

## Do "backscatter" X-ray systems pose a risk to frequent fliers?

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If you were pulled out of line at an [airport security](#) checkpoint and asked to choose between a pat-down and a very revealing [X-ray](#), which would you choose? In a three-month trial that began in the Phoenix Sky Harbor International Airport on February 23, 2007, most passengers chose the X-ray, known as the Z Backscatter X-ray system. **Backscatter technology** can detect objects that regular X-ray scanners and [metal detectors](#) can't pick up very well, like ceramic knives, drugs and [liquid explosives](#).

This is the technology that caused a privacy uproar when it was first revealed as a possible addition to airport security. The backscatter X-ray scanner sees through clothes and is capable of producing photo-quality views of its subject. So in theory, passengers selected for additional screening with the backscatter system could be subjecting themselves to a peep show by airport employees.

The backscatter system works differently than the usual X-ray scanners that check out your carry-on luggage.

The X-ray scanners we send our carry-on bags through are usually **dual-energy X-ray systems**. In this type of system, the X-ray source sends out a single X-ray beam. Different types of materials -- organic, inorganic and metallic, for instance -- react differently to X-rays, which are basically very high-energy [light photons](#). Depending on the density and atomic properties of an object, it may absorb X-rays, let X-rays pass right through or scatter the X-rays on impact. Organic material, like skin, bananas and liquid explosives, tend to let X-rays pass through them. In a dual-energy system, after the X-rays interact with the objects in your carry-on bag, they reach three barriers: a detector that picks up the pattern created by both high- and low-energy absorption and pass-through; a filter that then removes the lower-energy X-rays; and then a high-energy detector, which picks up the pattern of the high-energy X-ray absorption and pass-through. A computer program then compares the images from the two detectors in order to provide a very clear, color-coded image of the different types of materials in your bag. It's the comparison of the first detector's image with the last detector's image that highlights the "low-energy objects" -- mostly the organic stuff -- in the bag.

The Z Backscatter system made by American Science and Engineering works differently. Instead of relying on images created by the absorption and pass-through properties of the objects being X-rayed, the backscatter system picks up images produced when materials **scatter** X-ray photons. An X-ray scatter pattern is more specific than an absorption pattern when it comes to identifying organics. A scatter pattern changes depending on the element it's interacting with -- carbon, hydrogen or lithium, for instance. Elements with lower atomic numbers (fewer protons) on the periodic table scatter X-ray photons very powerfully, while elements located farther down on the periodic table tend to absorb more photons than they scatter. Most organics are located closer to the start of the periodic table. So backscatter systems are very good at imaging organic material --

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much better than dual-energy systems. They easily pick up the scatter patterns of drugs and explosives and body parts. This ability to detect and identify organic material, along with a technology called "Flying Spot" that lets the machine pinpoint the location of a particular X-ray beam at any given moment in time, allow backscatter images to be incredibly accurate and lifelike.

It's also why some people object to incorporating the technology into airport security checkpoints. Most of us don't want strangers viewing incredibly accurate and lifelike pictures of our bodies. And yes, it's possible for backscatter X-raying to produce photo-quality images of what's going on beneath our clothes. But because of privacy concerns, for the time being, the peep show has been **distorted**: The trial system in Phoenix produces cartoon-like outlines of the passengers being X-rayed, not photo-quality images, and the private areas are blurred.

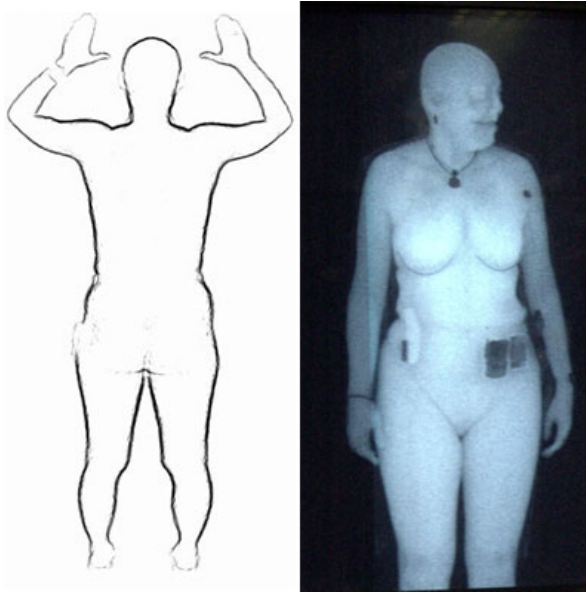


Image courtesy AP

**Left: The type of image the test system in Phoenix is producing  
Right: What Z Backscatter is capable of**

Some wonder how, then, the system can actually boost security. And the manufacturer, American Science and Engineering, Inc., admits that distorting the image does decrease the machine's usefulness. What if someone tapes a vial of liquid explosives to his scrotum? This is one of the issues the trial run in Phoenix hopes to resolve. Can a backscatter system still increase security if its images are obscured?

The other issue besides privacy that has surrounded backscatter X-raying has to do with **radiation exposure**. Most of us do not get X-rayed on a regular basis; and when we do get X-rayed in a hospital or doctor's office, we've got a lead vest thrown over our vital organs. But at airports, there's no lead vest. So are people who travel a lot going to be subjected to dangerous levels of radiation if they get backscattered too often? Most experts say no. According to the Health Physics Society (HPS), a person undergoing a backscatter scan receives approximately 0.005 millirems (mrem, a unit of absorbed radiation). American Science and Engineering, Inc., actually puts that number slightly higher, in the area of .009 mrem. According to U.S. regulatory agencies, 1 mrem per year is a negligible dose of radiation, and 25 mrem per year *from a single source* is the upper limit of safe radiation exposure. Using the HPS numbers, it would take 200 backscatter scans in a year to reach a negligible dose -- 1 mrem -- of radiation. You receive 1 mrem from three hours on an [airplane](#), from two days in Denver or from three days in Atlanta. And it would take 5,000 scans in a year to reach the upper limit of safety. A traveler would have to get 100 backscatter scans per week, every week, for a year, in order to be in real danger from the radiation. Few frequent flyers fly that frequently.

For more information on backscatter technology, airport security and related topics, check out the following links:

- [How Airport Security Works](#)
- [How Liquid Explosives Work](#)
- [How Metal Detectors Work](#)
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- [American Science and Engineering: Z Backscatter](#)
- [Electronic Privacy Information Center: "Backscatter" X-Ray Screening Technology](#)
- [Health Physics Society: Screening Individuals with Backscatter X-Ray Systems](#)

#### Sources

- Bowers, Faye. "With full-body X-ray, a closer look at air travelers." The Christian Science Monitor. Feb. 26, 2007.  
<http://www.csmonitor.com/2007/0226/p02s02-ussc.html>
- Frank, Thomas. "Revealing X-ray scanner makes its debut." USA Today. Feb. 26, 2007.  
[http://www.usatoday.com/travel/flights/2007-02-26-backscatter-usat\\_x.htm](http://www.usatoday.com/travel/flights/2007-02-26-backscatter-usat_x.htm)
- "Radiation Exposure Examples." HyperPhysics.  
<http://hyperphysics.phy-astr.gsu.edu/hbase/nucene/radexp.html>
- "Screening Individuals with Backscatter X-Ray Systems." Health Physics Society.  
<http://hps.org/hpspublications/articles/screenindx-ray.html>
- "Z Backscatter." American Science and Engineering, Inc.  
[http://www.as-e.com/products\\_solutions/z\\_backscatter.asp](http://www.as-e.com/products_solutions/z_backscatter.asp)

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