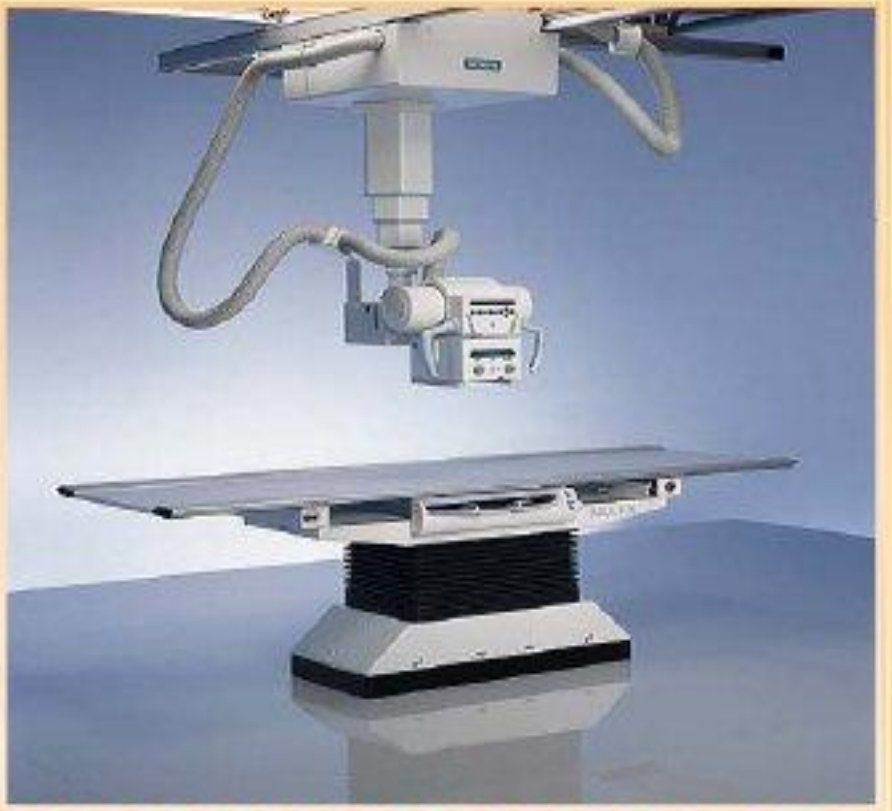
RAD 222/331
Lecture 2



INTRODUCTION TO RADIOGRAPHIC POSITIONING EQUIPMENT AND ACCESSORIES

EQUIPMENT

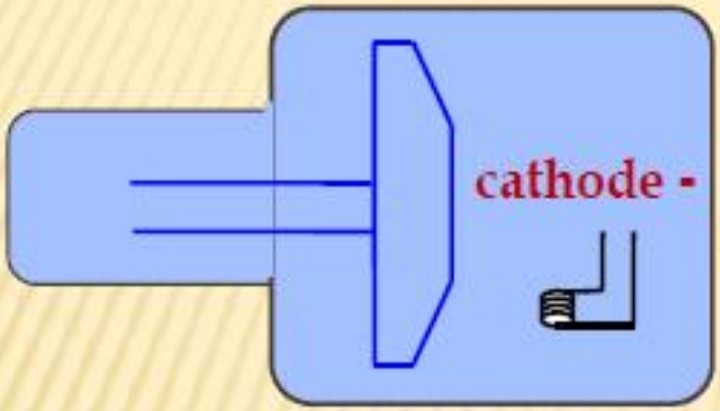
to produce x rays

- **to record the image**
- **to control size & shape of beam**
- **accessories & patient comfort items**
- **to process the image**

