

Not all X-Ray Generators are Created Equal

The frequency of the
System determines how much
useful radiation there is!

Theory

- Please keep in mind this is theory, and remember:
 - In theory there is no difference between theory and practice.
 - BUT
 - In practice there is!

Heterogeneous Radiation

- All electronic generated x-ray beams have a range of radiation energies.
 - Hard radiation
 - to
 - Soft radiation
 - Removing soft radiation can be done with a filter.

Homogeneity

- Homogeneity will occur as the radiation passed thru materiel. The point of homogeneity varies with the materiel of the absorber (filter) i.e. lead screens used on film.
- The amount of Soft to Hard is different in different generators.

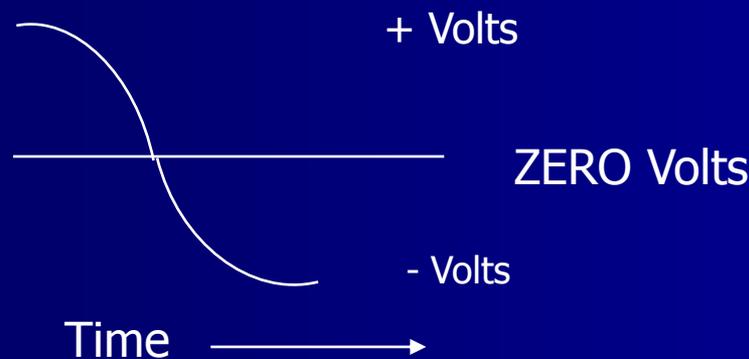
Theory

- When the x-ray tube is supplied a constant voltage it produces a very constant and hard beam. As the voltage is lowered the amount of soft radiation increases. During each cycle the longer period of low voltage produces greater portion of soft rays.

Frequency

■ Sine Wave

- Frequency determines the slope and rate of change. "Cycles per Second"



Effect of Frequency

- Low Frequency - Power cycles to the tube Slowly, and there are longer periods of low voltage. Sine wave goes thru 0 volts every second. (60 times a second)

This causes the spectrum of radiation to have a variation in intensity of X- ray radiation against wave length.

Semi Hard is OK?

- The range of frequencies.
- Low Frequency
 - 50/60 Hz
 - Very soft radiation
 - Lots of noise

Harder is even Better

- Medium Frequency
 - 500 Hz
 - Less Noise
 - More Hard radiation

Hardest is the Best

- Hi Frequency
 - 27 KHz
 - Low Noise
 - Lots of Hard radiation

Comparison

■ Penetration

Low frequency	160kV	22mm Steel
Med frequency	160kV	30mm Steel
High frequency	160kV	45mm Steel

Why?

Effect of Frequency

- High Frequency

- 27KHz

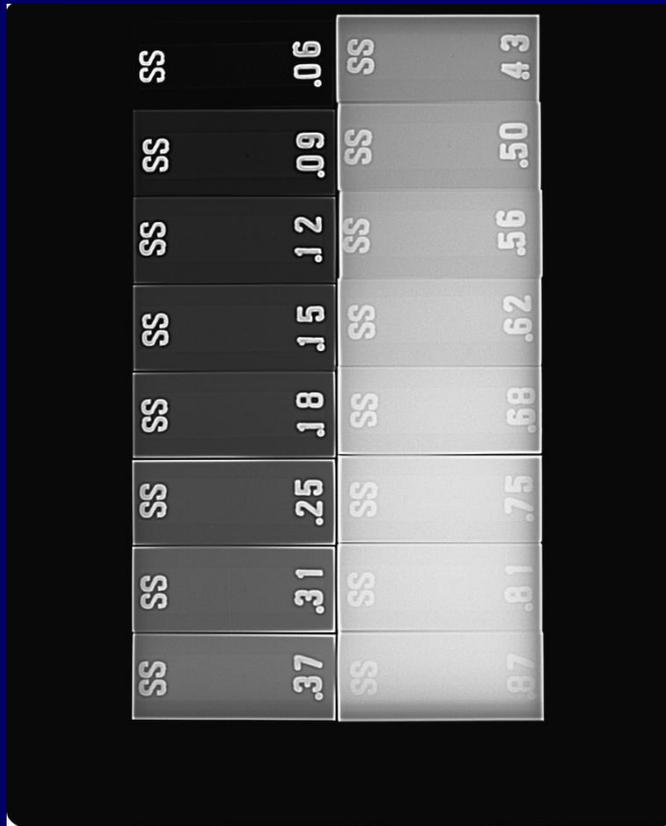
- Very short periods of 0 voltage in proportion to high voltage. This equates to the amount of X-ray radiation against wave length – more hard radiation.
 - Wave length determines the hardness of the x-ray beam. The shorter the wave length the better.
 - Think of it this way High frequency short wave length = hard radiation.

