

## Radiation-Emitting Products

### Frequently Asked Questions on Cabinet X-ray Systems

#### **Q1: What is a cabinet x-ray system?**

A1: A cabinet x-ray system is an x-ray system installed in an enclosure. The enclosure is intended to protect people from the x-rays generated and to exclude people from the enclosure's interior. Cabinet x-ray systems are primarily used for security screening and industrial quality control. Security applications range from screening baggage at an airport to examining whole trucks at the border. Industrial quality control applications include the x-ray examination of foods, circuit boards, and tires. Some cabinet x-ray systems are also medical devices, such as a cabinet x-ray system used for analysis of tissue samples in a medical laboratory.

#### **Q2: What are other common names for cabinet x-ray systems?**

A2: Other common names for cabinet x-ray systems are X-ray Inspection Systems, X-ray Screening Systems, X-ray Security Systems, and Baggage X-ray Systems. The words inspection, screening, security, and baggage might also be used interchangeably with or in addition to the description of a cabinet x-ray system.

#### **Q3: Which agency has responsibility for assuring that manufacturers produce cabinet x-ray systems that do not pose a radiation safety hazard?**

A3: The US Food and Drug Administration (FDA) has responsibility for assuring manufacturers produce cabinet x-ray systems that do not pose a radiation safety hazard. For most electronic products that emit radiation, safety regulation is divided between FDA and state regulatory agencies. Typically, FDA regulates the manufacture of the products and the states regulate the use of the products. For further information on FDA regulations that apply to manufacturers of electronic products that emit radiation (such as a cabinet x-ray system) see the FDA web site (<http://www.fda.gov/cdrh/radhealth/ppandt.html>).

Note: Manufacturers may be subject to additional FDA regulations if their cabinet x-ray system product is intended to be used in a medical application (e.g. specimen radiographs made in a medical laboratory) or in the inspection of foods (e.g. finding contamination in food such as metal fragments or bone chips found during manufacturing). These regulations do not address cabinet x-ray system radiation safety and their details are beyond the scope of this document.

#### **Q4: What other Federal Agencies are involved in radiation safety when the source of the radiation is an x-ray product?**

A4: The US Environmental Protection Agency (EPA) is responsible for issuing

general radiation guidance to Federal Agencies. Additionally, basic information about radiation is available on the EPA web site (<http://www.epa.gov/radiation/index.html>). The US Occupational Health and Safety Administration (OSHA) has regulations on worker safety from radiation in the workplace (<http://www.osha.gov>).

**Q5: Is it safe to stand or walk near a cabinet x-ray system while it is producing x-rays?**

A5: Yes. Manufacturers are required to certify that their products meet the Federal radiation safety performance standard for cabinet x-ray systems. Specifically, the standard requires that the radiation emitted from a cabinet x-ray system not exceed an exposure of 0.5 milliroentgens in one hour at any point five centimeters from the external surface. Most cabinet x-ray systems emit less than this limit. In addition, the standard also requires safety features that include warning lights, warning labels, and interlocks.

For comparison, the average person in the United States receives a dose of about 360 millirem of radiation per year from background radiation. (Note: 1 milliroentgen of exposure to x-rays will result in approximately 1 millirem of dose. These terms are defined later in this document.) Background radiation is radiation that is always present in the environment. Eighty percent of that exposure comes from natural sources: radon gas, the human body, outer space, rocks, and soil. The remaining 20 percent comes from man-made radiation sources, primarily medical x rays.

For additional information on certification and labeling, see [Title 21 Code of Federal Regulations \(CFR\) 1010](#). For the details of the cabinet x-ray performance standard see [Title 21 CFR 1020.40](#). For further information on recommended limits of radiation exposure, we recommend the National Council on Radiation Protection and Measurements Report 116, *Limitation of Exposure to Ionizing Radiation (1993)*.

**Q6: Is it safe for pregnant women to stand or walk near a cabinet x-ray system while it is producing x-rays?**

A6: Yes. The limit on radiation emission established by the performance standard is sufficiently restrictive that there is no additional hazard for specific populations such as children or pregnant women. For additional details please see the answer to [question 5](#).