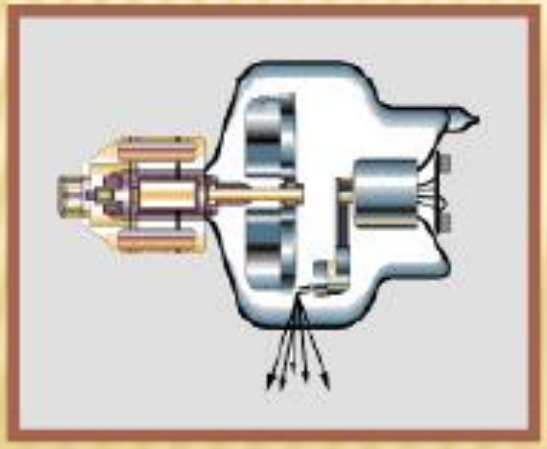
X-RAY PRODUCING EQUIPMENT

- x-ray tube
- high voltage generator
- control console

X-RAY TUBE



anode +



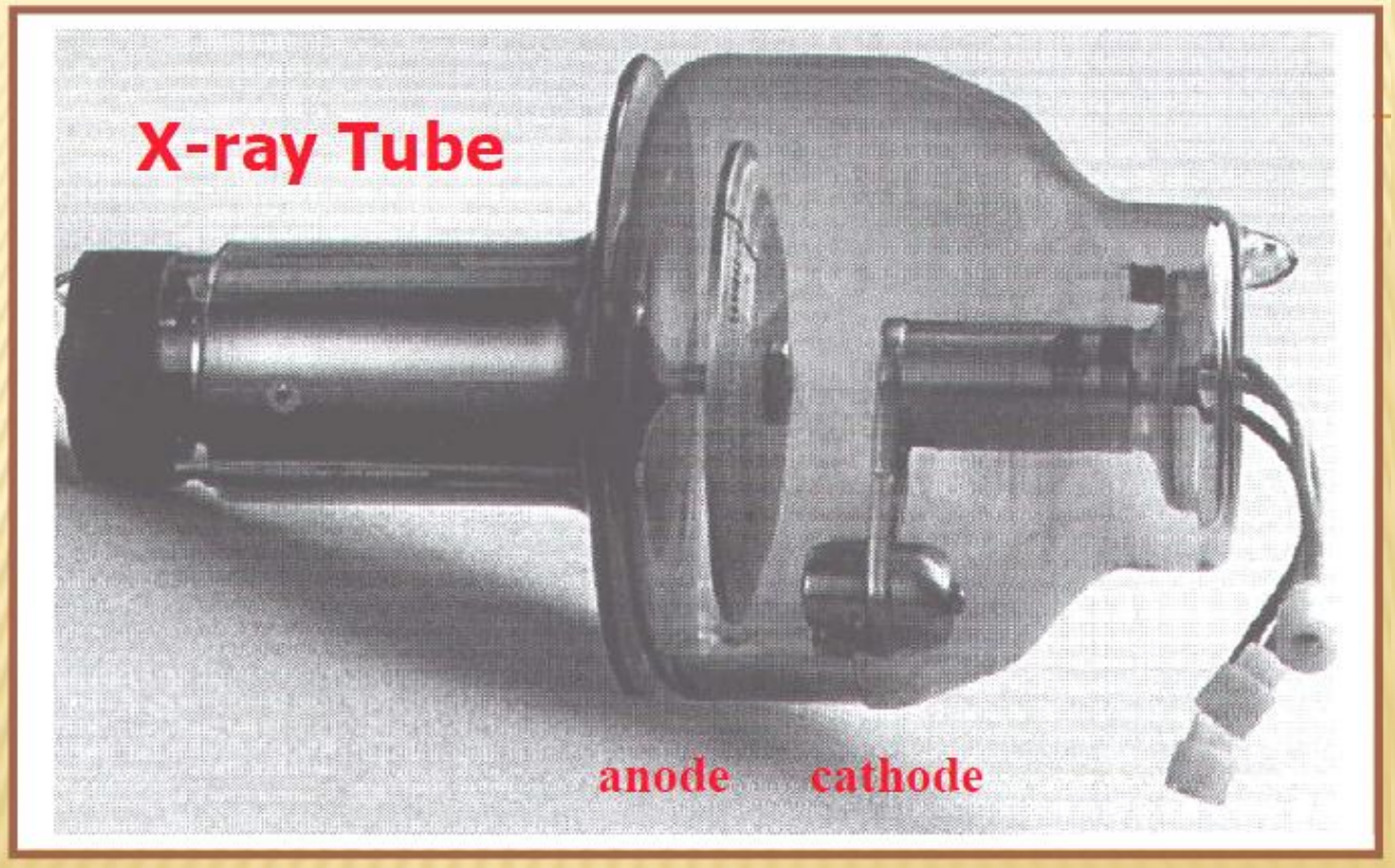
Glass vacuum diode tube

cathode

- negative electrode
- source of electrons
- 2 filaments (coils)

anode

- positive electrode
- attracts & stops electrons


X-ray Tube
anode
cathode

ANODE

- target
  - Area on anode where electrons stop
- focal spot
  - Area on target that emits the x rays
- types of anodes

