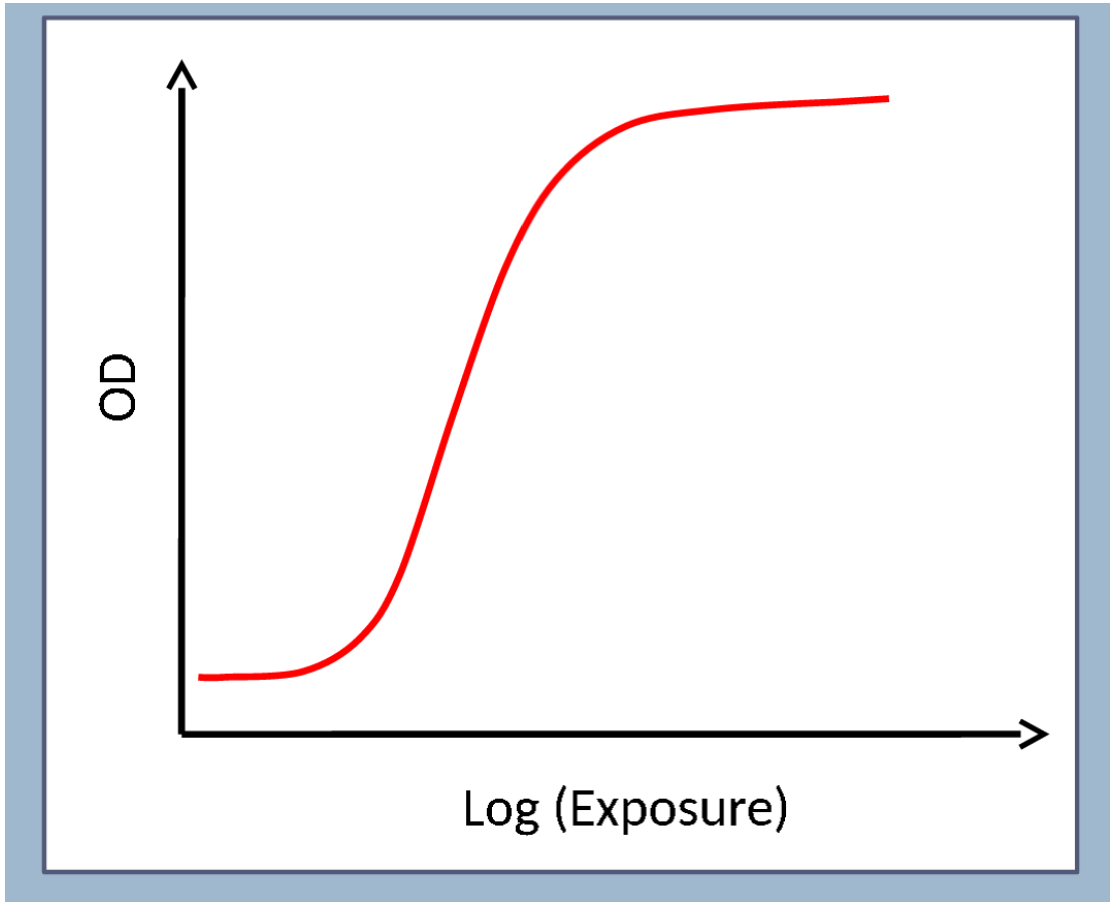
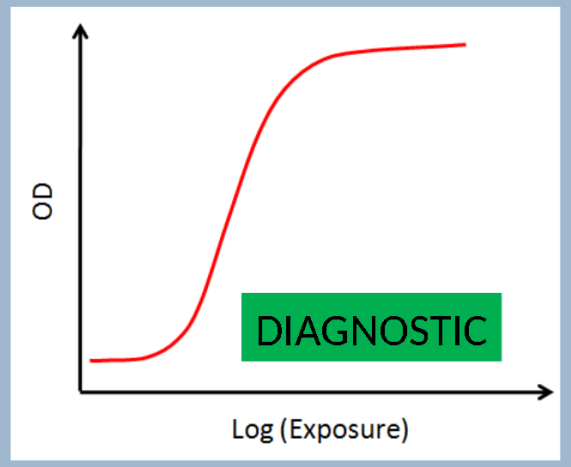
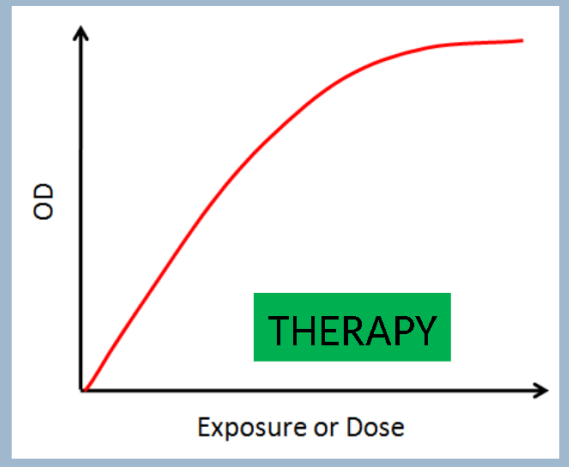
What is this curve called?
Discuss its characteristics