**Q7: Are the operators of cabinet x-ray systems required to wear a "radiation badge"?**

A7: Personnel monitoring equipment is not required by Federal regulation for operators of cabinet x-ray systems. It is possible that some state regulations or the policies of the operators' employer require use of personnel monitoring equipment. Personnel monitoring equipment means devices designed to be worn or carried by

an individual for the purpose of measuring a radiation dose received (e.g. film badges, pocket dosimeters, film rings, etc.). For more information, please see the OSHA regulations found in Title 29 CFR 1910.1096(d) *Precautionary procedures and personal monitoring* and contact OSHA. The OSHA regulations are based on the amount of radiation that a worker can receive in a specific area from all radiation sources. The Federal limit on cabinet x-ray system emissions ensures the maximum possible exposure from cabinet x-ray systems in the workplace will always fall below the minimum threshold where personnel monitoring might be required.

**Q8: Is it safe to eat food, drink beverages, use medicine, or apply cosmetics if any of these products have gone through a cabinet x-ray system?**

A8: There are no known adverse effects from eating food, drinking beverages, using medicine, or applying cosmetics that have been irradiated by a cabinet x ray system used for security screening.

The radiation dose typically received by objects scanned by a cabinet x-ray system is 1 millirad or less. The average dose rate from background radiation is 360 millirad per year. The minimum dose used in food irradiation for food preservation or destruction of parasites or pathogens is 30,000 rad.

For more detailed information on radiation used for food inspection or food treatment, see [Title 21 CFR 179](#), [www.FoodSafety.gov](http://www.FoodSafety.gov), contact FDA's [Center for Food Safety and Nutrition](#), or contact the [United States Department of Agriculture Food Safety Inspection Service](#).

**Q9: Will my electronic equipment be harmed by x-rays when it passes through a cabinet x ray system?**

A9: No, the x-ray dose received when a piece of electronic equipment is scanned by a cabinet x ray system used for security screening will not harm electronic equipment.

**Q10: Will my photographic film be damaged by x-rays when it passes through a cabinet x ray system?**

A10: It is unlikely, but possible. Most cabinet x-ray systems used in the United States for security screening are built to be safe for all but the fastest film speeds (speeds below 1000). Multiple exposures of film to even film safe x-ray systems may eventually result in fogging or increased granularity. However, some systems, usually those scanning checked baggage, and some x-ray systems used in other parts of the world are not designed to be film safe. Manufacturers are not required by federal regulation to build their systems to be film safe. Your film manufacturer should be able to provide more specific recommendations about the storage and transport of exposed and unexposed film.

**Q11: What do the terms exposure and dose mean? What do their measurement units mean?**

A11: **Exposure** is a term defining the amount of ionizing radiation that strikes living or inanimate material. (This is a general definition. In health physics, exposure is specifically defined as a measure of ionization in air caused by x-ray or gamma radiation only.)

**Dose** means the quantity of radiation or energy absorbed. Dose may refer to the following:

- absorbed dose, the amount of energy deposited per unit mass.
- equivalent dose, the absorbed dose adjusted for the relative biological effect of the type of radiation being measured.

**Roentgen (R)** is a unit of exposure of ionizing radiation and indicates the strength of the ionizing radiation. One Roentgen is the amount of x-ray needed to produce ions carrying 1 electrostatic unit of electrical charge in 1 cubic centimeter of dry air under standard conditions.

**Roentgen absorbed dose (rad)** is the basic unit of absorbed radiation dose. A dose of 1 rad to an object means each gram of the object received 100 ergs of energy or  $1 \text{ rad} = 100 \text{ ergs/gram}$ .

**Roentgen Equivalent Man (rem)** is the basic unit of equivalent dose, and relates the absorbed dose in human tissue to the biological effect of the radiation. Not all radiation has the same biological effect, even for the same amount of absorbed dose.