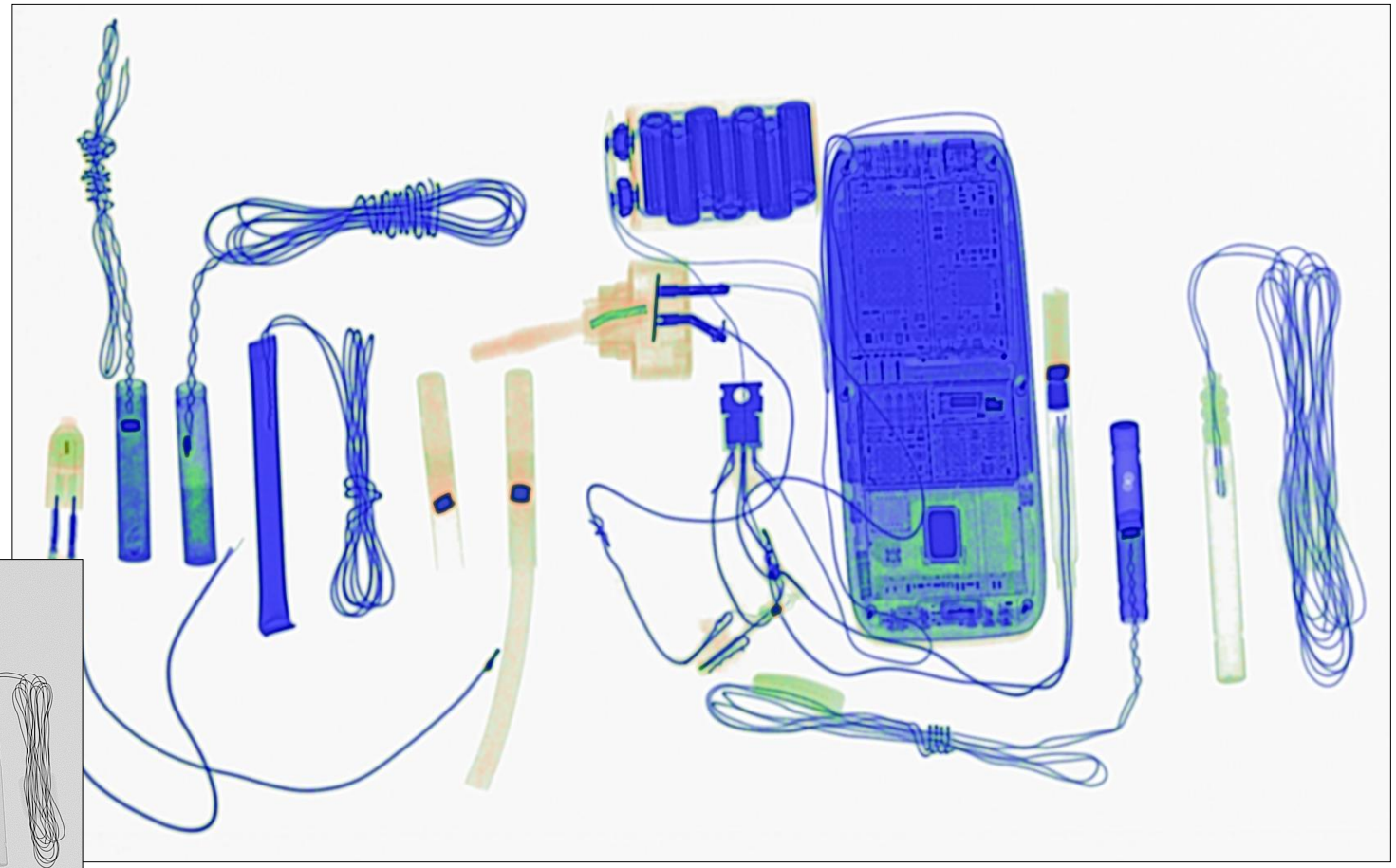
Detonators and Initiators

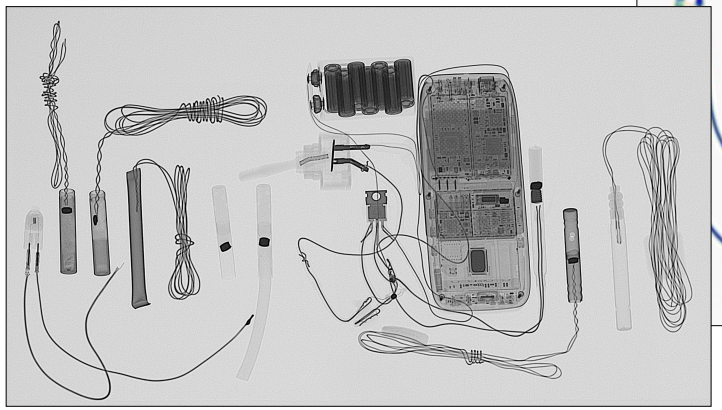
Identification of IED Dets (Grey Scale)



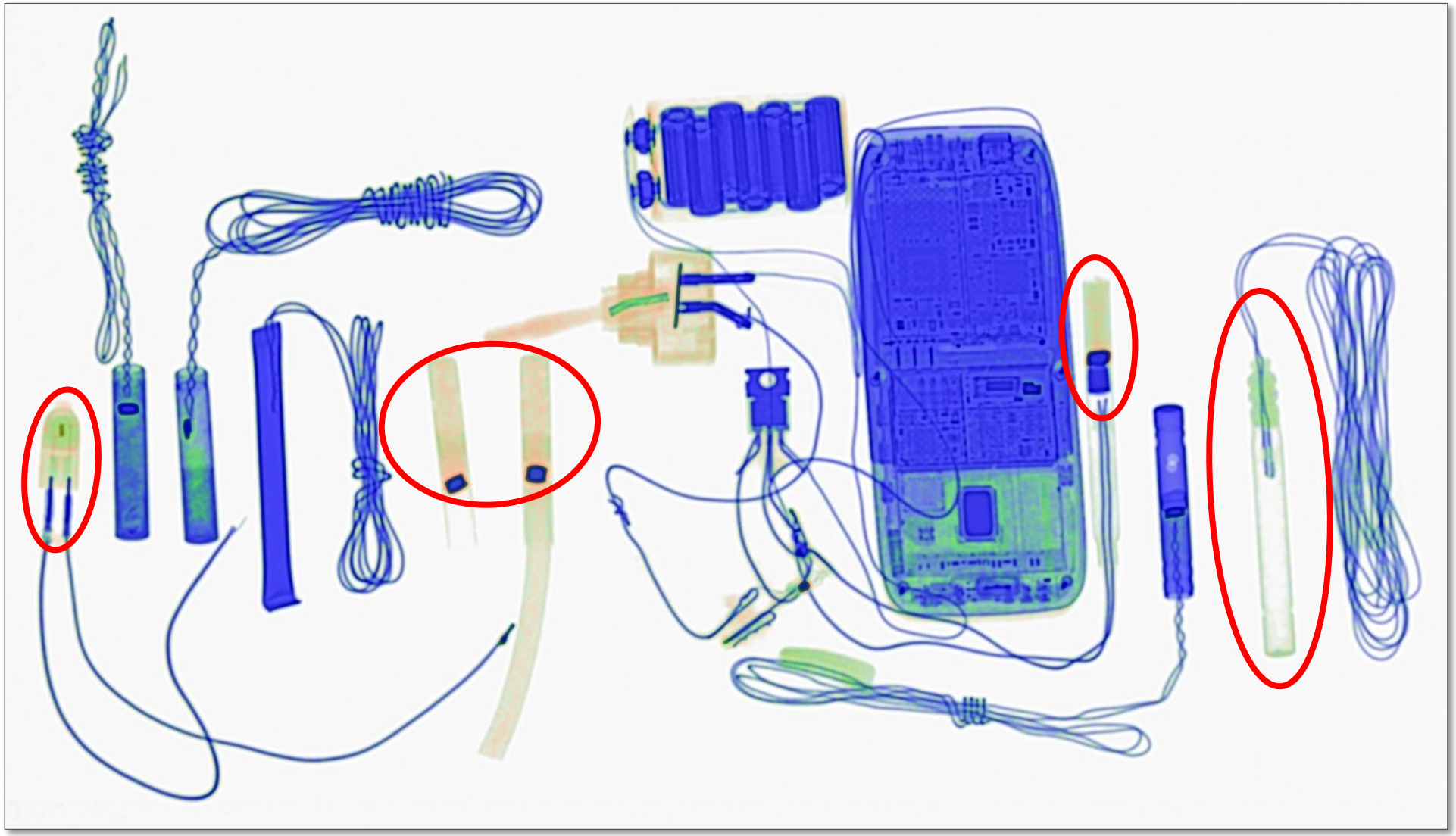
Identification of IED Dets

What information does grey scale provide vs dual energy when you look at detonators and initiators?



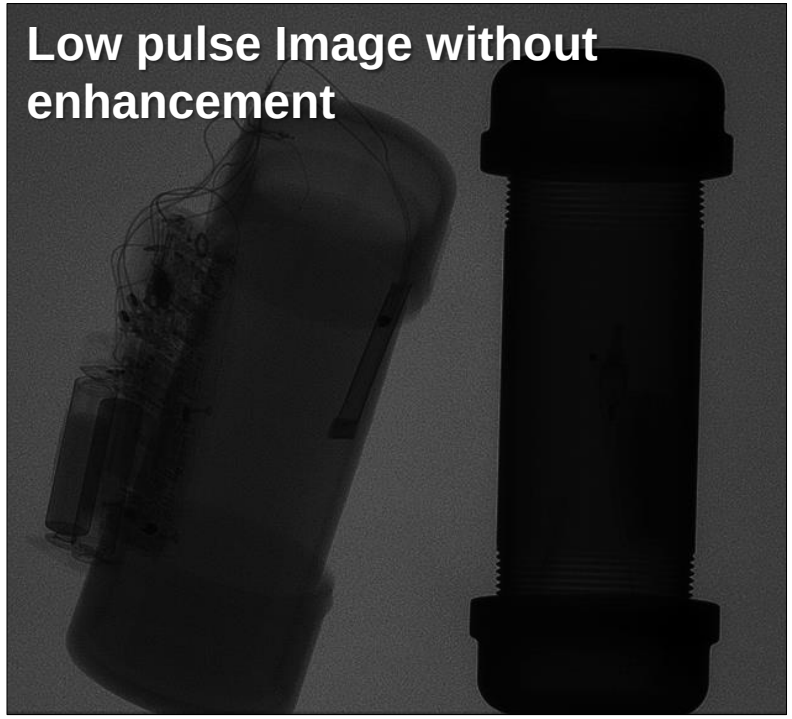


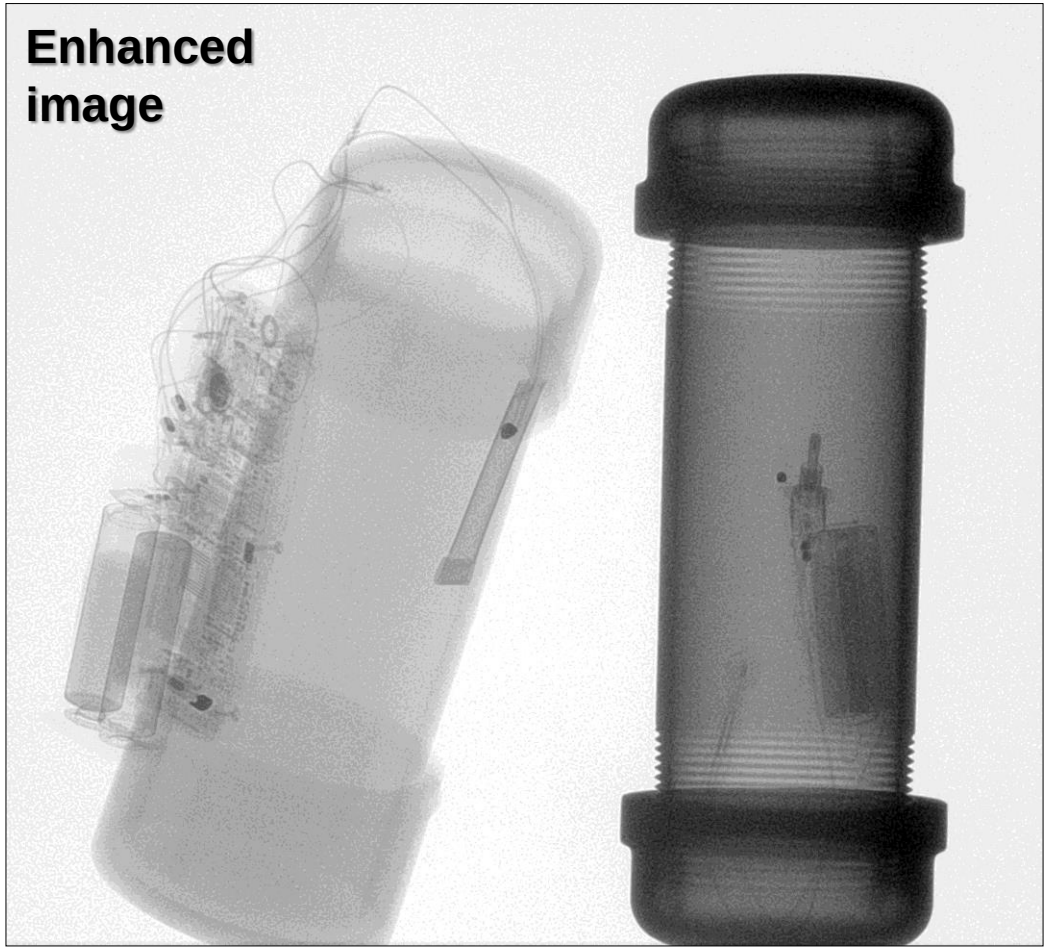
Identification of „Metals“ IED Dets



Pipe Bombs

Identification of Pipe Bombs





What kind of pipe?

