Health Physics Society
Fact Sheet
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Health Physics Society
Specialists in Radiation Safety

Airport and Security Screening Systems

Denver airport security screening.
Photo courtesy of Dan Paluska/Flickr

Introduction

We as a society are now accustomed to seeing security screening systems in use at airports, courthouses, schools, ports of entry, and other areas where enhanced security measures are warranted. Several different systems exist to meet a certain need; some use *ionizing radiation*[*] such as x rays and some use *nonionizing radiation* such as millimeter waves and magnetic fields. Visitors, employees, students, and travelers alike are required to go through metal detectors and/or other security systems and often their personal belongings are x rayed if they wish to gain access to a certain building or area. Even with all of the screening, radiation exposure—both to the person being screened and the system's operator—is minimal and far below any level that would be of concern. This document will introduce and explain security screening equipment and its potential for exposing people to radiation. As with any use of radiation, the overarching concept is one of risk versus benefit. As we will see, the tiny incremental amount of risk, if any at all, posed by this radiation exposure is far outweighed by society's need for safe air travel, safe ports of entry, safe courthouses and schools, etc.

Metal Detectors

Metal detectors use low-intensity magnetic fields to locate metallic objects. When metal passes through these fields, sensors detect a change in the fields and an alarm goes off. Advanced metal detectors have several arrays of sensors that tell the operator where on the person metal was detected. Unfortunately, potentially harmful objects not containing metal may often pass undetected through these systems. Even though magnetic fields are a form of radiation, the radiation the machine emits is nonionizing. Essentially, this means that exposure to these low-intensity magnetic fields does not cause biological damage and even repeated exposure to metal detectors has shown no associated radiation risk.

Luggage and Bag Screening

Self-contained machines, typically called cabinet x-ray systems, are used to screen luggage and bags by using x rays to analyze the contents. The amount of radiation used is higher than in other screening technologies (like backscatter x-ray systems described below), but this is contained within the x-ray machine. Passengers and operators are exposed to very little radiation.

[*] Words in italics are defined in the Glossary on page 3.

These x-ray machines are designed with built-in shielding to help prevent radiation from exiting the device. A small amount of radiation may come out of this shielding—this is termed "leakage radiation." There are federal limits placed by the US Food and Drug Administration (FDA) on acceptable leakage rates for all types of x-ray producing equipment. These limits are established to keep people safe.

Any item that goes through an x-ray screening machine will receive ionizing radiation exposure; however, it is too low to damage your personal belongings and they cannot become radioactive from this procedure. Some photographic film may need to be hand-screened because the x rays can partially expose the film (just like a plain film x ray at the doctor's office).

Airport and Personnel Screening Systems

Some of the newest traveler screening systems use x rays for full-body scanning of travelers; these are generally referred to as backscatter systems. In these systems, low-energy x rays bounce off of the skin (or whatever is in your pockets) and back to detectors to show an image. That image will show hard objects (such as weapons) as well as soft objects (like a packet of gel or powder, which would not be caught by metal detectors).

Unlike metal detectors, these systems use ionizing radiation. Ionizing radiation, like x rays, has the potential for damaging human *DNA*. Because the public is being exposed to this radiation, exposure must be limited to a safe level. An American National Standards Institute/Health Physics Society industry standard states that the maximum allowable effective radiation *dose* for an individual from one screening (which generally consists of two scans) is limited to 0.25 *μSv* (microsieverts) with a maximum of 250 μSv per year for frequent flyers (ANSI 2009). Technology is constantly changing and most units (at the time of this writing) expose people to about half of the 0.25 μSv limit per two scans. This amount of exposure is well below any level of concern and, in fact, is less than 1 percent of the radiation you receive from natural sources in a single day or less than two minutes of airplane flight.

One alternative to backscatter x-ray systems, millimeter wave scanners, can also be found in use at security checkpoints. These systems use nonionizing radiation for full-body scanning of passengers. As with backscatter systems, millimeter wave scanners will also detect hard objects and those soft objects a metal detector would likely miss.

Other Security Screening Systems

Just as cabinet x-ray systems are used to screen a backpack or your luggage, some agencies use large cabinet x-ray systems to screen entire trucks and shipping containers for dangerous materials and contraband like illegal drugs. Also in common use are large radiation detectors called portal monitors to screen for radioactive material in a truck or container. Bomb squads are also equipped with portable units they can use to identify the internal contents of a suspicious package or unattended object.

Regulations

The FDA regulates the use of these devices (see the FDA website for details, linked in *Resources for More Information* below). In addition, individual states require periodic checks of x-ray systems used in public places, and they place restrictions on the radiation dose to which workers and members of the public can be exposed. Even older systems are still checked periodically to make sure they are safe and being operated in a safe manner by the facility's personnel.

Conclusion

Manufacturers of the radiation-generating systems for security screening purposes are continually improving the systems to reduce radiation exposure to personnel operating the systems and those who may pass through to be screened. Systems made today will give a lower radiation dose than systems made a decade ago. That doesn't mean older systems are unsafe—it is most accurate to say that these systems have gone from being **safe** to being **very safe**.

Security screening is a part of modern living and the need for safety continues. The technology used in screening people and their belongings exposes us to minimal amounts of radiation.

Glossary

This fact sheet may use terms that are unfamiliar. Many of these are denoted in italics in the text and are defined in this glossary. More can be found on the Radiation Terms and Definitions page on the Health Physics Society website at http://hps.org/publicinformation/radterms.

DNA
Deoxyribonucleic acid (DNA) is a nucleic acid that contains the genetic instructions for the biological development of a cellular form of life or a virus. All known cellular life and some viruses have DNA. DNA is a long polymer of nucleotides (a polynucleotide) that encodes the sequence of amino acid residues in proteins, using the genetic code.

Dose
A general term used to refer either to the amount of energy absorbed by a material exposed to radiation (absorbed dose) or to the potential biological effect in tissue exposed to radiation (equivalent dose).

Ionizing Radiation
Electromagnetic waves or particles of high-enough energy to create ions, that is, to remove electrons from an atom.

Nonionizing Radiation
Electromagnetic waves or particles with insufficient energy to create ions.

Sievert or Sv
The International System of Units (SI) unit for dose equivalent equal to 1 joule/kilogram. The sievert has replaced the rem; one sievert is equal to 100 rem. The average person in the United States receives about 6 millisievert annually.

References

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Resources for More Information

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The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Formed in 1956, the Society has approximately 3,500 scientists, physicians, engineers, lawyers, and other professionals. Activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. The Society may be contacted at 950 Herndon Parkway, Suite 450, Herndon, VA 20170; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.