SIMCO ION™
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TECHNICAL NOTE

Photon Safety Considerations

Simco-Ion, Technology Group provides two Photon Ionization products for critical applications: Model 4901 and Model 4903. The air ions are created by photons from a soft X-ray source. Soft X-rays versus hard X-rays, such as those used for industrial or medical uses, have very low energy and are absorbed by very thin layers of almost any material. Indeed, the very low-energy X-ray sources used in Model 4901 and Model 4903 Photon Ionizers are absorbed in only about 35 cm of air. While interlocks are recommended when using these photon ionizers, the risk of exposure is very low. Even placing a bare hand within 10 cm of the X-ray source for a short time will not create a significant risk to the user. The biggest risk to the user is exposure to the eyes as the membrane covering one's retina is too thin to effectively filter the X-ray photons before damage to the retina can occur. Despite the low risk to personnel, photon ionization is best used in enclosed tooling where an interlock can be implemented to prevent any risk of the user inadvertently being exposed to the photon energy.

Photon Energy and Voltage Source

The energy of the X-ray photons determines several critical things:

1. The distance at which the photons will travel before they are absorbed in various materials.
2. The amount and type of damage to human tissue that will result from exposure to photon energy.
3. The photon energy is inversely proportional to the wavelength of the photon.

X-ray sources are frequently described by their excitation energy. Table 1 describes the various X-ray energy sources used in the industry, along with typical estimates of dosage levels.

It is interesting to note that every human on Earth receives approximately three mSv of radiation from background radiation every year.

As shown in Table 1, the energy used in the Model 4901 and Model 4903 Photon Ionizers is several orders of magnitude lower than the energy used in medical or dental X-ray systems. Additionally, the photon energy produced by an X-ray source can never exceed the energy provided by its excitation source.

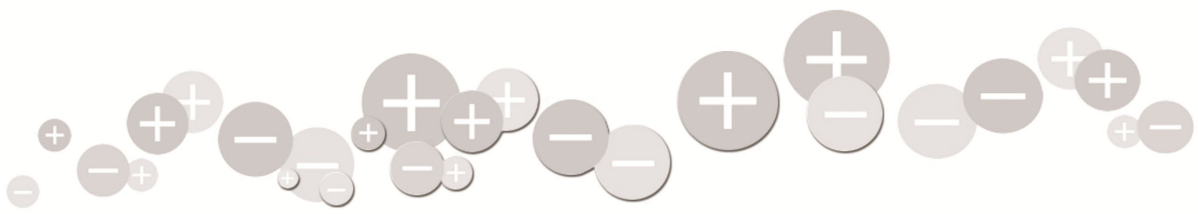
Ozone and Particulate Generation

The photon ionization process generates neither ozone nor nanoparticles. If the ionizer is cleaned properly prior to installation, it can be operated in an ISO Class 1 or cleaner process.

Table 1. Comparison of Photon Ionization to Common X-ray Sources

Use		Accelerating Potential	Average Photon Energy	Radiation Dosage Estimates
Photon Ionizers	Model 4901	4.98 kV	4.98 keV	<0.0005 mSv/hr*
	Model 4903	4.98 kV	4.98 keV	<0.0005 mSv/hr*
Diagnostic X-ray Procedures	Mammography	25-30 kV	20 keV	0.4 mSv
	Dental	60 kV	30 keV	0.004 mSv
	General	50-140 kV	40 keV	0.01-0.9 mSv
	CT	80-140 kV	60 keV	8-11 mSv

* When used in accordance with safety suggestions herein (shielding or maintaining a distance of at least 150 cm from the source).



Shielding Considerations

Minimal shielding is required due to the low energy of the photons emitting from the ionizer. However, to ensure maximum safety, it is highly recommended that the ionizer be placed within an interlocked enclosure (both ionizers have an interlock to power the X-ray source off when triggered). Model 4901 Pin Ionizer utilizes the interlock feature (connecting or disconnecting pins 1 & 2 in the connector). The Model 4903 bar ionizer has an ON/OFF switch in addition to an interlock feature. Like the Model 4901, though, the Model 4903's interlock is activated when two pins are shorted or opened. On Model 4903, this interlock connection utilizes pins 14 & 15. For shielding materials and thicknesses, Table 2 defines the suggested thickness depending on the material used.

Table 2. Shielding Thickness vs. Material

Shielding Material	Thickness* (mm)
Stainless Steel	0.2
Aluminum	0.3
Glass	0.4
PVC	0.8
Acrylic	4.0

* Shield at a distance of 10 mm from the X-ray source; if placed closer, thicker material may be needed.

Other Critical Specifications

	Model 4901	Model 4903
Power Input	24 VDC, 60W by Adapter (100-240 VAC to 24 VDC)	Model 4903-CTRL Controller (100-240 VAC, 80W with 8 tubes, max)
Emitter	Photon generating tube with beam angle 150° in tube type Type: Hot filament Voltage: 4.98 kV Current: 400 µA (max), on-site receptacle	Photon generating tube with beam angle 150° in tube type Type: Hot filament Voltage: 4.98 kV Current: 400 µA (max), on-site receptacle
Cleanroom Class	Zero particle generation	Zero particle generation
LED Indicator	Run, Lifetime, Alarm	Bar: Normal, Alarm Controller: Power On/Off, Interlock, Head fail, Remote, Alarm (end of tube life)
Alarm	Head fail, System fail	Head fail, System fail
Operating Env	32-122°F (0 to +50°C); 35-85% RH, non-condensing	32-122°F (0 to +50°C), 35-85% RH, non-condensing

Both ionizers should be installed with bracketing to avoid mechanical shock to ensure the beryllium window is not damaged.

Other detailed instructions, information, and specifications are included in the manuals for both ionizers.

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