Circa Frequency

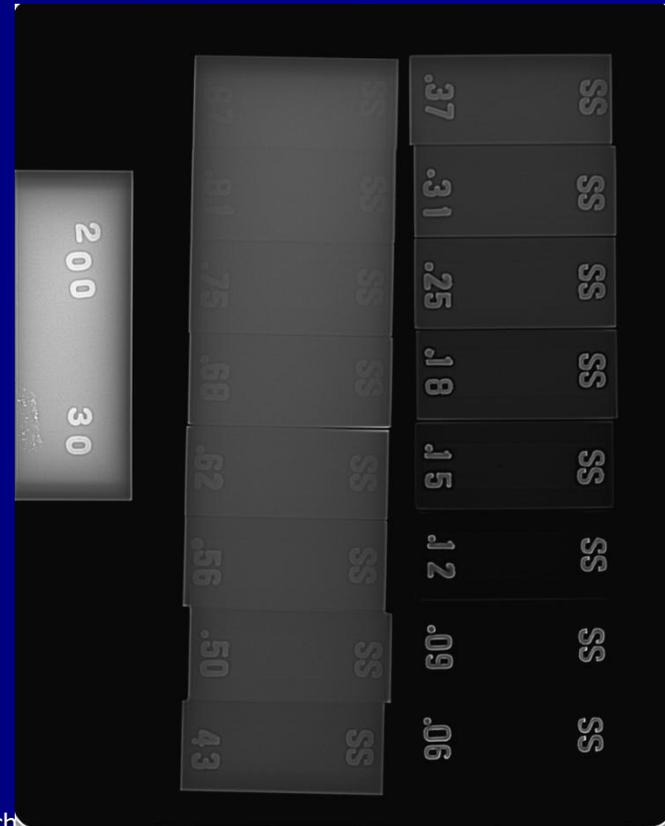
- Low frequency - up to 1960
 - 70% On Power
- Mid frequency - up to 1980
 - 80% On Power
- Hi frequency – Current
 - 90% On Power
- Very Hi frequency – Available 2007
 - Over 95% On Power

It's all about the image

HIGH FREQ



LO FREQ



DYNAMIC RANGE

The two images were taken with the identical Blocks and Image Quality Indicators (IQI).

The only difference is the frequency of the x-ray generator.

Image one has a higher signal to noise ratio than image two

ASTM E 2446 -05 makes reference to Signal-Noise Ratio



CR System Classification	Minimum Signal-Noise Ratio
ASTM IP Special/Y	130
ASTM IP I/Y	65
ASTM IP II/Y	52
ASTM IP III/Y	43

DYNAMIC RANGE

Signal to Noise also will have an effect on the dynamic range of a Digital Image.

The following image when seen on a Digital System demonstrates the effect of a very low noise – high frequency x-ray generator.

DYNAMIC RANGE

TV	TV	TV							
.06	.09	.12	.15	.18	.25	.31	.37		
TV	TV								
43	.50	.56	.62	.68	.75	.81	.87		
TV	TV								
93	1.0	1.1	1.2	1.3	1.4	1.5	1.6		

IN THE END.....

It is all about

– The IMAGE....

- The IMAGE
and

The IMAGE.