Australian Government
Australian Radiation Protection and Nuclear Safety Agency

# Fact Sheet 29

# Airport Passenger Screening Technologies

## The latest airport security screening technologies use non-ionising radiation for whole-body imaging

### Introduction

Security screening at airports has been common practice for many years, but has recently undergone significant changes. The latest technologies for airport security screening are whole-body imaging machines. These machines operate by scanning X-ray (ionising radiation) or extremely high frequency radiofrequency (RF) radiation (non-ionising radiation) over the passenger's form. These low output X-ray whole-body scanners or millimetre wave scanners provide alternatives to the traditional pat-down method of body searching and extend the detection capabilities of existing technologies. The machines are designed to detect weapons, explosives and other prohibited items. Some of these technologies can also detect explosives that can be carried by passengers onto civil aircraft in a liquid, aerosol or gel form. Some of these technologies are already in use in the United States, Canada and Europe.

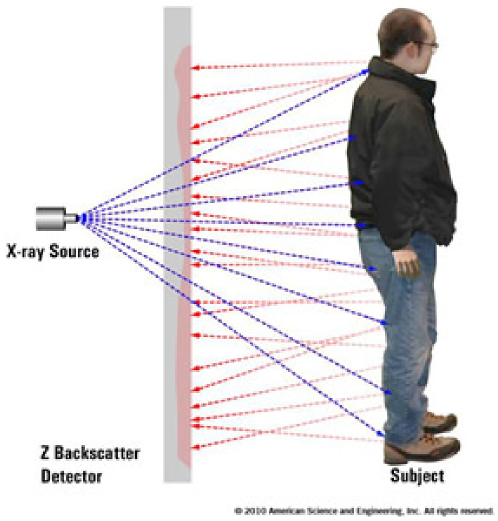
### Millimetre-Wave Technologies

The Department of Infrastructure and Transport has announced that active millimetre wave scanners will be used at Australian international airports from July 2012. These use non-ionising radiation in the form of millimetre waves. Millimetre waves are radiofrequency radiation in the gigahertz bands, similar to that emitted by mobile phones. Clothing and other organic materials appear translucent to radiation of this type. These machines collect radio waves emitted by or reflected from the body to create a three-dimensional image.

These scanners are available in both active and passive forms. Active scanners transmit very low intensity millimetre waves from one or more antennas as they are rotated about the person being scanned. The reflected waves are then measured and reconstructed into a 3-D image. A passive scanner collects the millimetre waves emitted by any warm object such as a human body, and does not transmit any radiofrequency radiation onto the person being scanned. In both cases objects beneath clothing will be displayed in sharp contrast to the body being scanned. The very low intensity of the millimetre waves and the short duration of the scan means that the person being scanned is exposed to less electromagnetic energy than from a short mobile phone call.

### X-ray Backscatter Technology

X-rays are a form of ionising radiation and they interact with matter in one of three ways – they pass through matter, are absorbed by matter (are attenuated), or are scattered by matter. Objects with higher density attenuate more X-rays than those with lower density. Traditional transmission X-ray equipment relies on the pass-through and absorption properties of X-rays. Backscatter X-ray (also known as




Z-Backscatter) measures the X-rays that are backscattered from the object, in this case a person being screened. A backscatter X-ray pattern is more specific than an absorption pattern in the way that it interacts with organic matter. Backscatter patterns can change depending on the elements that are present.

Light (low Z) elements such as hydrogen, carbon, oxygen or nitrogen scatter low energy X-rays more readily than heavier (high Z) elements such as metals. Heavier elements are more prone to absorb X-rays than they are to scatter them. For this reason materials made from light elements do not appear very clearly using traditional pass-through higher energy X-ray techniques, but more dense materials do. Because organic material is usually composed of lighter elements, backscatter X-ray scanning equipment is ideal for imaging organic material such as the human body.



Email: info@arpansa.gov.au | Internet: www.arpansa.gov.au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619 Lower Plenty Road, Yallambie VIC 3085
Telephone: +61 3 9433 2211
Fax: + 61 3 9432 1835

Backscatter X-ray systems also recognise the lack of scattering that occurs from metal objects, making them useful for imaging both organic and metallic materials. A body scanner using backscatter X-ray technology directs a narrow, low intensity X-ray beam over the body surface at high speed. This equipment generates an image from the beam that is reflected back from the body and objects carried on the body.

## Radiation Dose from Backscatter X-ray Scanners

Radiation is present all around us and X-rays are used in many facets of everyday life, particularly in medical procedures. Exposure to ionising radiation is known to cause harmful effects to the human body. It is assumed in international radiation protection guidance that all exposure to ionising radiation carries some level of risk, with the highest concern related to the possibility of cancer formation. The effective whole body radiation dose provides a measure of this radiation (or cancer) risk. The effective whole body radiation dose is measured in units called microsieverts. The amount of radiation received during a scan is very low, particularly with some of the current generation of backscatter scanners. The dose received in one scan is 200 to 1000 times less than the amount received during a chest X-ray. This is comparable to two minutes of flight at cruising altitude (exposure to cosmic radiation), or exposure to less than 40 minutes of normal radiation background (the radiation that is always all around us). It would require 10,000 to 50,000 scans in a year to reach the dose limit for a member of the public. Typical values are compared in the following table:

| Ionising Radiation Source | Radiation Dose (microsieverts) |
|---|---|
| Backscatter body X-ray scan | 0.02 to 0.1 |
| Dental X-ray (bitewing) | 4 |
| Flight Melbourne – Brisbane | 7 |
| Chest X-ray (*PA) | 20 |
| Annual dose limit for public exposure to ionising radiation | 1000 |
| Australian annual background radiation dose | 1500 |
| Chest CT scan | 7000 |

* PA – Posterior-Anterior (or back-to-front)


While any exposure to ionising radiation could potentially create an increased risk for cancer, the radiation risk resulting from the use of backscatter scanners is very small, even for a child or a pregnant women. The ionising radiation from backscatter scanners, is in the form of low energy X-rays, which will deposit most of their energy in the skin and underlying tissue.  Considering the low radiation doses delivered by these machines, the resultant increase in the incidence of skin cancers within the population of scanned individuals from the use of backscatter scanners will be extremely low.