

# Gamma vs X-ray Comparison

## What is Ionizing Radiation?

Ionizing radiation consists of subatomic particles or electromagnetic waves that are energetic enough to detach electrons from atoms or molecules, ionizing them. Two of the most common forms of ionizing radiation are gamma rays and X-rays. Both forms of ionizing radiation are almost identical with exception to their source of origination. Gamma rays originate from the nucleus while X-rays originate in the electron fields surrounding the nucleus or are machine produced.

## How is Ionizing Radiation Generated?

Ionizing radiation comes from radioactive sources such as cobalt-60 and cesium-137 and non-radioactive sources such as X-ray tubes. Radioactive sources are unstable materials that generate gamma rays as they decay. X-rays are generated in a vacuum tube where high voltage is used to accelerate electrons to a high velocity, that then collide with a metal target, an anode creating X-rays.

## How is X-ray and Gamma Ionizing Radiation Different?

There are three primary differences between X-ray and gamma ionizing radiation; frequency, wavelength, and photon energy. While the first two are used as identifiers to differentiate the various wavelengths, the third, photon energy describes the energy or speed at which the rays are traveling. Described in units of electronvolts, cesium-137 is 662 keV, cobalt-60 is 2.5 MeV, and Rad Source X-ray is 160 kVp. This energy equates to penetration power; the higher the energy the greater the penetration power. For both gamma and X-ray, energies are emissions in free space. In actual use, where they are confined in a lead chamber, the energies of both are affected by scattering and fluorescence until actual energy spectrums are difficult to define. The greater the energy, the more shielding is required for safe operation.

## What is Ionizing Radiation Used for?

Because of the penetrating properties of ionizing radiation and their ability to inactivate microorganisms, ionizing radiation is used for a number of different purposes. Including, virus inactivation for research, as well as to sterilize or reduce the microbial load of many different types of products such as medical devices, packaging, cosmetics, foods, and agricultural products. It is also used to alter the properties of many different polymers through recombination, cross-linkage, and cross scission.

## Why use X-ray versus Gamma produced Ionizing Radiation?

Radioactive sources are very dangerous requiring specialized shipping containers and services with heavy shielding and high levels of security. The radioactive sources once delivered, require specialized rooms and personnel must have background checks, and radiation badges to operate the radioactive unit. The unstable material is constantly decaying and cannot be turned off. Cobalt-60's half-life is 5.27 years while cesium-137's half-life is 30.17 years. Once the radiation source drops below a useable level, the radioactive source generally cannot be reloaded and must be disposed of following specific, costly protocols that involve the above mentioned shipping containers and the long-term storage of the radioactive source that continues to degrade for tens to hundreds of years.

X-ray ionizing radiation is produced by a X-ray tube, therefore it can be turned off when it is not in use. At 160 kVp, X-rays have more than enough penetration power to achieve the desired results and yet requires much less shielding. The X-ray unit does not require any special licensing or special room accommodations\*. Operators of the X-ray unit do not require background checks prior to operation nor do they require the use of radiation badges (21CFR1020.40 compliant). When the X-ray unit reaches the end of it's lifecycle, it does not require the expensive disposal costs associated with the transportation and storage of radioactive sources.

\*Based on using a Rad Source Technologies unit and current operating knowledge of global regulations. This information is subject to change, please contact your Rad Source representative for specific and up-to-date information.