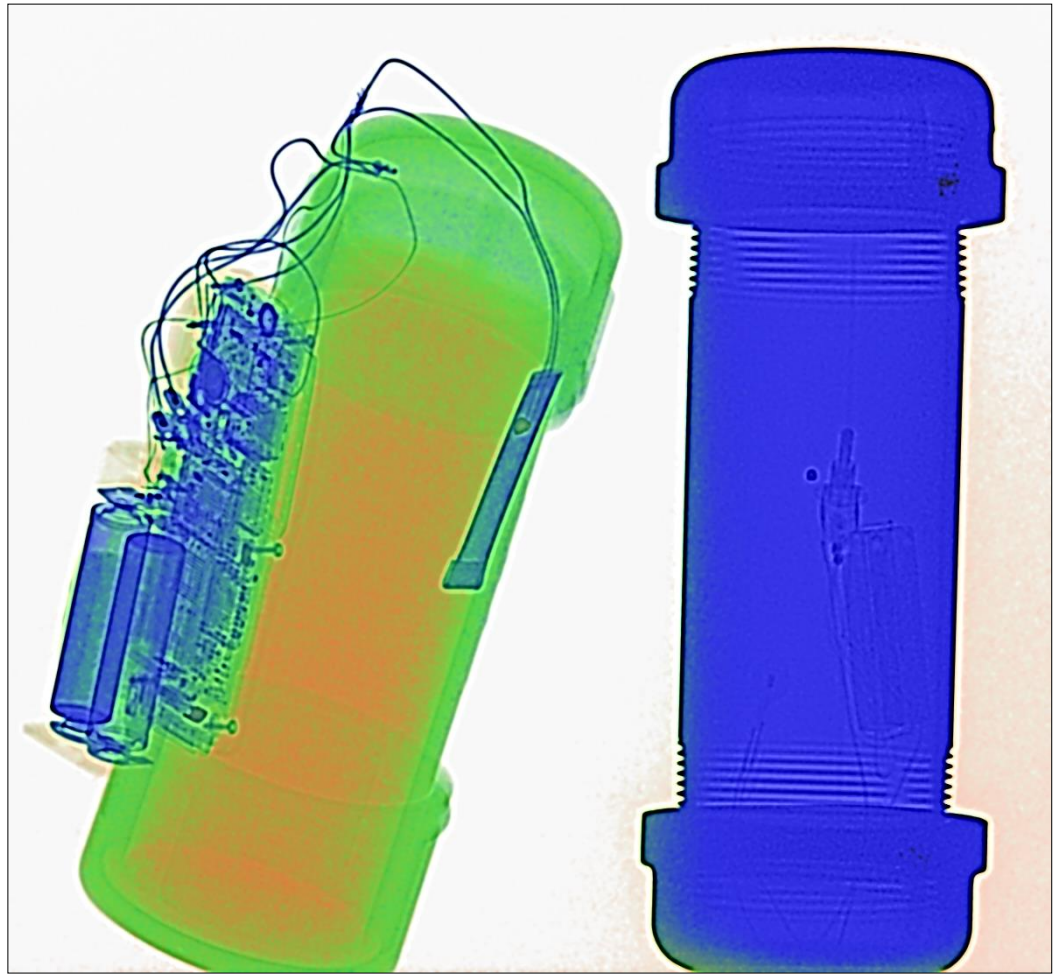
Is it filled or empty?

What kind of explosive?

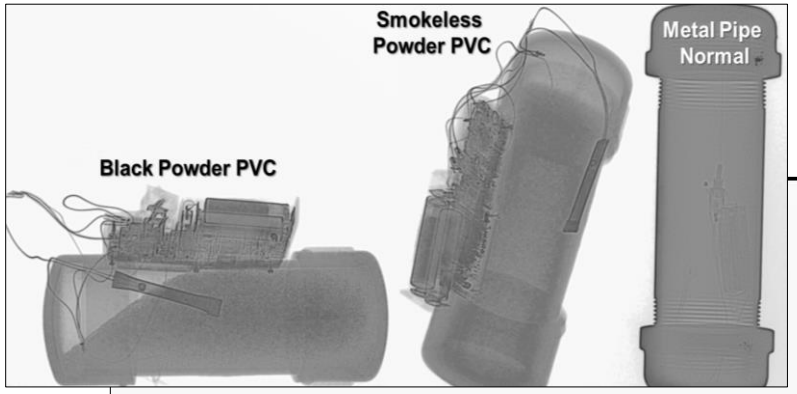
Identification of Pipe Bombs

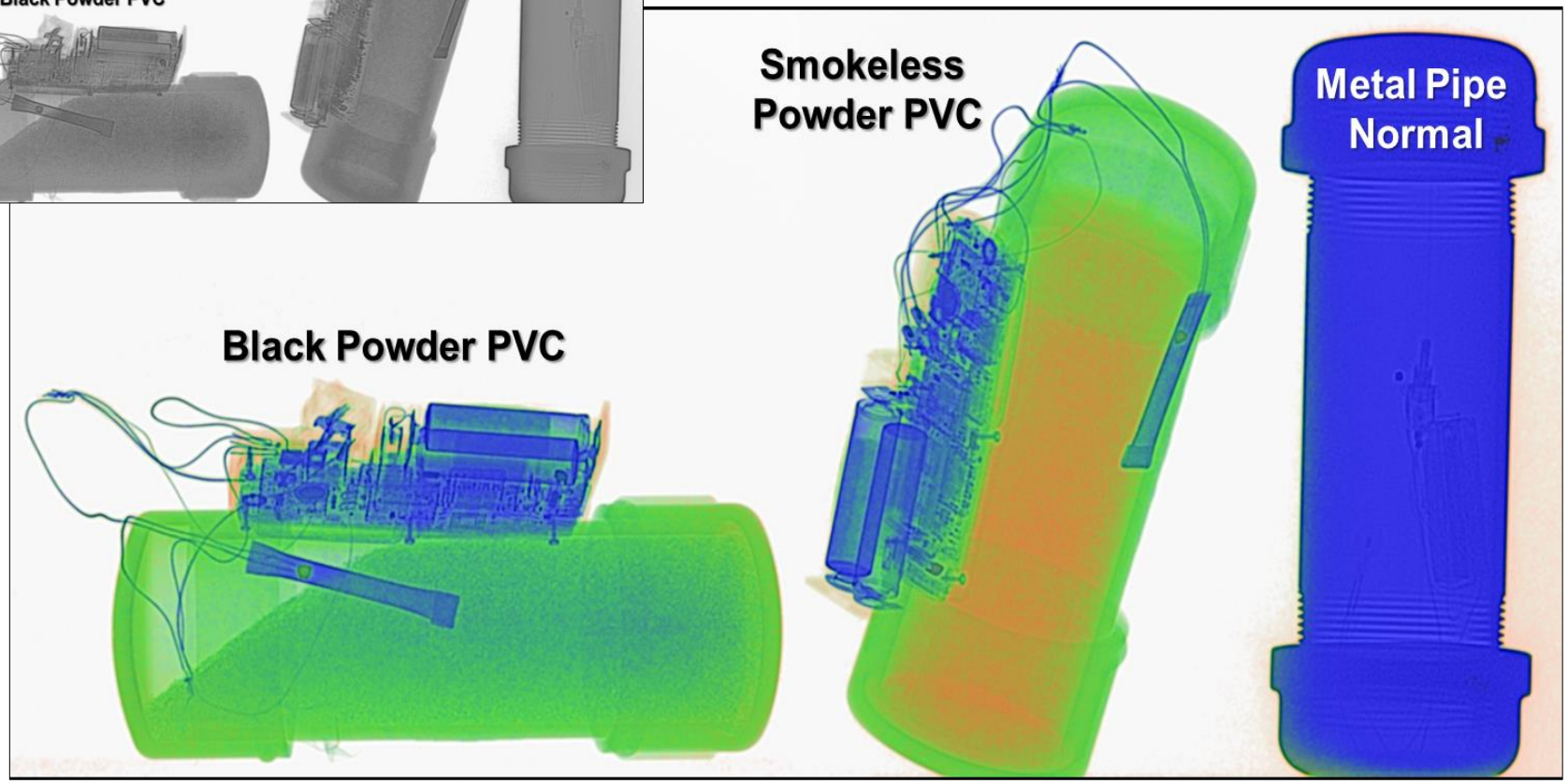
Dual Energy tells me:

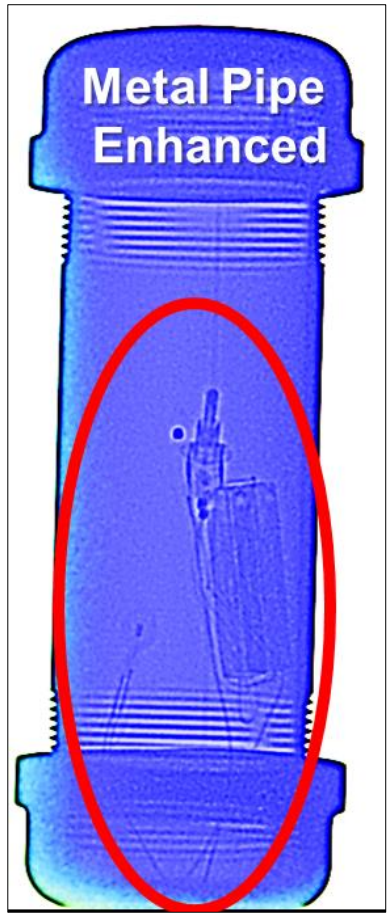
- One pipe is metal
- One pipe is PVC (Green outside)
- The PVC pipe is filled with a Smokeless powder (orange color inside of the pipe)
- Grey scale CANNOT provide this information



