Ministry of Higher Education and Scientific Research
Al-Mustaqbal University College
Radiology Techniques Department

Radiology Equipment Techniques

Al-Mustaqbal University College

2nd Class

Radiology Techniques Department

By

Assistant lecturer Hussein Ali Madlool

MS.C. Theoretical Physics

Second Semester

Lecture 12: Screen Film Radiography

Part: 1

2021/2022

Cassette

The cassette is the rigid holder that contains the film and the radiographic intensifying screens.

The front cover, the side facing the x-ray source, is made of material with a low atomic number such as plastic or carbon fiber and is designed for minimum attenuation of the x-ray beam.

- Carbon fiber (Z = 6) absorbs only 50% of X-rays compared to aluminum.

Attached to the inside of the front cover is the front screen, and attached to the back cover is the back screen. The radiographic film is sandwiched between the two screens.

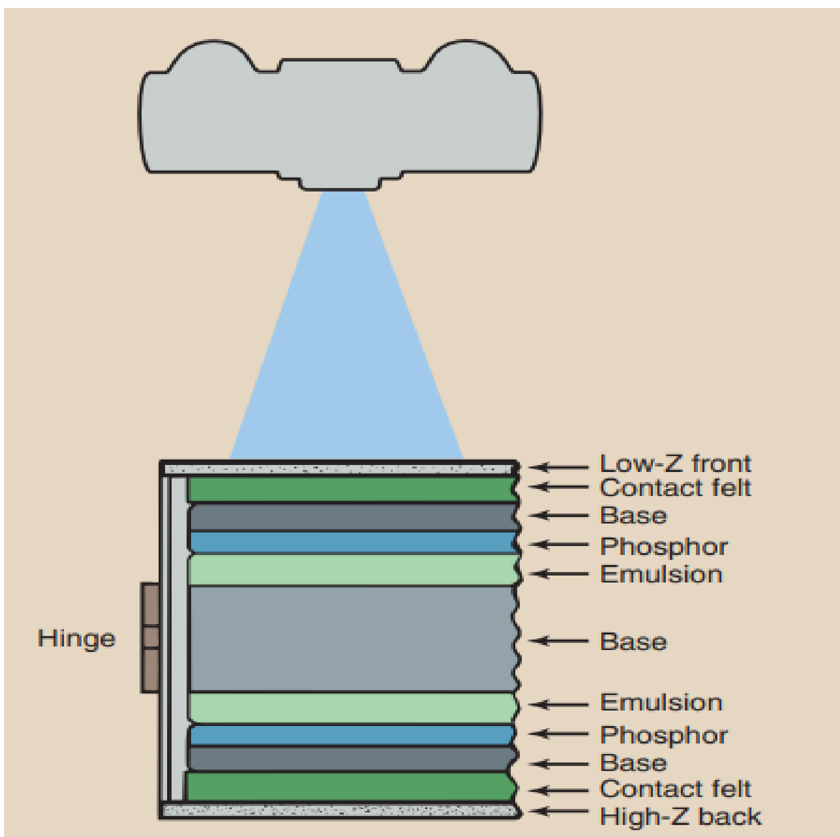

Figure (1) Cross-sectional view of cassette containing front and back screens and loaded with double-emulsion film.

Between each screen and the cassette cover is some sort of compression device, such as radiolucent plastic foam, which maintains close screen-film contact when the cassette is closed and latched.

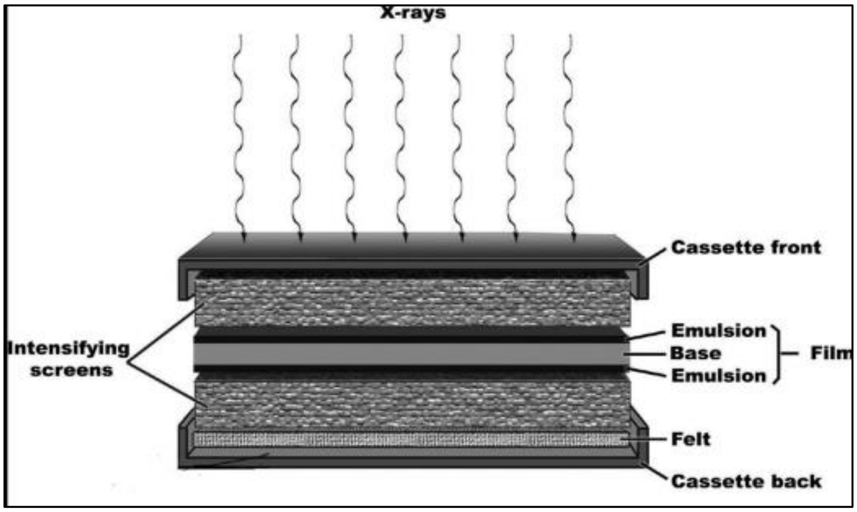

Figure (2) another view of cassette

The back cover is usually made of heavy metal to minimize backscatter. The x-rays transmitted through the screen-film combination to the back cover more readily undergo photoelectric effect in a high-Z material than in a low-Z material