What is this curve called? Discuss its characteristics

- This is called the HD curve (for Hurter and Driffield). Sometimes also called the characteristic or sensitometric curve.
- For diagnostic imaging, the abscissa is the LOG of exposure. This gives the well-known S-like curve. Diagnostic people cares about finding exposure level that gives the optimal contrast
- For therapy or dosimetric purposes, the abscissa is the dose itself (not the LOG). Therapy cares about using film for dosimetry



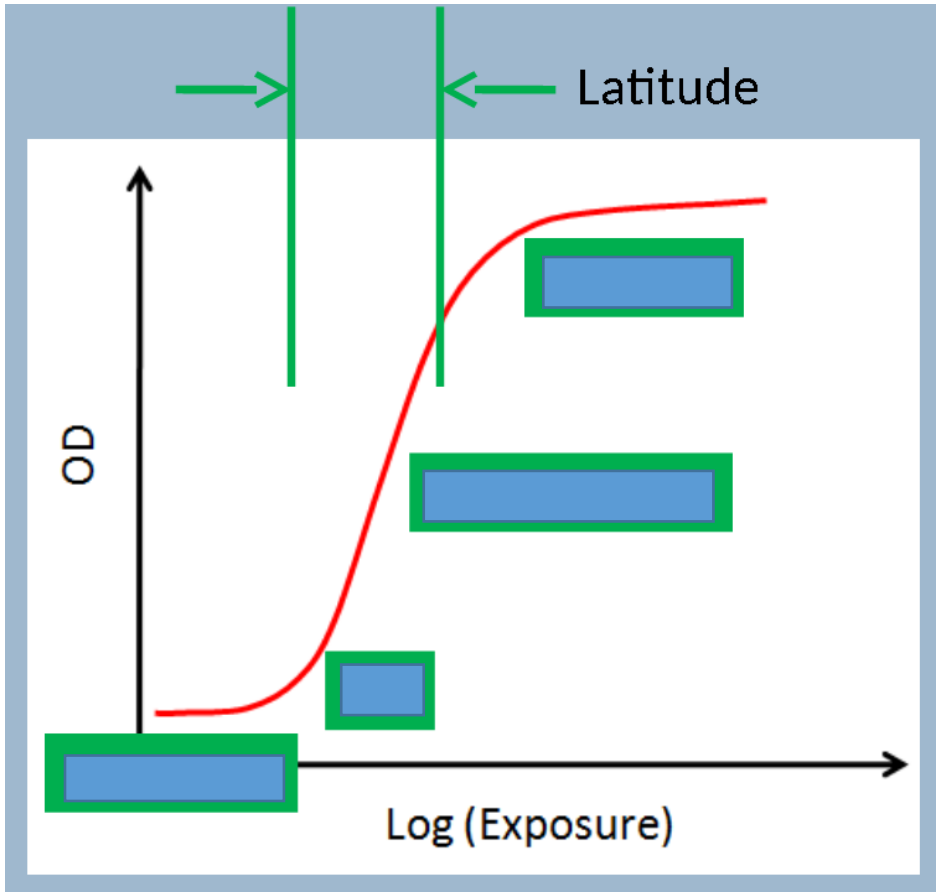


- $OD = \log (I_0 / I)$
- I_0 = intensity measured by the densitometer with NO film
- I = intensity measured with film