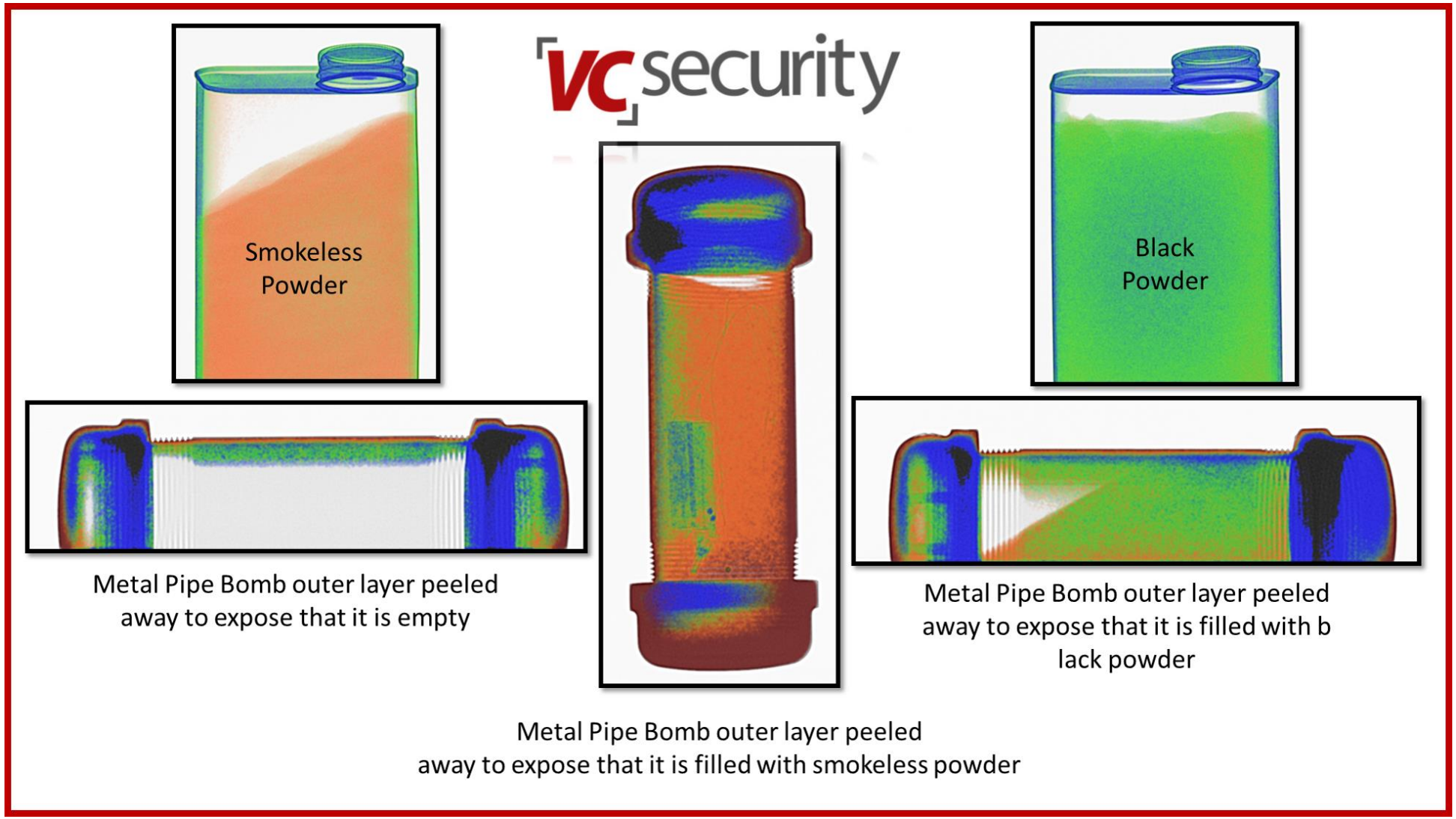
Identification of Pipe Bombs





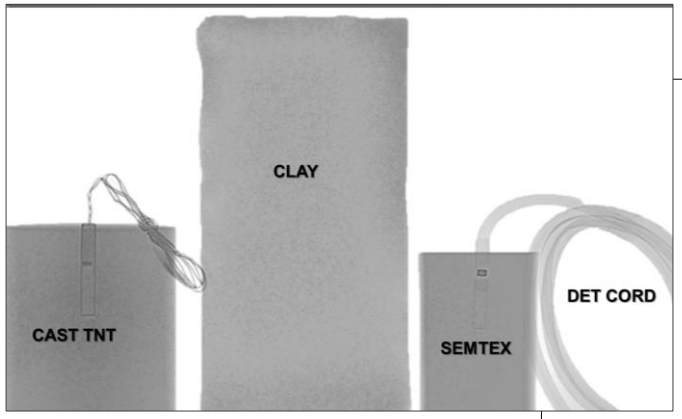


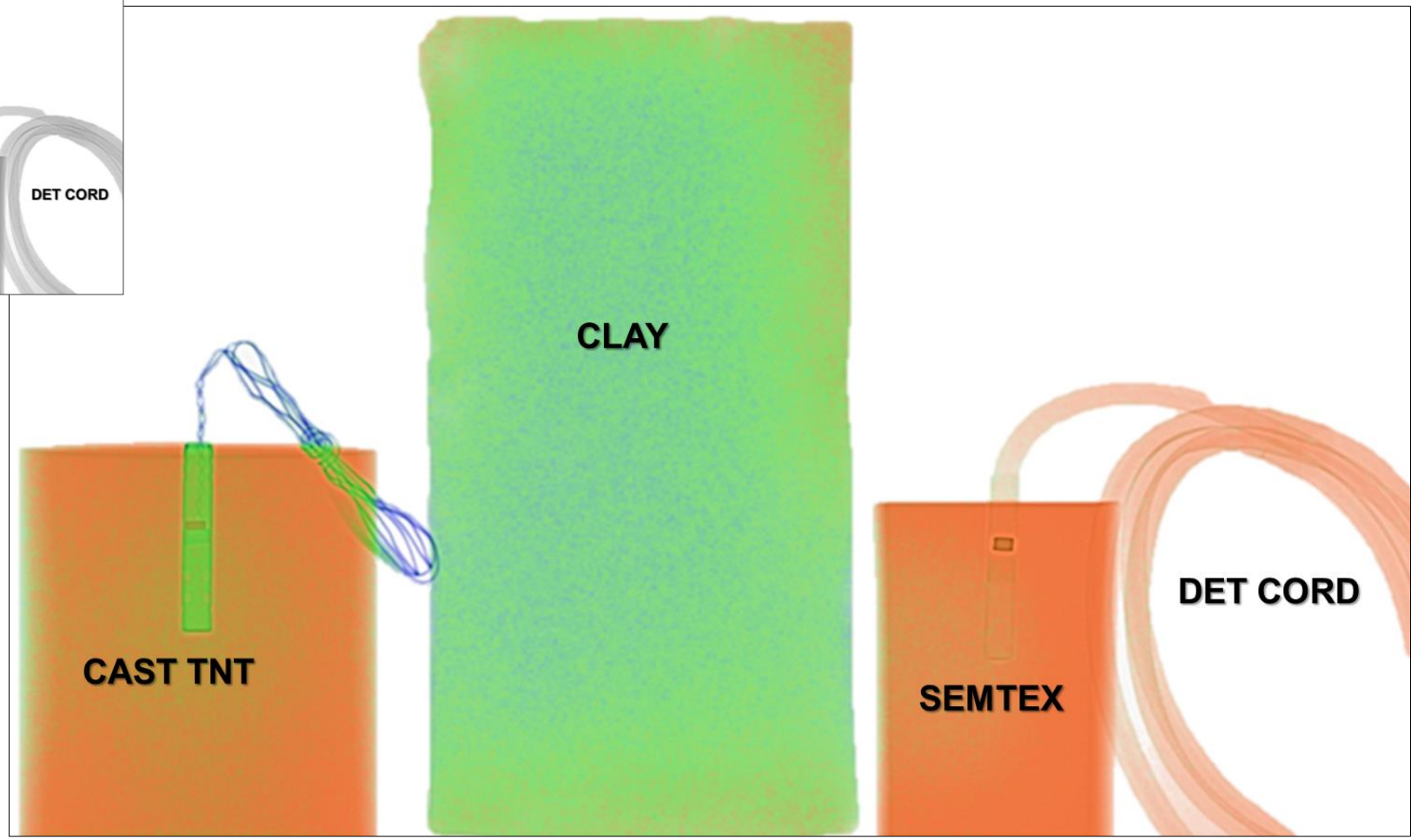
Identification of Pipe Bombs (Peeling)