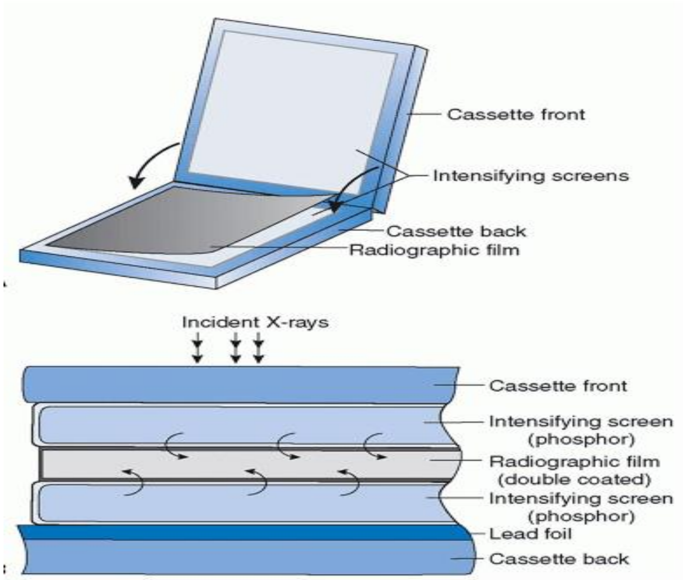

Figure (3): the combination of film, intensifying screen, cassette

Radiographic Intensifying Screen

An intensifying screen is a device found in radiographic cassettes that contains phosphors to convert x-ray energy into light, which then exposes the radiographic film

- The purpose of this device is to intensify the action of the x-rays and permit much lower x-ray exposures compared with film alone.
- Film is much more sensitive to visible light than to x-rays and requires more amount of X-rays to produce an image

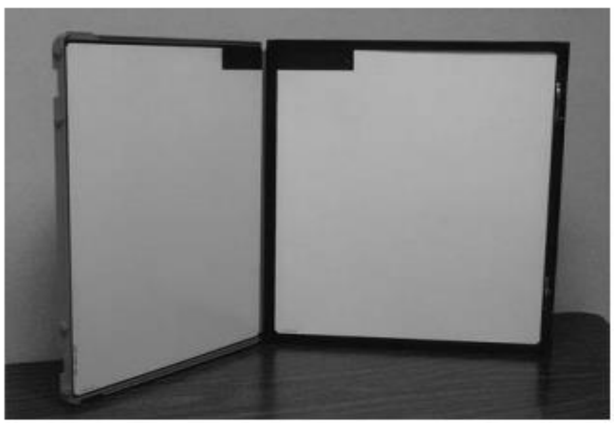

Figure (4) Typical set of intensifying screens inside a cassette.

- By converting each absorbed high energy x-ray photon into thousands of visible light photons
- The total amount of energy to which the film is exposed is divided between x-rays and light. When intensifying screens are used, approximately 90%–99% of the total energy to which the film is exposed is light. X-rays account for the remaining 1%–10% of the energy.

Composition of Intensifying Screen

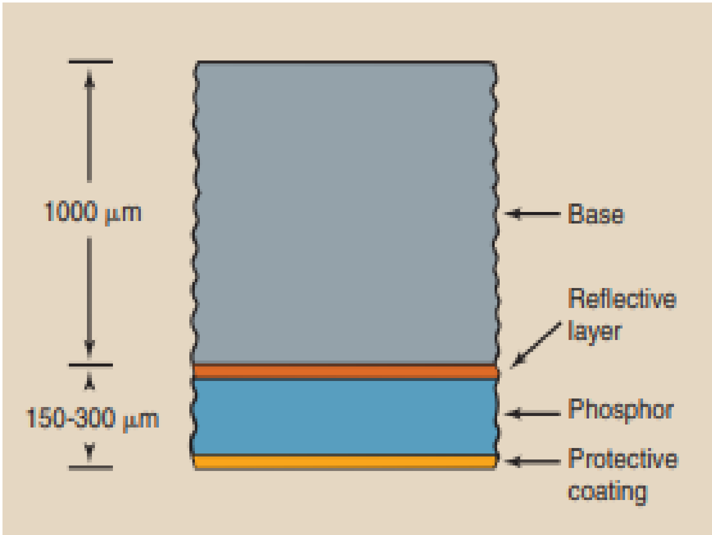

Figure (7): Cross-sectional view of an intensifying screen, showing its four principal layers.

1-Protective Coating

The protective coating is applied to the face of the screen to make the screen resistant to the abrasion and damage caused by handling.