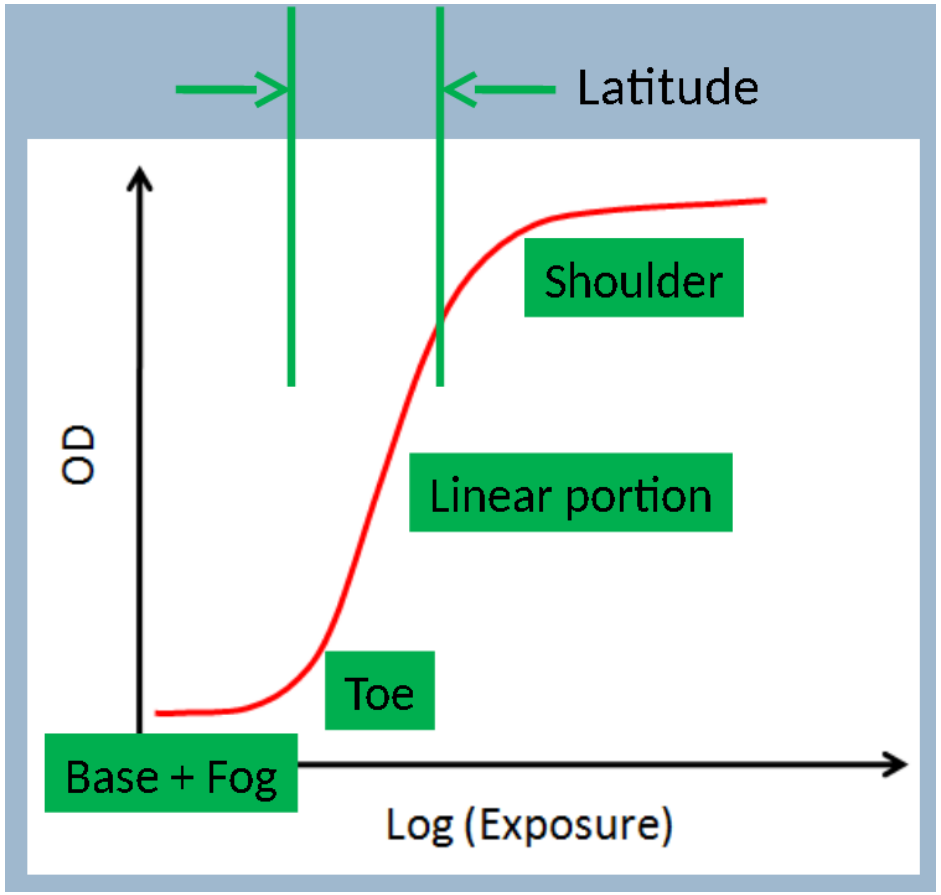
- $Net\ OD = \log (I_u / I) = OD - OD(base + fog)$
- I_u = intensity measured by the densitometer with UNEXPOSED film

- OD(base) = optical density of processed unexposed FRESH film, typically ranges from 0.1 to 0.15
- OD(base + fog) = optical density of process unexposed OLD film (stored for a long time, exposed to heat/background radiation), typically about 0.2