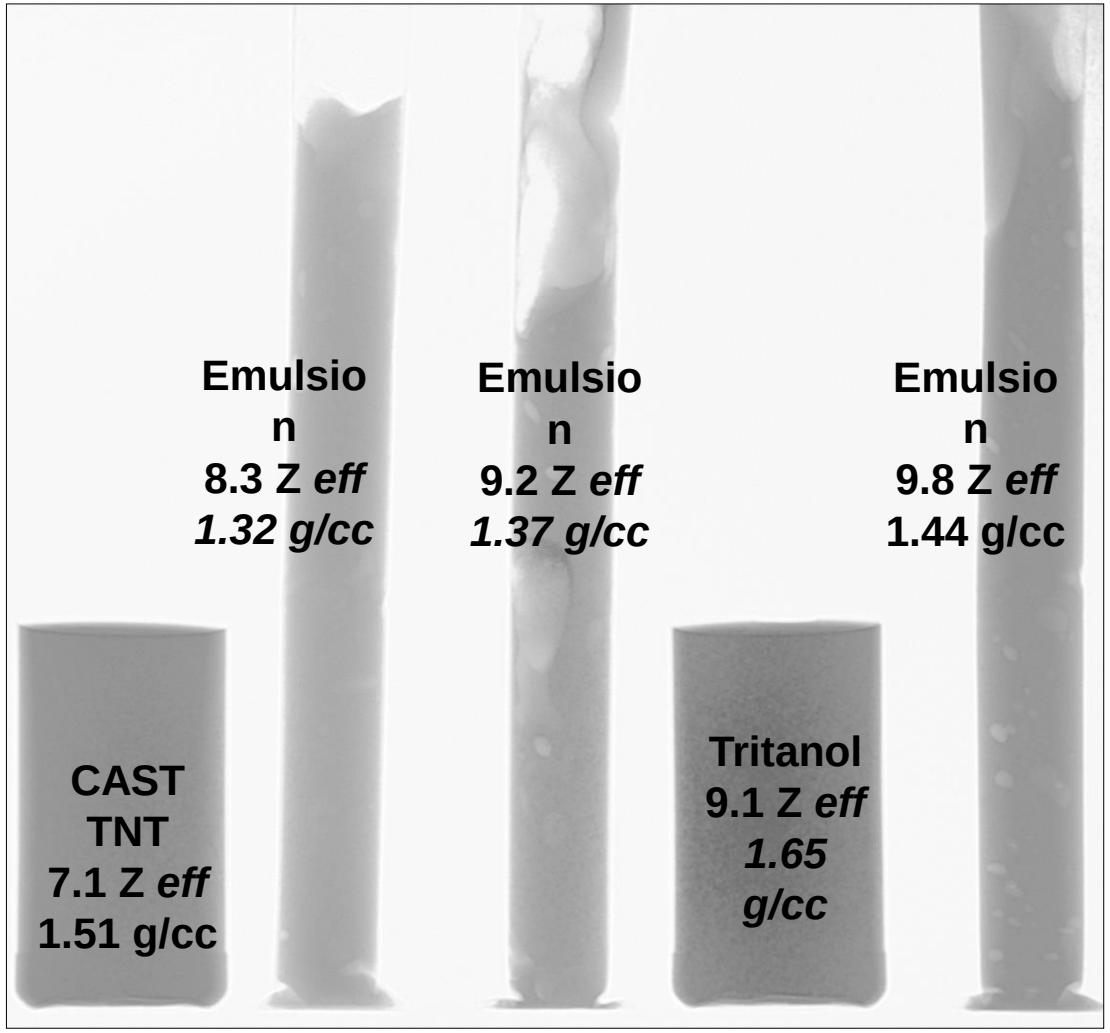
Explosives

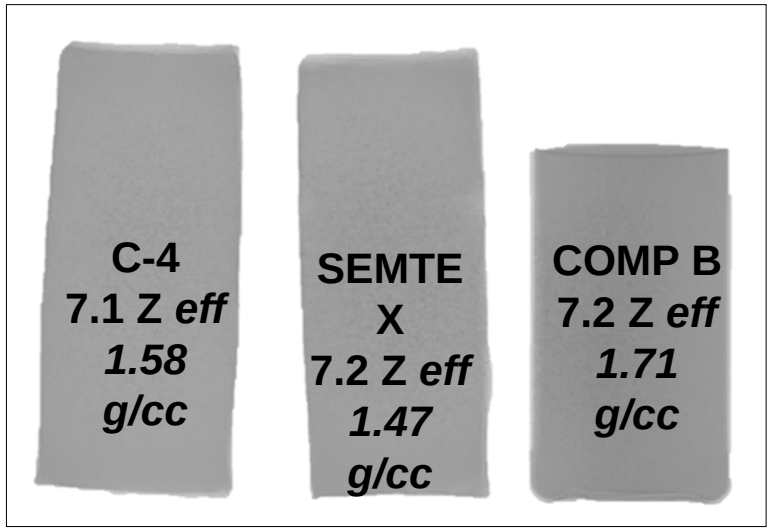
Identification of Explosives

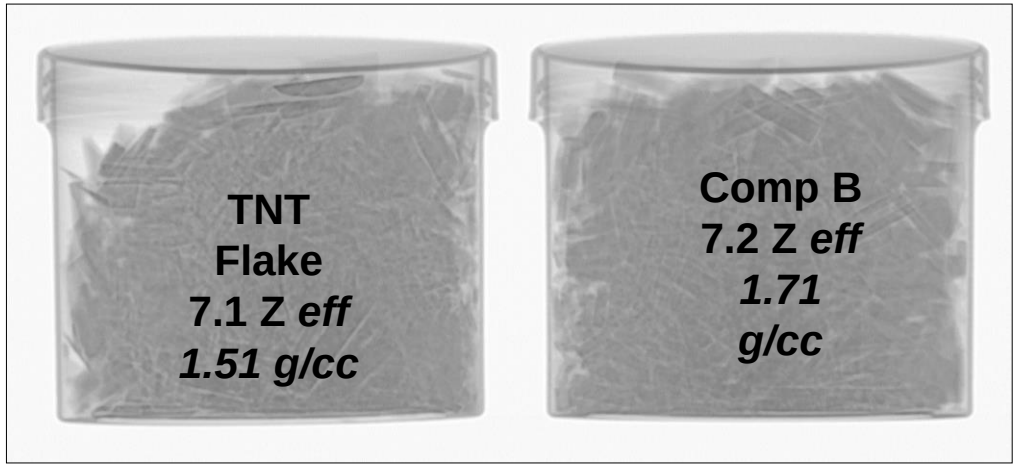




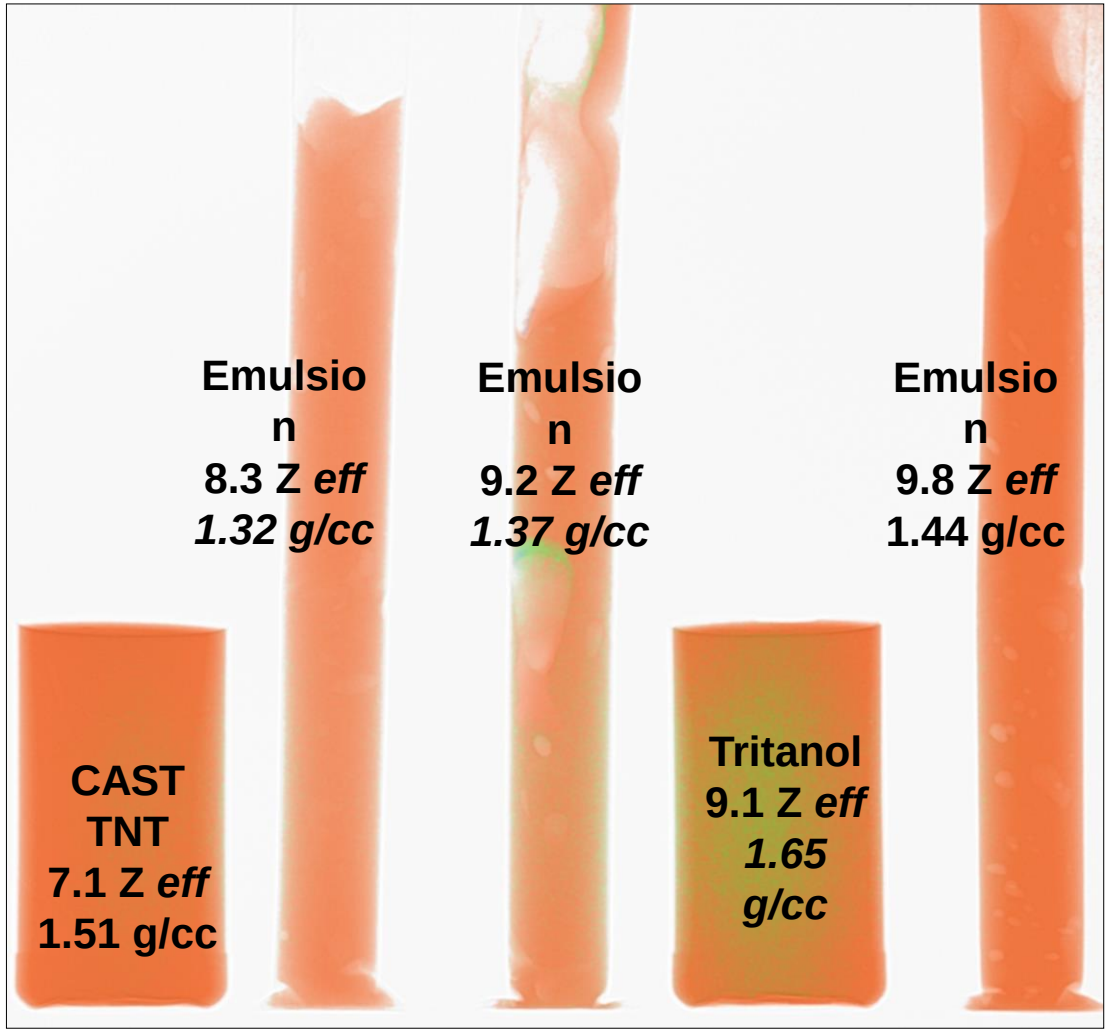
Identification of Explosives

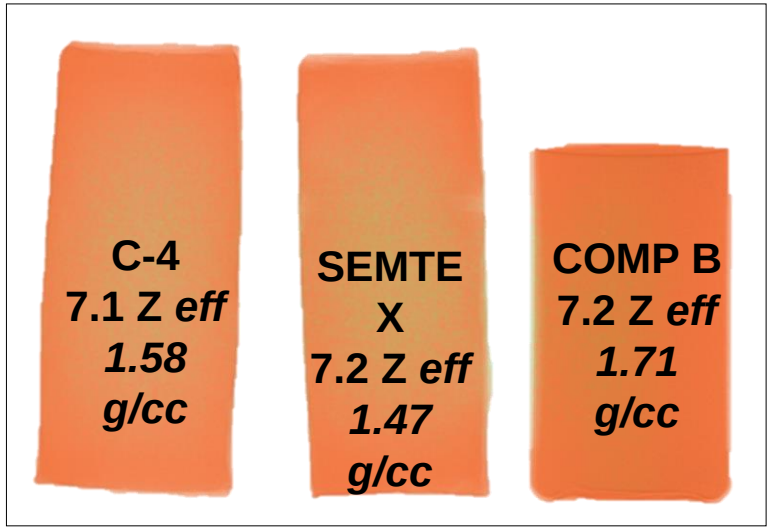


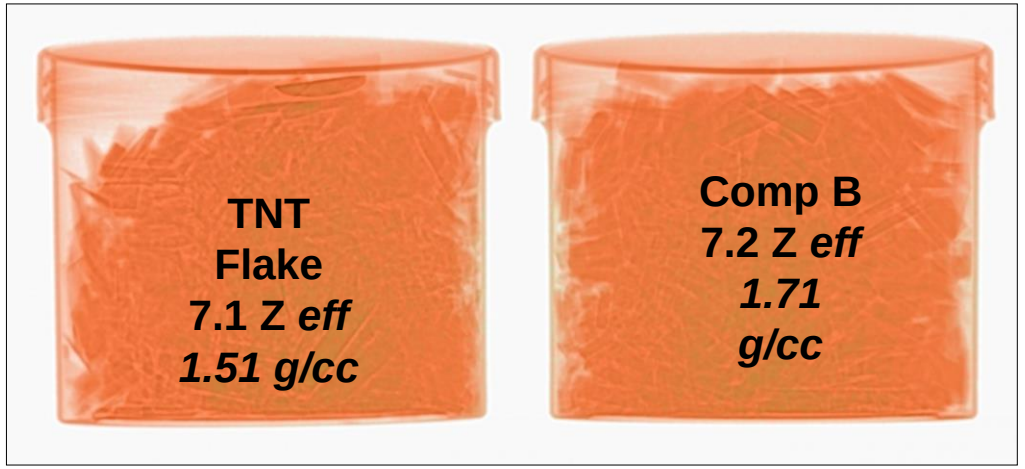




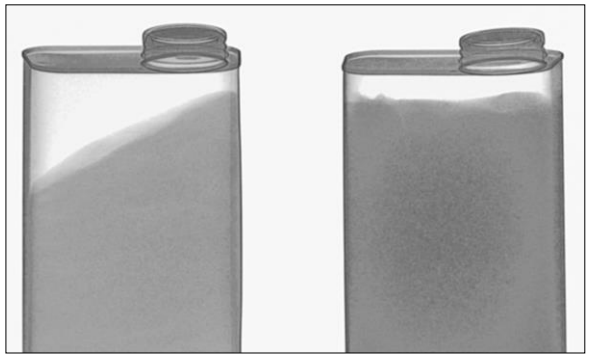
Identification of Explosives

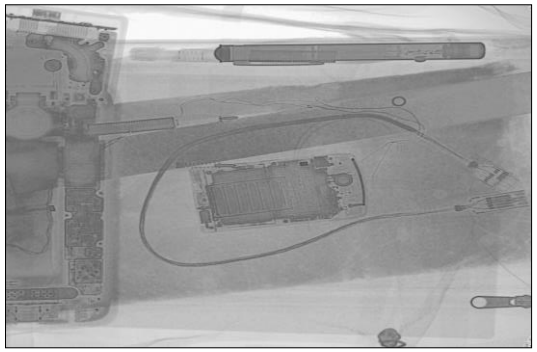


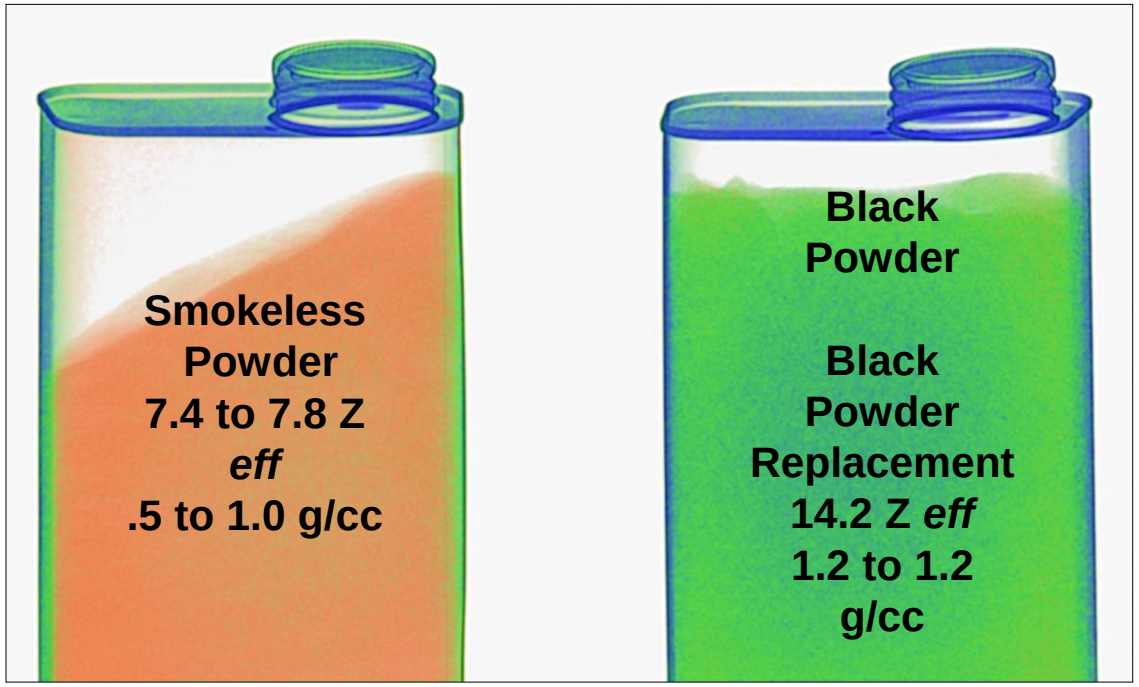


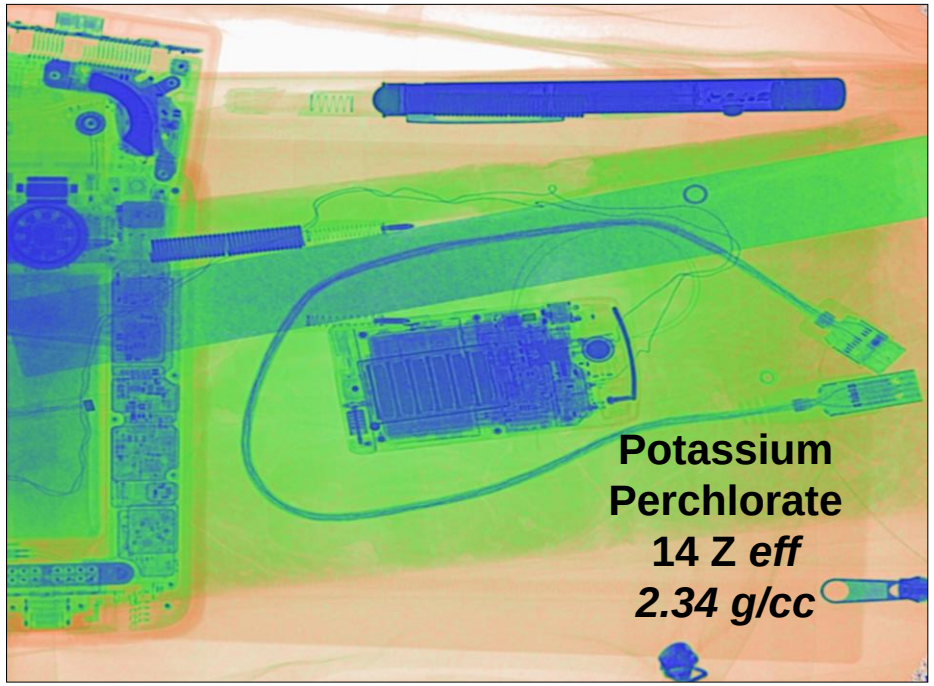


