Screen-Film Radiography

Formulas:

$M = SID/SOD$	(M) magnification (SID) source-to-image distance (SOD) source-to-object distance
$T = I_t/I_o$	(T) transmittance (I_o) incident light (I_t) transmitted light
$OD = -\log (T) = \log (1/T) = \log (I_o/I_t)$	(OD) optical density
Ave gradient = $[OD_2 – OD_1]/[\log E_2 – \log E_1]$ = "rise over run"	(E) exposure
Grid ratio = h/D	(h) interspace height (D) interspace width
Stripline density = 1/D+d "lines per unit length"	(d) strip width

Facts:

Only 5% of film darkening is due to direct xray interaction with the film
CaWO4 (calcium tungstate) screens convert 5% of detected xray energy to blue light
Gd2O2S (gadolinium oxysulfide), the most common rare earth screen, converts 15% of detected xray energy to green light; has increased CE
General radiology uses dual-screen, dual emulsion screen-film combination
Mammo uses single-screen, single emulsion
Detail cassettes used in mammo place the screen on the opposite side of the film from the patient
Use of a screen reduces patient dose by a factor of 50
Film processing reduces silver halide into metallic silver grains
Characteristic curve (H&D curve) describes OD (y-axis) versus the log of exposure (x-axis)
Base + fog OD should be < 0.20
Film latitude: range of exposures over which the film may be used; wide lat used for chest films
Dynamic range: ratio of highest to lowest exposure that can be usefully detected (40:1 for typical film)
Use of a grid increases dose 3-5X
Grid ratios of 8:1, 10:1, and 12:1 for general radiography; 5:1 for mammo
Inc kVp 15% ≈ 2X mAs
Dec kVp 15% ≈ ½ mAs
2X mAs = 2X OD

Relationships:

If	*Then*
Inc object distance from the focal spot	Dec mag

Prepared by Charles Kosydar, Evan Sirc, Travis Clark

Inc mag	Increase blur May inc spatial resolution
Inc size of the focal spot	Inc focal spot blur
Use a screen	Dec number of required incident photons (dec dose) Dec exposure time Dec scatter (due to dec number of incident photons) Dec blur (from pt motion) Dec spatial resolution
Change to a rare earth screen (increased AE)	Able to dec screen thickness Increase spatial resolution Inc screen-film speed
Inc AE (and keep OD the same) (dec dose) photons	Inc fraction of detected xray photons Dec number of required incident photons No change in total number of detected No change in noise
Double the amount of xray energy absorbed by a screen	Double the light intensity produced by the screen
Inc screen thickness	Inc AE Inc screen-film speed exponentially Dec number of required incident photons (dec dose) Dec spatial resolution
Inc CE (and keep OD the same)	Detected photons more efficiently darken film Inc screen-film speed Dec number of required incident photons (dec dose) Inc noise
Inc OD	Dec T
Shift characteristic curve to the left	Inc screen-film speed
Inc slope of characteristic curve	Inc contrast

Inc contrast	Dec latitude
Inc the film gradient (slope b/t two film densities)	Dec latitude
Inc kVp	Inc penetrability Dec entrance exposure Dec dose (b/c mAs can be decreased) Dec contrast
Dec kVp	Inc absorption Inc dose (b/c mAs must be increased) Dec scatter Inc contrast
Inc scatter	Dec contrast resolution Dec signal to noise ratio
Inc field size, or inc pt thickness	Inc scatter
Collimate the xray field	Dec scatter
Inc grid ratio	Dec scatter Inc image contrast Inc tube loading, pt dose Inc grid cutoff
Inc air gap	Reduce scatter Inc magnification