

HOW THE IMAGE INTENSIFIER WORKS:

1. The primary x-ray beam exits the patient and strikes the input screen of the image intensifier (II) tube, which is a vacuum tube with a cathode and an anode.
2. The fluorescent screen is built into the II as an input screen.
3. The fluorescent screen absorbs the x-ray photons and emits light photons, which immediately encounter the photocathode (the cathode of the tube) that is in contact with the input screen to prevent divergence of the light beam.
4. The photocathode absorbs the light photons and emits electrons.
5. The electrons are then accelerated from the cathode towards the anode and the output screen by the potential difference that exists between the cathode and anode.
6. At the same time the electron beam is focused onto the output screen which is much smaller than the input screen.
7. Electrostatic lenses are used to accelerate and focus the electrons. The primary brightness gain occurs from the acceleration and focusing of the electron beam.
8. The acceleration of the electron beam increases its energy and its ability to emit light at the output screen. The focusing of the electron beam intensifies the image into a smaller area.
9. The output screen absorbs the electrons and emits light photons, which are then available for viewing or further electronic processing by a video system.
10. There are changes in the quantity of photons and electrons in the image at each stage of the intensification process.

The entire II tube is encased in a lead lined housing that effectively absorbs the primary beam while permitting the intensified light photon image to be transmitted to the viewer. An ion pump device called a getter is used to remove the ions produced during operation and to maintain the vacuum within the tube.

so in a nut shell it is:

x-rays photons to light photons to electrons to light photons

input screen = fluorescent screen = to photocathode = anode to output screen

INPUT SCREEN AND PHOTOCATHODE

1. The input fluorescent screen consists of 0.1-0.2 MM layer of sodium-activated cesium iodide (CsI) Phosphors coated into the concave surface of the II tube.
2. This surface may be made of glass, titanium, steel or aluminum and ranges from 6" to 23" in diameter.

3. The screen is concave to maintain the same distance between each point on the input screen and its corresponding location on the output screen.
4. Failure to maintain this distance would result in distortion of the image because points farther from the center would be more magnified.
5. The CsI phosphors are packed together very tightly so they absorb about 66% of the incident beam, producing a good conversion efficiency.
6. The phosphors then light photons, vertically, in proportion to the absorption, thus reducing the lateral spread of light photons that would reduce the image detail.
7. As an example, a single 25 keV incident photon would typically produce over 1,500 light photons.
8. An extremely thin protective coating is applied to the input screen to prevent a chemical interaction with the photocathode.
9. The photocathode material is composed of photoemissive metals, usually cesium and antimony compounds, which are applied to their protective coating.
10. The photoemissive materials absorb the light photons and emit electrons in a process called photoemission.

Here is a basic idea of what happens in the II.