Identification of Explosives

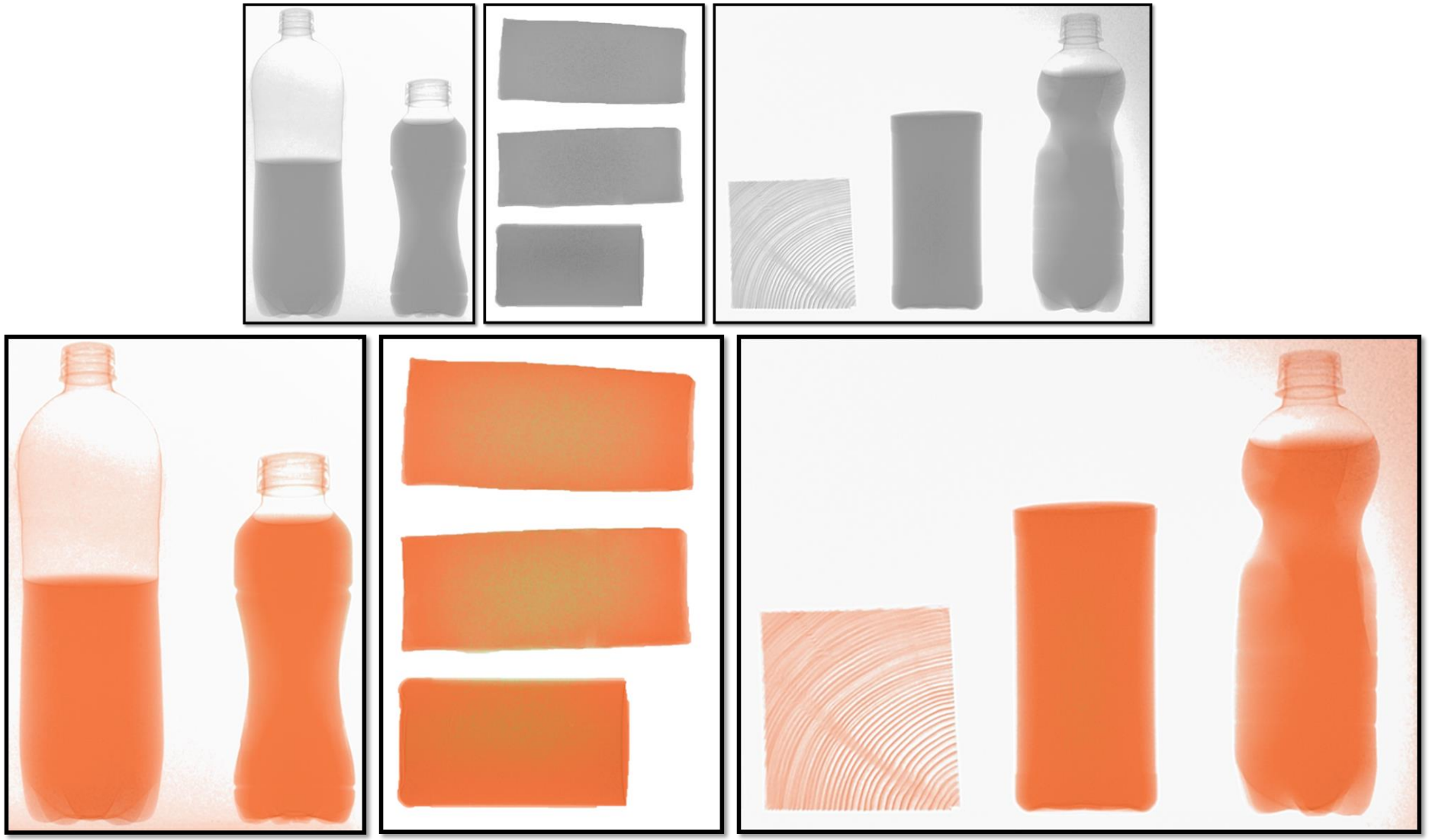




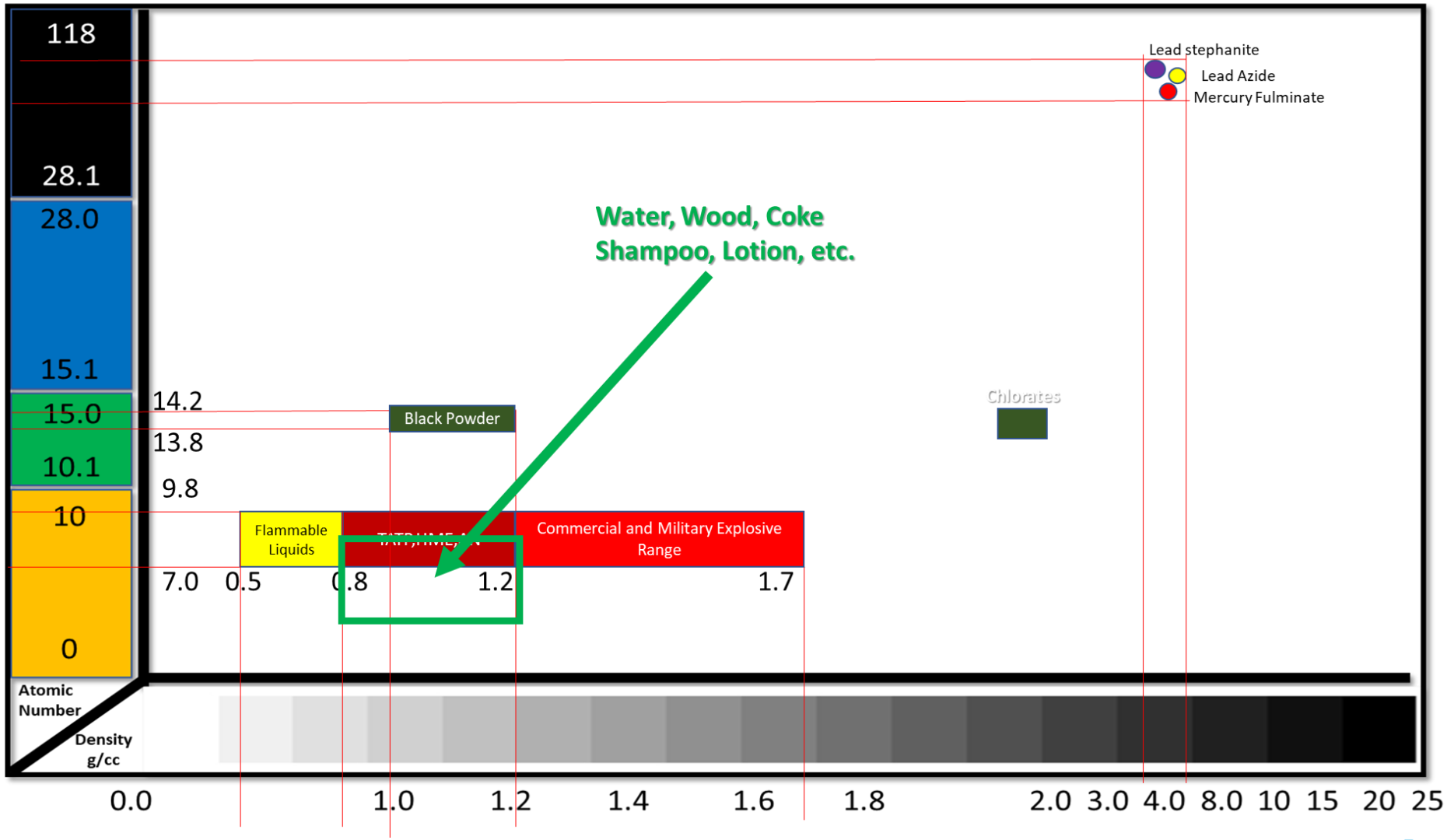




Organics, how do you tell the difference

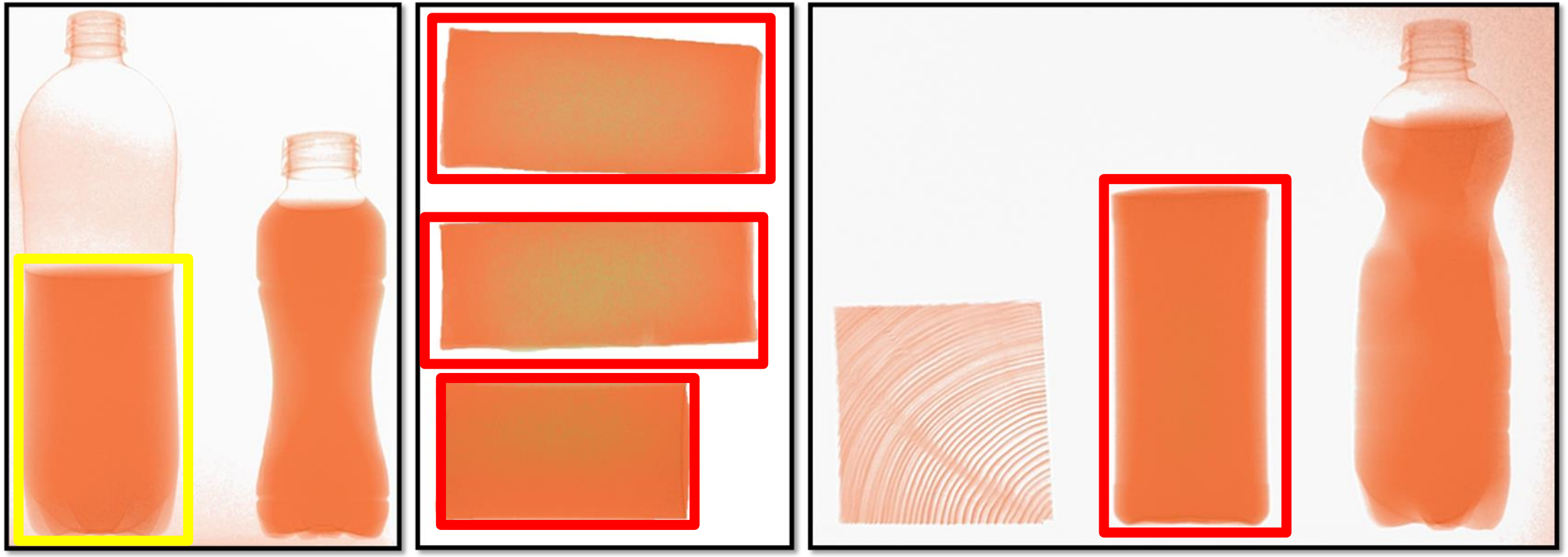


Organics, how do you tell the difference

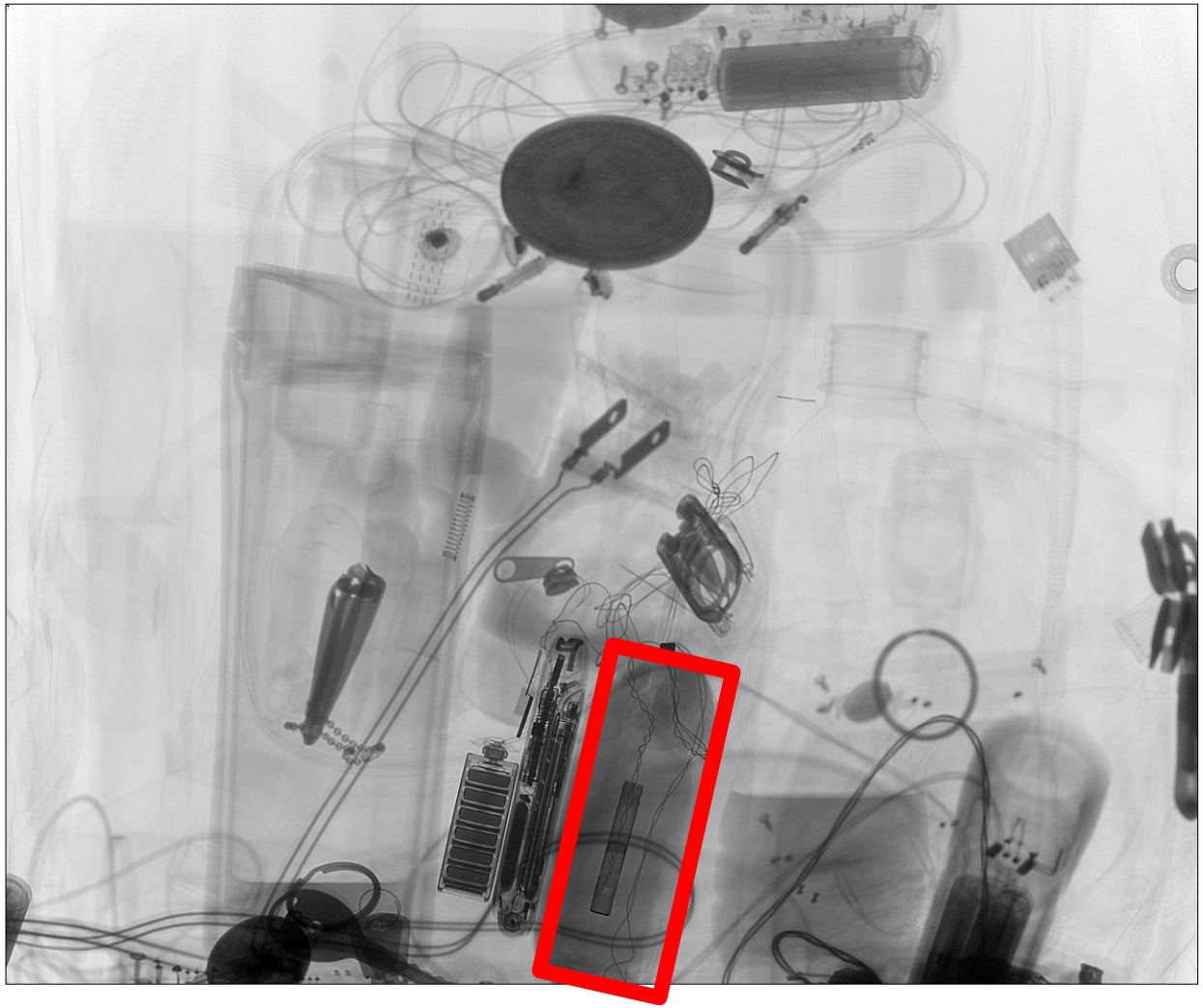


Organics, how do you tell the difference

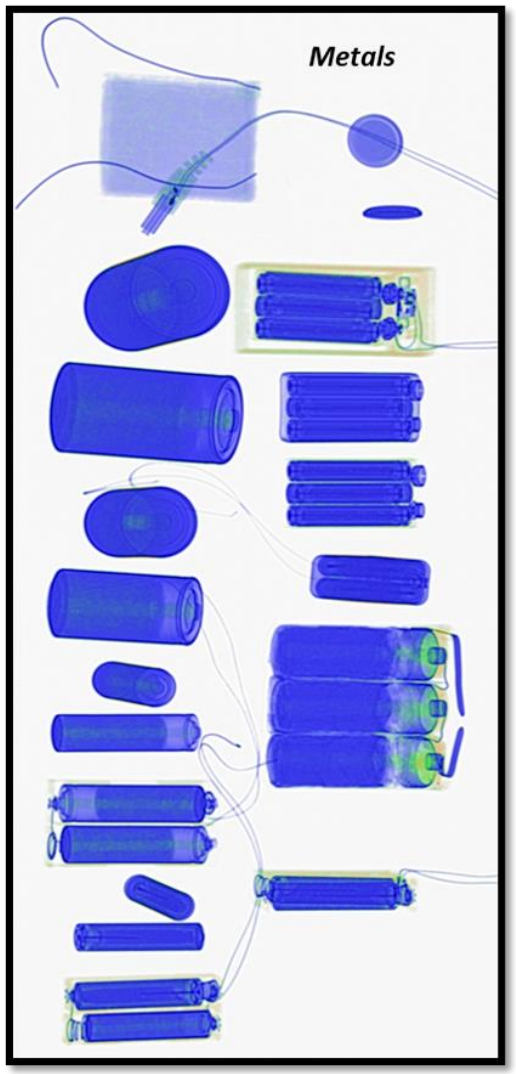
With a dual energy measurement you can DIFFERENTIATE between potential explosives, flammable, and other organic materials
You CANNOT do this with grey scale