Discuss the characteristics of the HD curve

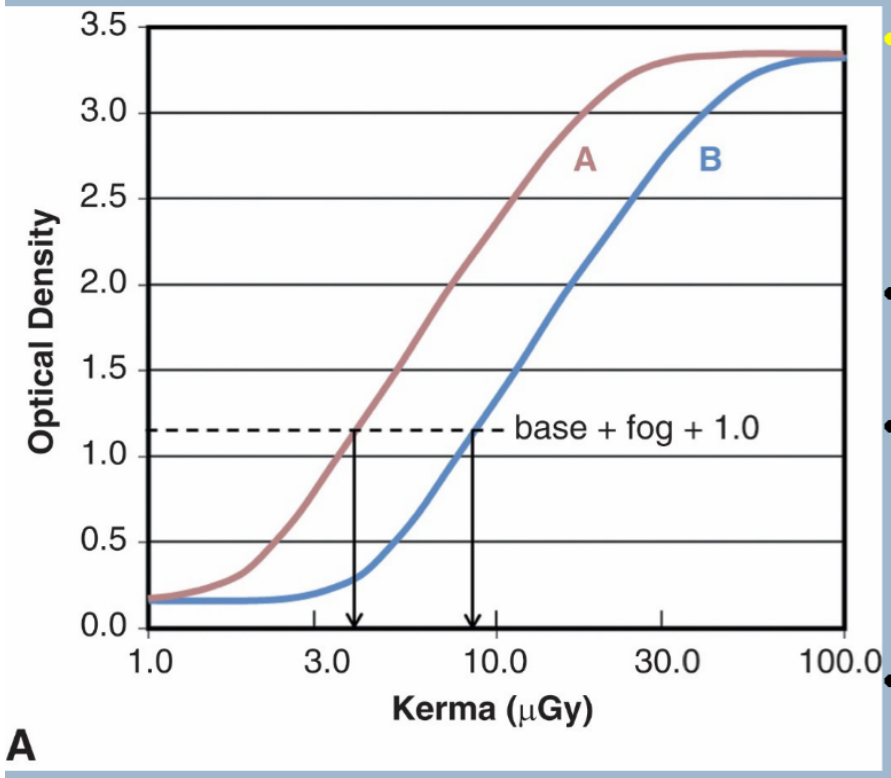


Discuss the characteristics of the HD curve



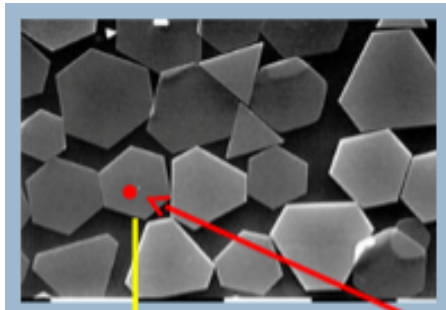
- The H&D curve has a logarithmic scale on the x-axis and is often called log relative exposure
- The y-axis is the logarithm of the transmission
- The toe is the low-exposure region of the curve. Toe extends to zero exposure
- The film OD at zero exposure corresponds to base+fog level.
- Beyond the toe is the linear region of the H&D curve. Ideally all radiographic image should be exposed in this region
- The shoulder is the region of high exposure.

Discuss the characteristics of the HD curve

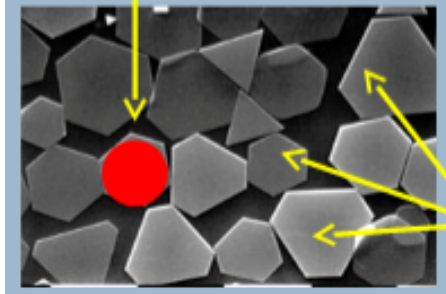


- Gamma = slope of the linear portion of the curve
- Speed In the graph shown here, there is a lateral shift in H&D curve indicating a change in speed between the two film detectors A and B
- OD=1.0+fog+base indicates the point at which the speed is evaluated
- System A require less exposure than B to achieve same OD. Therefore A is faster, more sensitive of the two screens-film systems
- For Kodak films, OD(base) ≈ 0.15, OD(base + fog) ≈ 0.2

How does film work? How is the image formed on a film?