- The protective layer is transparent to light.
- Protective layer plastic that protects the phosphor

2-Phosphor layer

- It is the active layer of the radiographic intensifying screen
- The rare earth elements gadolinium, lanthanum, and yttrium are the phosphor material in newer, faster screens.

<u>**The phosphor should:**</u>

1. have a high atomic number so that x-ray absorption is high. This is called detective quantum efficiency (DQE).

2. Emit a large amount of light per x-ray absorption. This is called the x-ray conversion efficiency (CE).
3. Not be affected by heat, humidity, or other environmental conditions.

- The phosphor converts the x-ray beam into light.

Use of rare earth screens results in a lower patient dose, less thermal stress on the x-ray tube, and reduced shielding for x-ray rooms

3-Reflecting layer

The reflective layer enhances the efficiency of the radiographic intensifying screen, nearly doubling the number of light photons that reach the film.

- Made of a shiny substance such as magnesium oxide or titanium dioxid
- Reflecting layer: reflects light toward the film or Absorbing layer absorbs light directed toward it

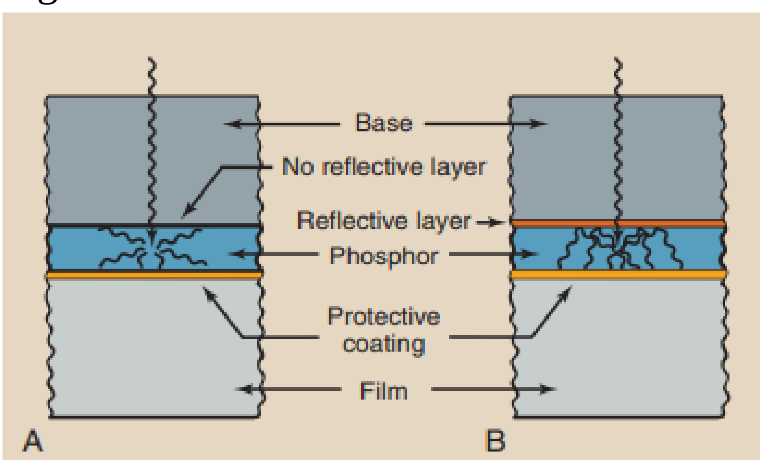

Figure (6): A, Screen without reflective layer. B, Screen with reflective layer. Screens without reflective layers are not as efficient as those with reflective layers because fewer light photons reach the film.

4-Base

The layer farthest from the radiographic film is the base.
The base is approximately 1 mm thick and serves principally as a mechanical support for the active phosphor layer. Polyester is the popular base material in radiographic intensifying screens

Luminescence

Any material that emits light in response to some outside stimulation is called a luminescent material, or a phosphor, and the emitted visible light is called luminescence.
luminescence involves outer-shell electrons (Figure 7). In a radiographic intensifying screen, absorption of a single x-ray causes emission of thousands of light photons.

- When a luminescent material is stimulated, the outer shell electrons are raised to excited energy levels. This effectively creates a hole in the outer-shell electron, which is an unstable condition for the atom. The hole is filled when the excited electron returns to its normal state. This transition is accompanied by the emission of a visible light photon.

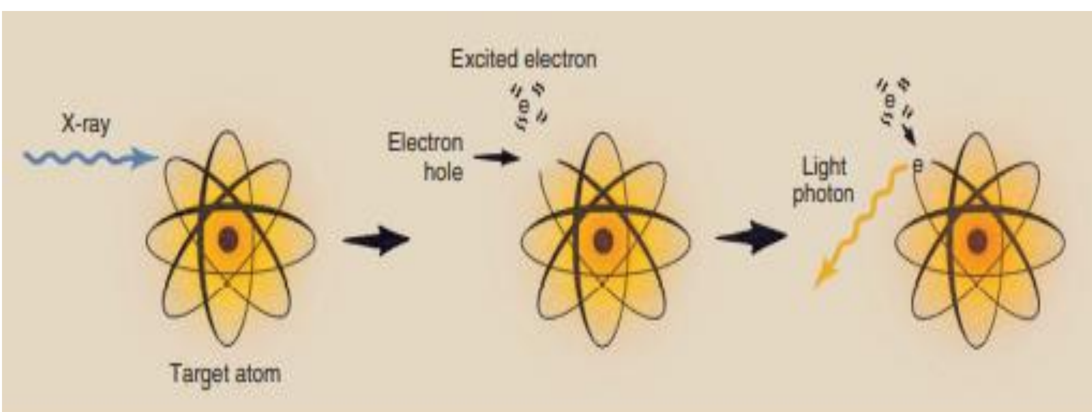

Figure (7): Luminescence occurs when an outer-shell electron is raised to an excited state and returns to its normal state with the emission of a light photon.