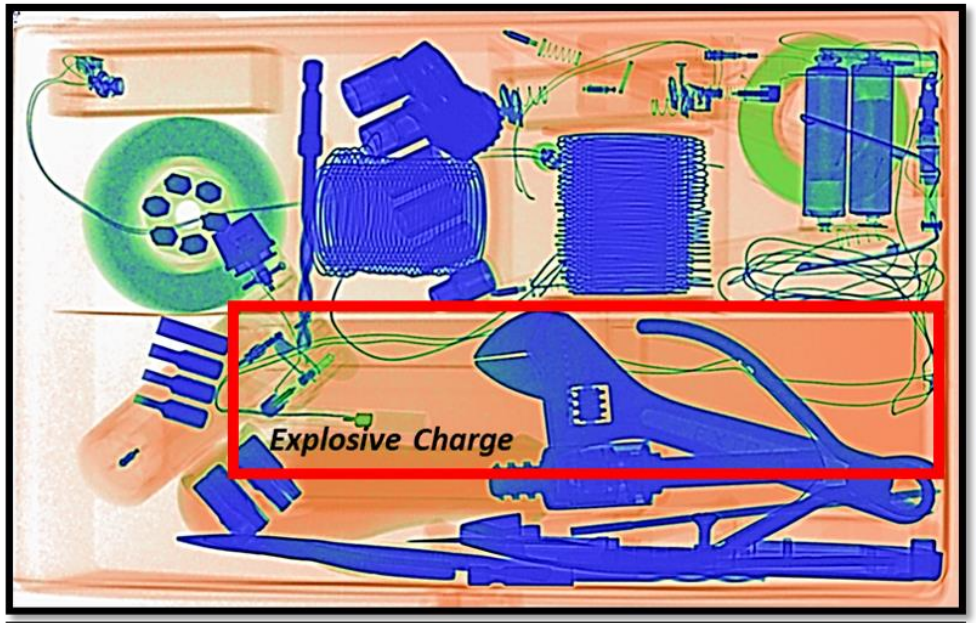


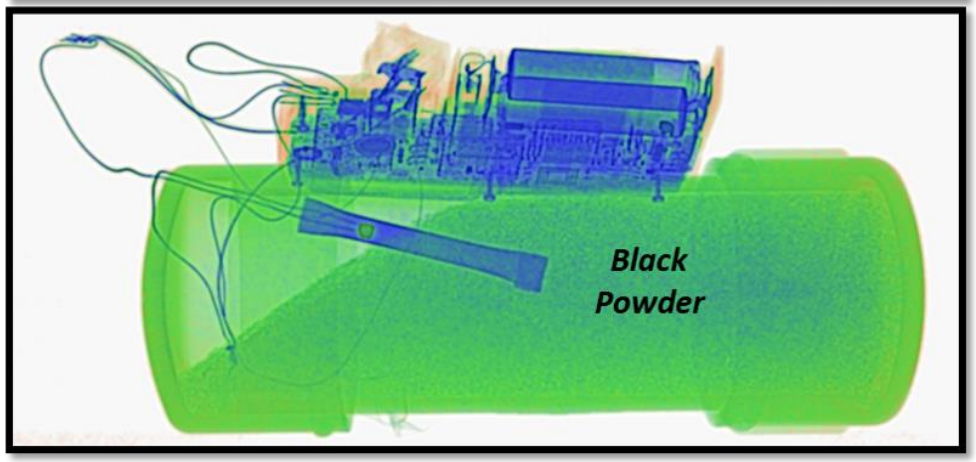
Organics, how do you tell the difference

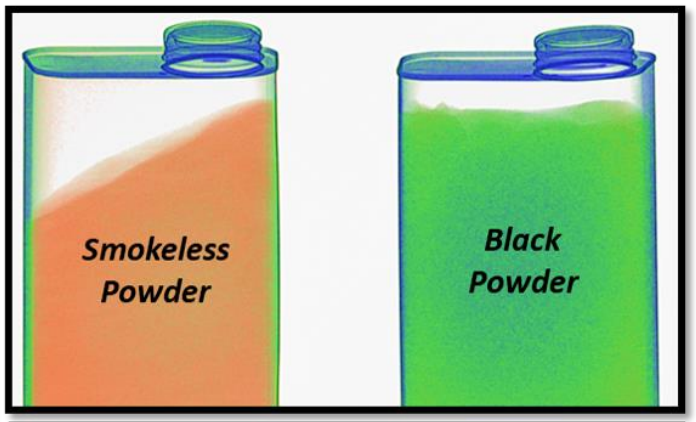


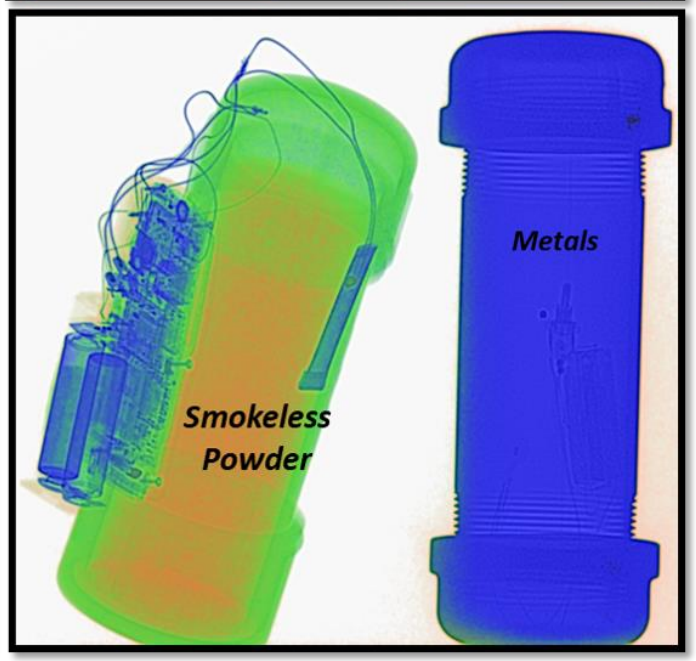
Dual Energy provides more information









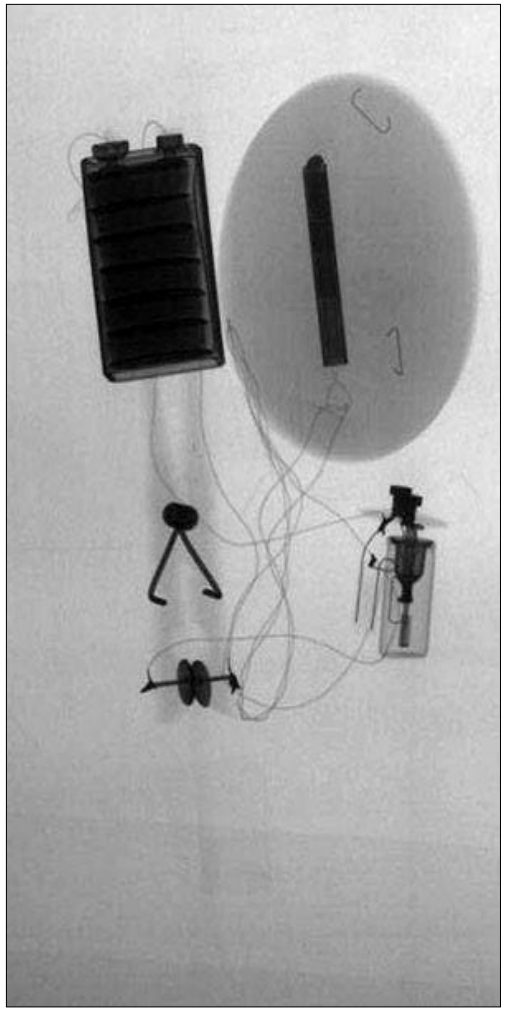


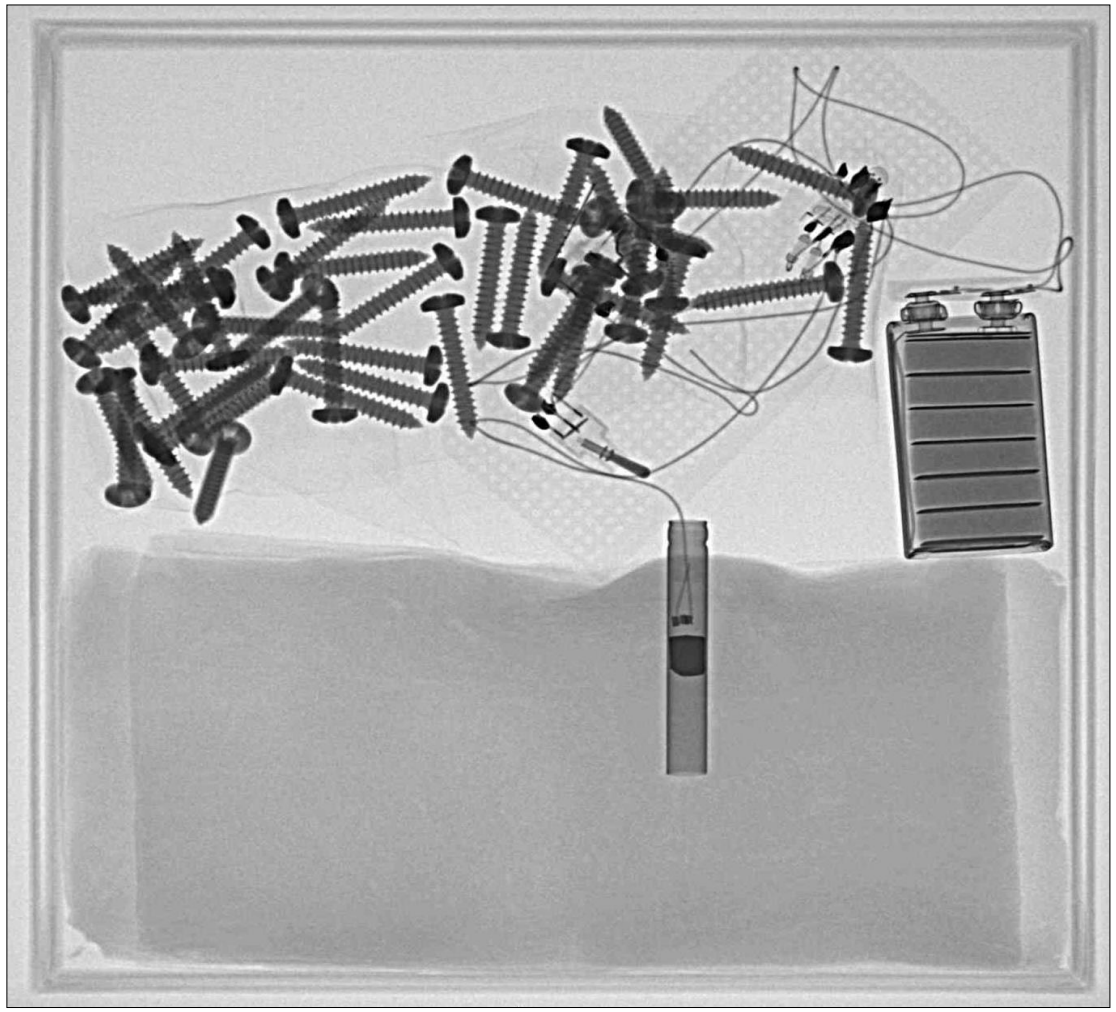
Render Safe Grey Scale vs Dual Energy

Render Safe

When the

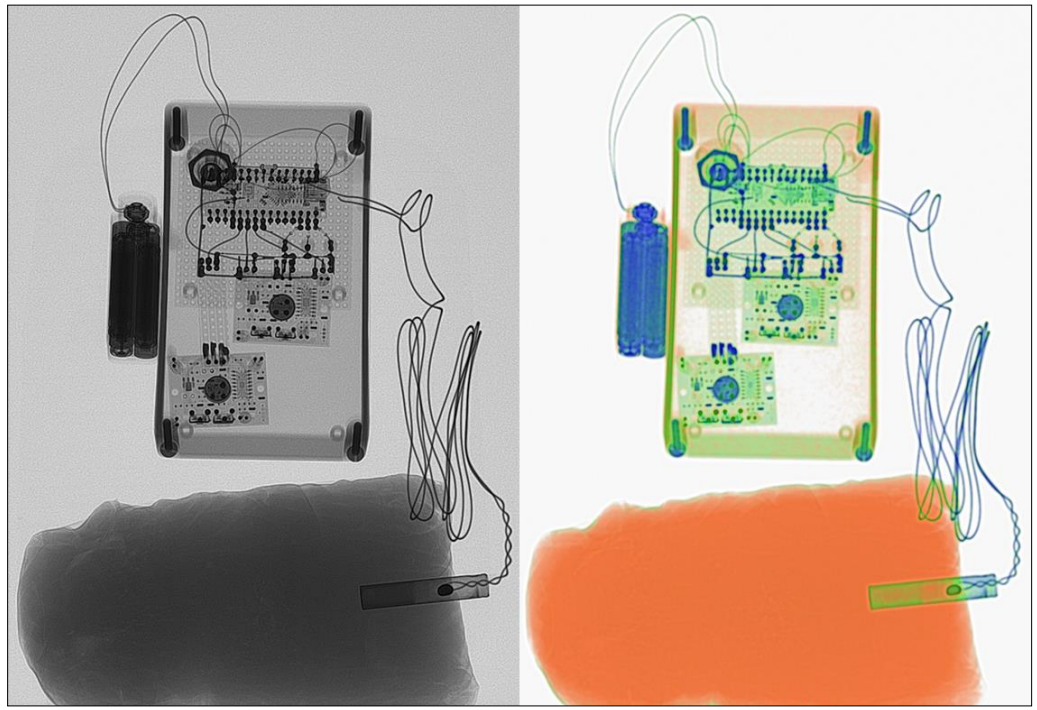
IED looks like this the render safe procedure is easy and grey scale works great