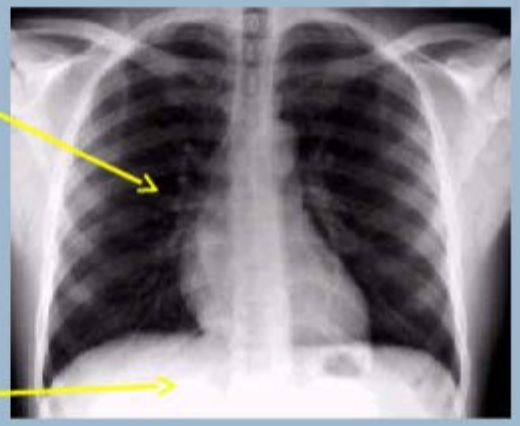
Processing magnifies the center size up to 10^9 times!



- Film contains emulsion of AgBr grains, with Ag^+ and Br^- ions, in gelatin
- Grains are only 1–2 microns in size
- Loosely bound electrons are freed by X-ray and combine with Ag^+ ion to make metallic silver: $Ag^+ + e \rightarrow Ag$
- A group of few silver atoms created this way makes a latent image center, this is a very small part of a grain
- Film processing catalyzes the conversion of the rest of silver ions inside the grain into silver → larger grain = faster film
- Grains that do not have latent image center are washed out during processing

Dark on film = Exposed area → contains a lot of metallic silver grains

White areas on film = Not exposed (or lightly exposed) → very few metallic silver grains