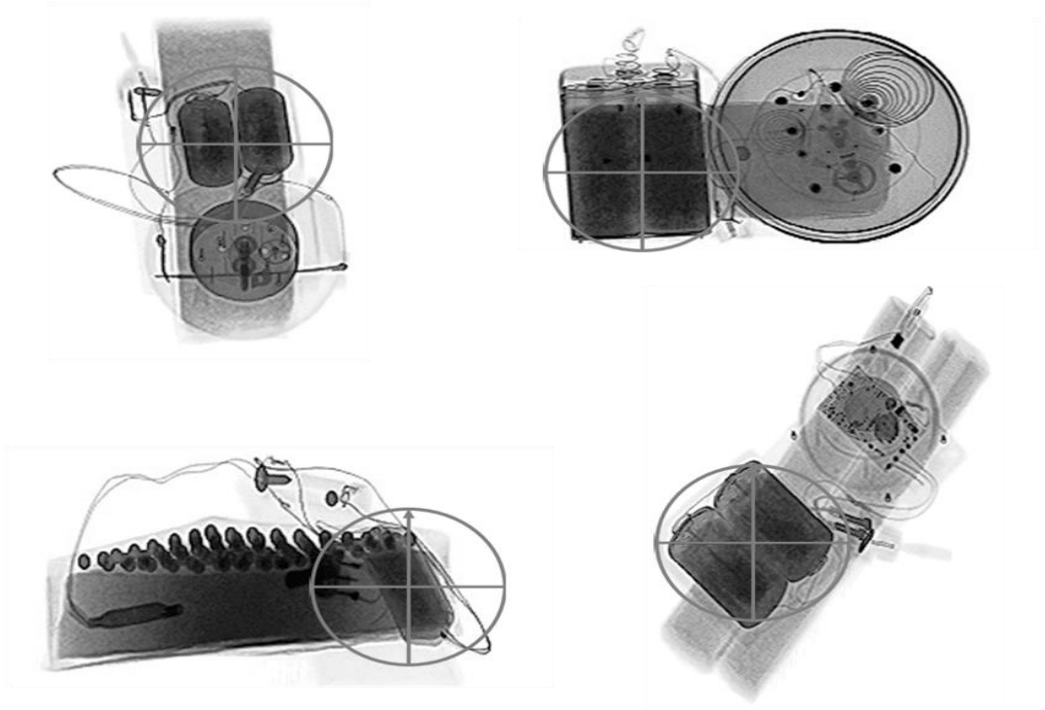
Render Safe

This is a *component based* constructed IED meaning each part is all laid out nice and neat. They are not made like this.



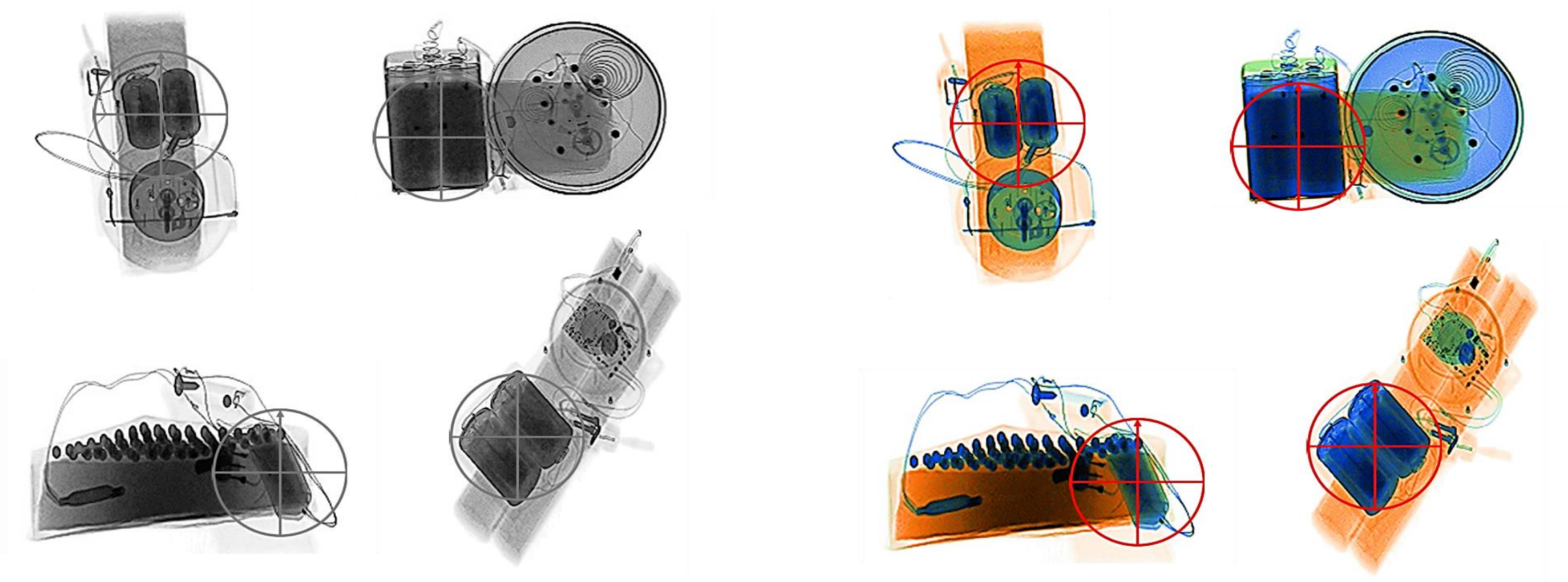
This is a *holistic based* constructed IED meaning everything is combined

Where is the explosive?

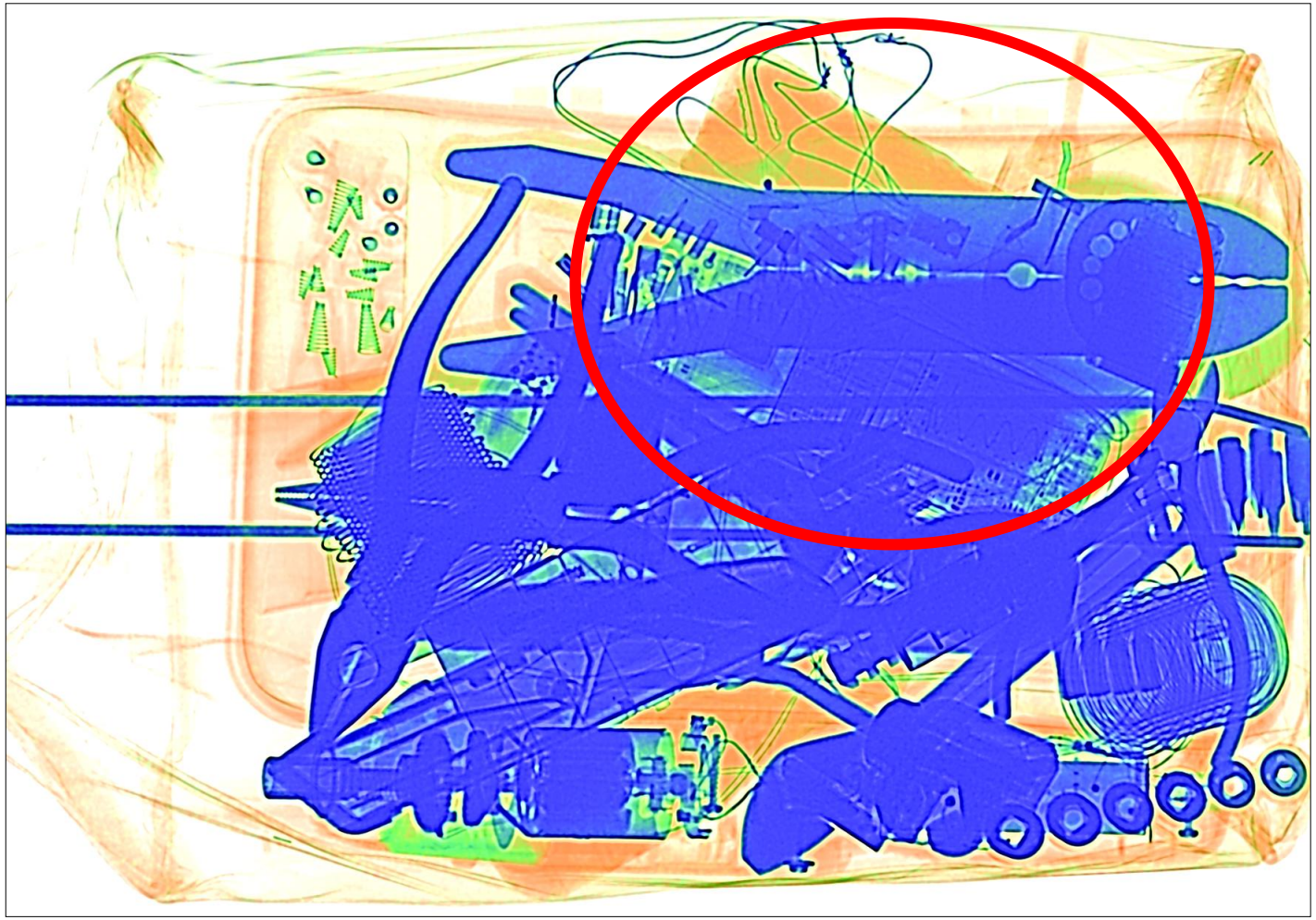


Render Safe

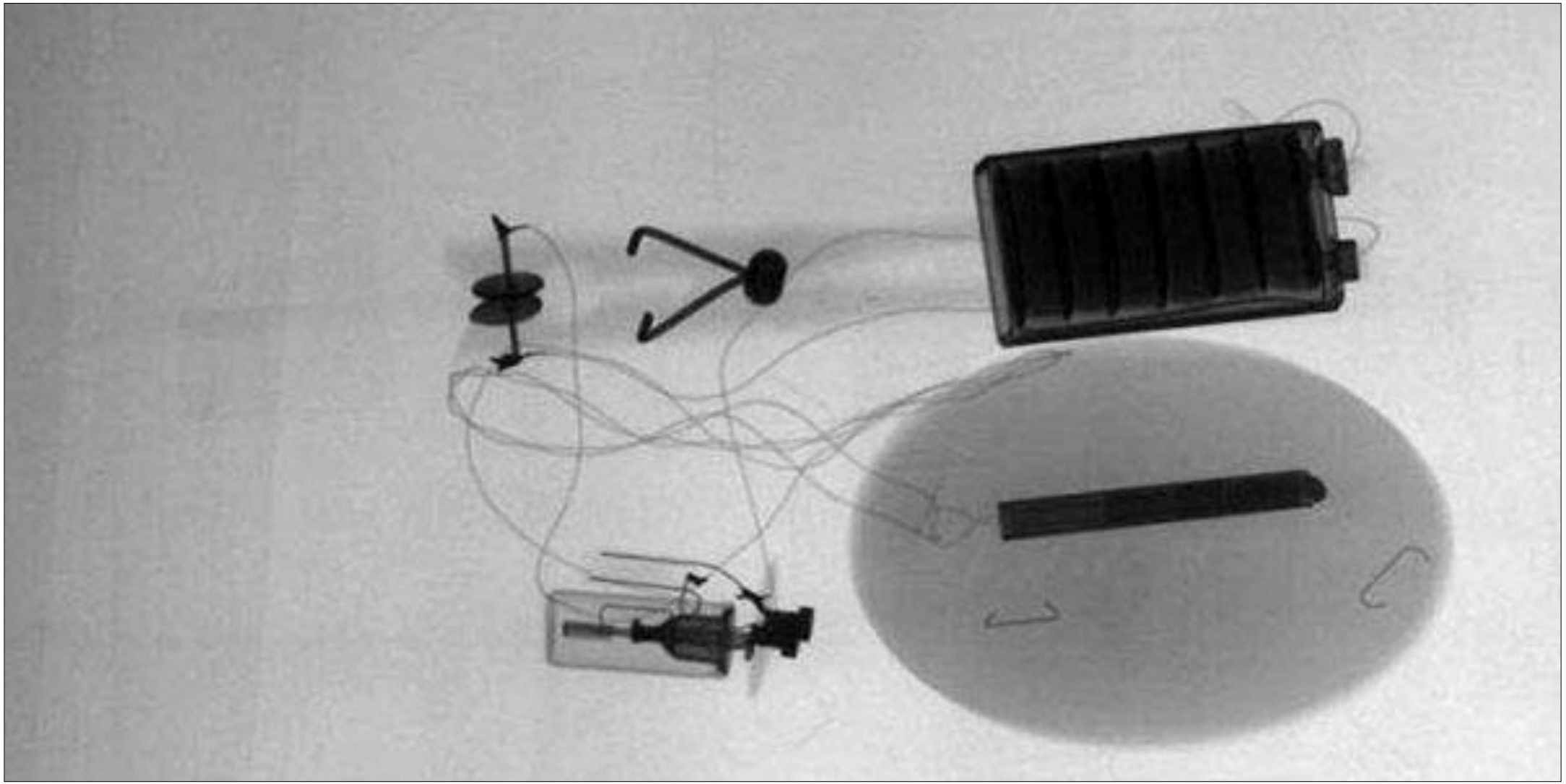
You cannot develop an educated RSP with grey scale on a holistic constructed IED



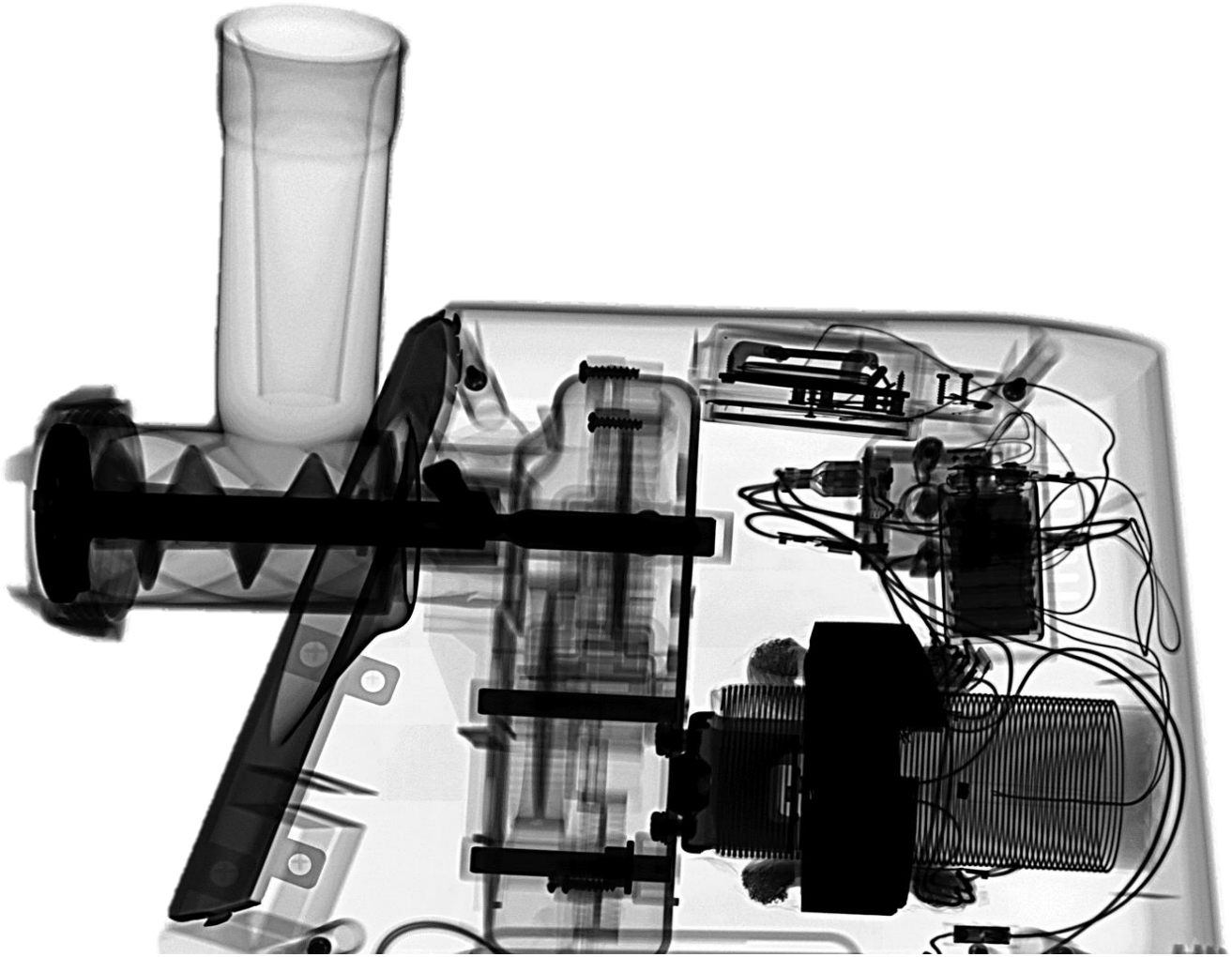
Reality

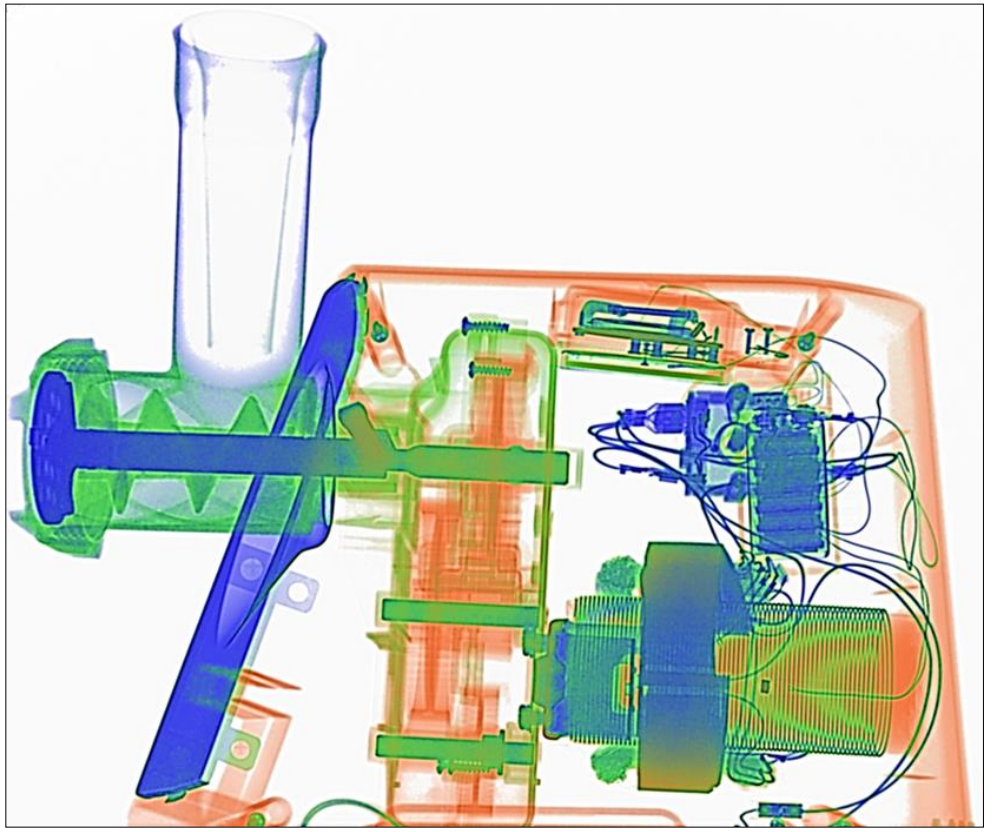


Not Reality

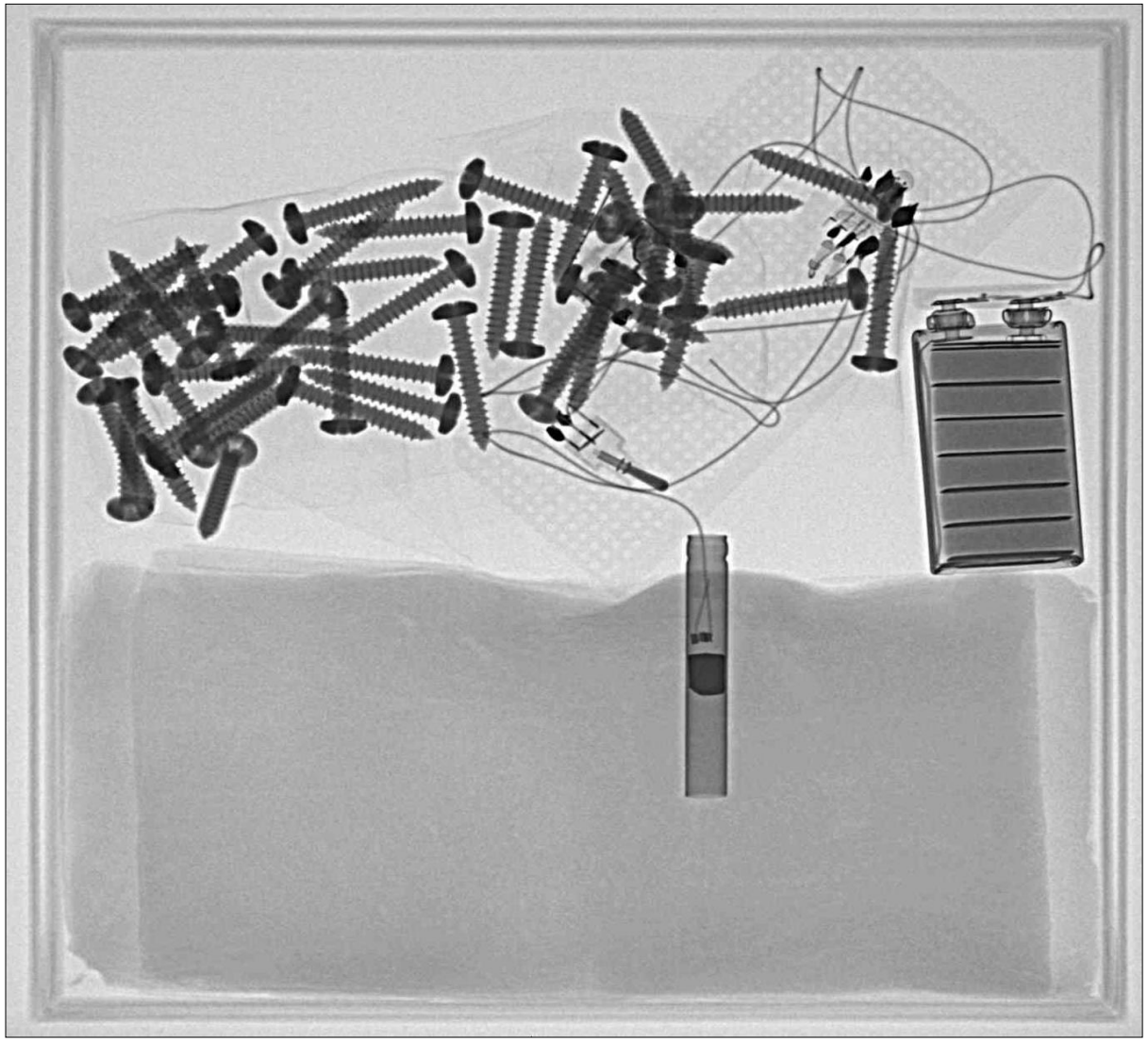


Reality

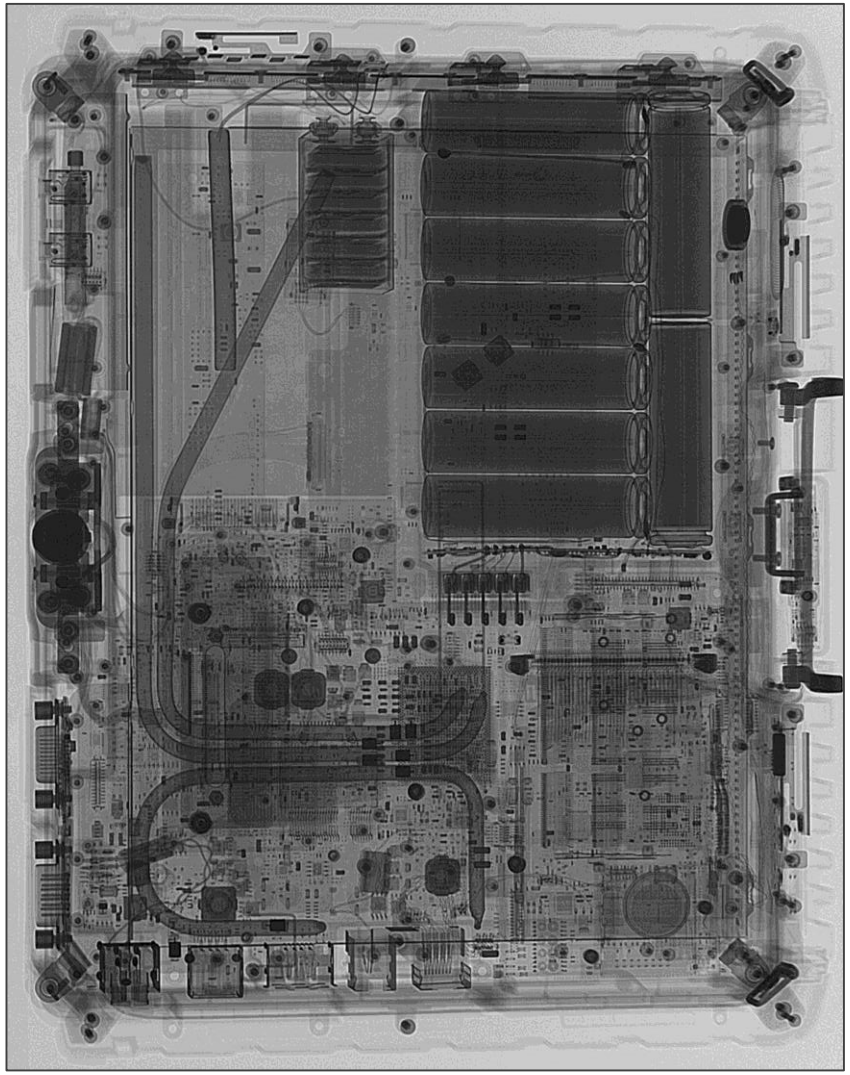




Not Reality



Reality



Not Reality

Reality

IED’s are complex 3D problems that a 2D grey scale images provide very little ability to solve

Dual energy provides more information that allows you to apply more information to the problem

The goal is a successful RSP and grey scale on real IED’s is a poor tool for the job

VC security

by VisiConsult

Contact

Liron Noar, Security Division Manager: +34 600 796 152

John Howell, Security EOD/IED Specialist: +1 828 564 3456