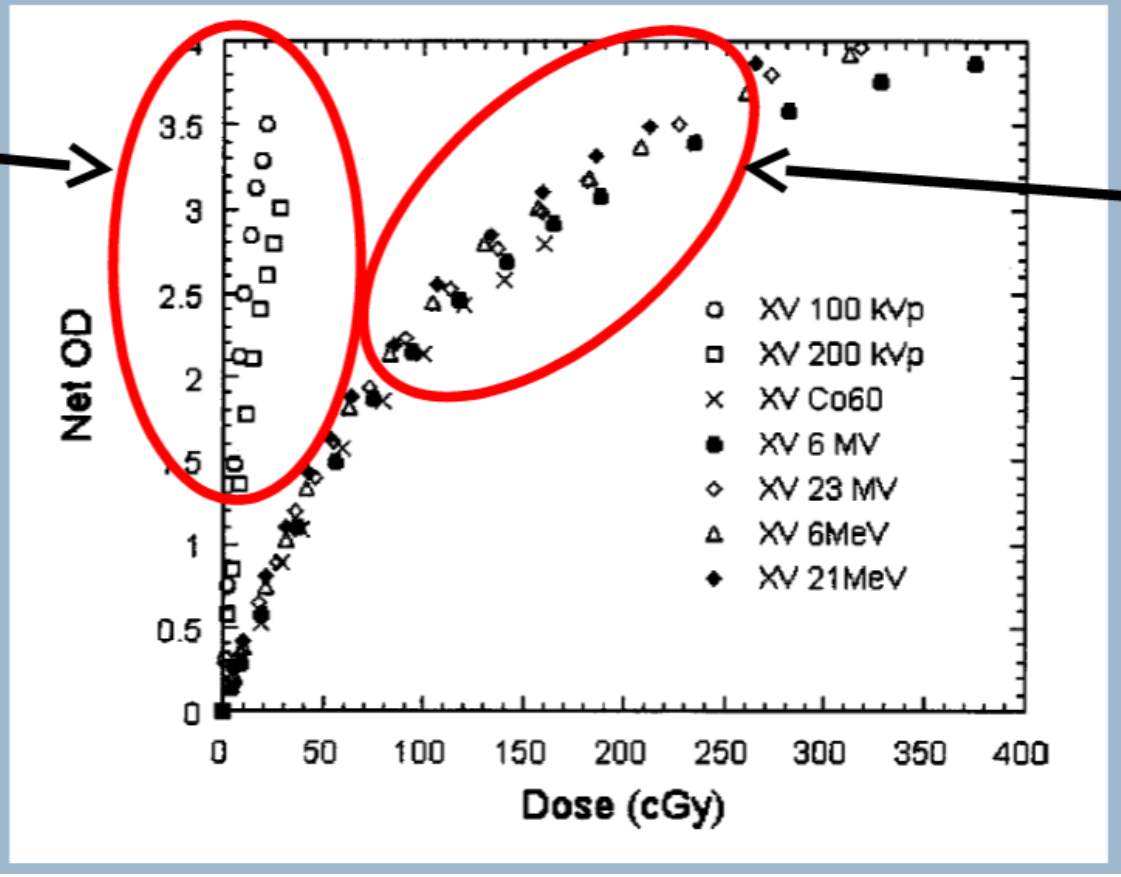


If you process an unexposed film, you wash away all the silver on it → you are left with a simple plastic sheet !!!

Does Film have an Energy Dependence?

Does Film have an Energy Dependence?

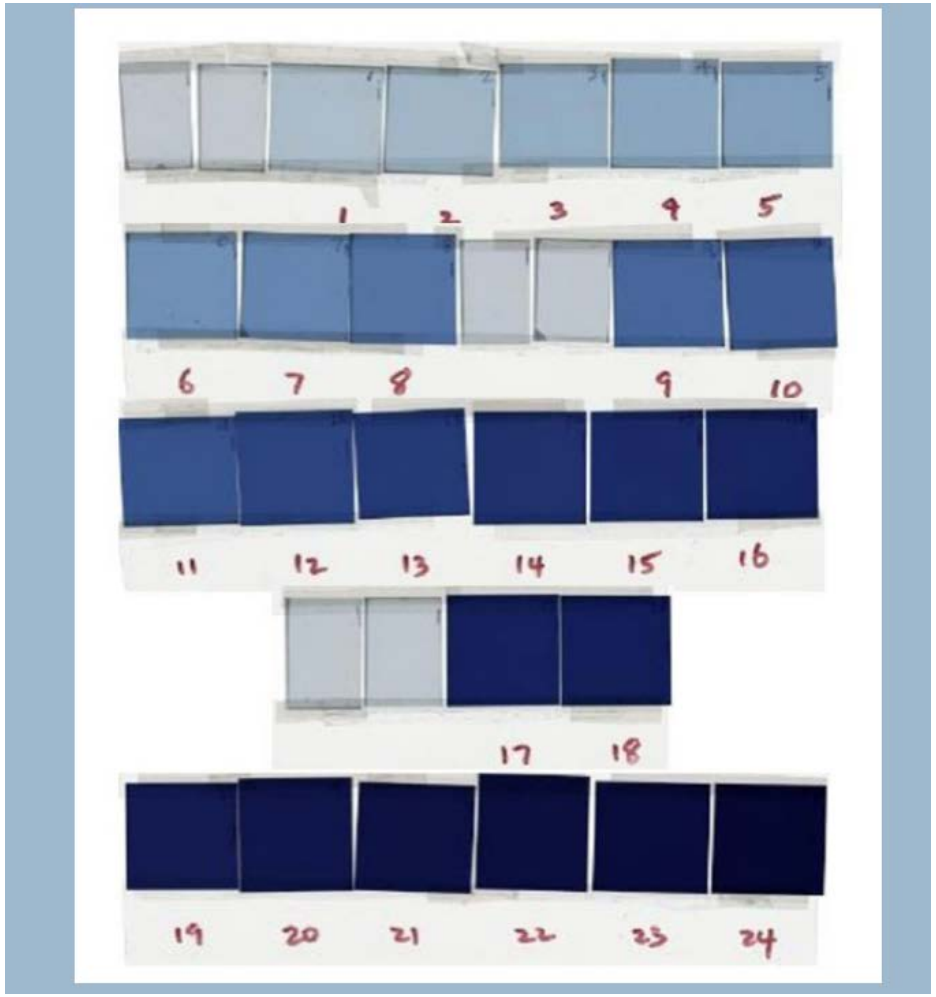
kV



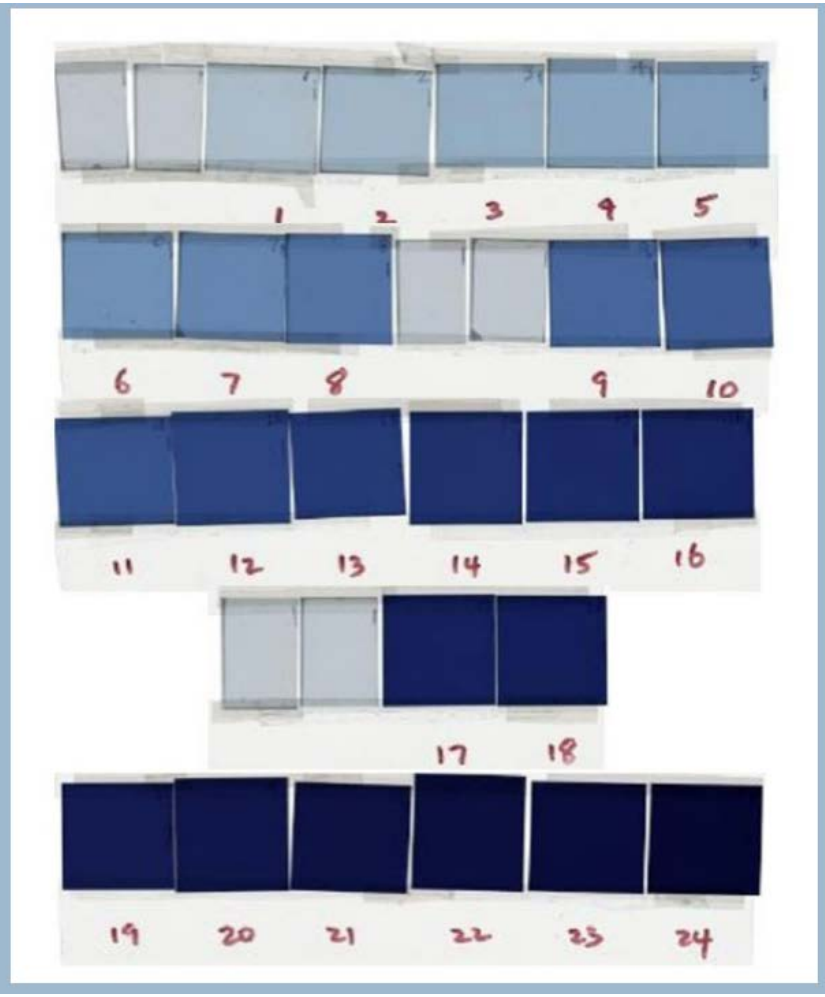
MV

This is for XV. EDR behaves similarly.

How Does Radiochromic Film Work?



How Does Radiochromic Film Work?



- Radiochromic reactions are defined by the direct coloration of media by the absorption of radiation and does not require thermal, optical or chemical development.
- Image formation on radiochromic film is a dye-forming or polymerization process
  - Energy is transferred from an energetic photon or particle to the receptive part of the leuko-dye or colorless photomonomer molecule
  - Color formation results from solid state polymerization.

To what extent is radiochromic film energy and dose-rate dependent?

To what extent is radiochromic film energy and dose-rate dependent?

- Energy: Energy dependency varies between film types however the commonly used GAFCHROMIC EBT film claims energy independence from 30 kV to 18 MV.

- Dose Rate: In general, radiochromic film is independent of dose rate effects at the clinically relevant dose rates of 2-4 Gy per minute.

- What is OD? What is net OD?
- •
- What is the difference between the curve for XV and
- EDR films?
- •
- How does film work? How is an image formed on a
- film?
- •
- You have a film calibration curve measured with your
- 6X photon energy. Can you use that to estimate the
- dose from your CBCT?
- •
- How does a change in processor temperature affect
- your film?