Rotating Anode

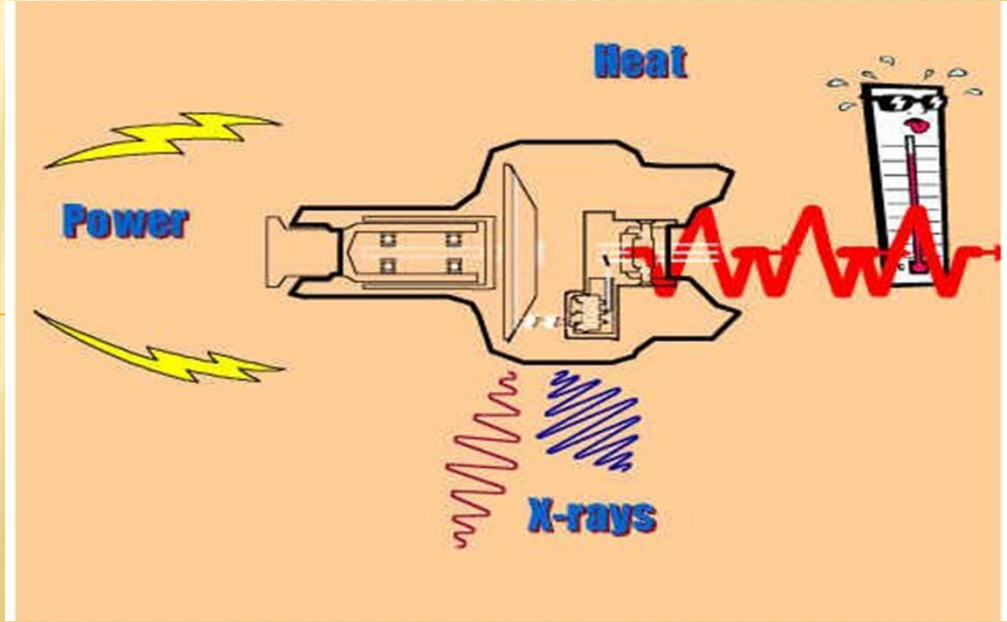
Side view Front view

Stationary Anode

Side view Front view

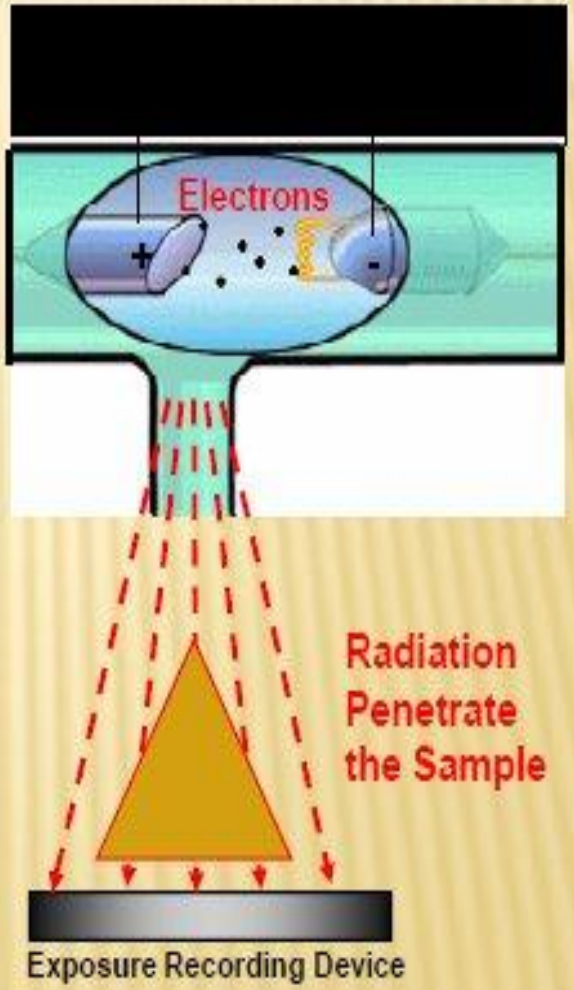
WHY ROTATING ANODE

- Only small fraction of energy of accelerated electrons converted into x-ray .
- The remaining energy is converted to heat .
- Most x-ray machines is have rotating a nodes to spread out the heat to prevent anode melting
- This is reason of the noise hearing from an x-ray machine .

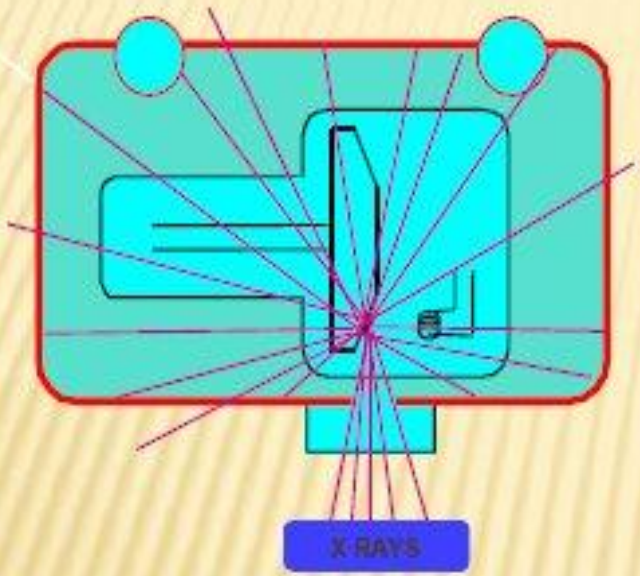


WHAT HAPPENS IN AN X-RAY TUBE:

- cathode – supplies e-
- anode – attracts e-
- electrons – move at high speed (KE) to target
  - collide with target
  - KE of e- changed to x rays & heat
- x rays – emitted at focal spot
- Unusable –x-rays absorbed by tube shielding



PROTECTIVE X-RAY TUBE HOUSING



- Lead Surrounds tube
- Small opening allowing beam of x rays to exit
- Shield to absorb x rays not used
- Leakage radiation - x rays that penetrate the housing

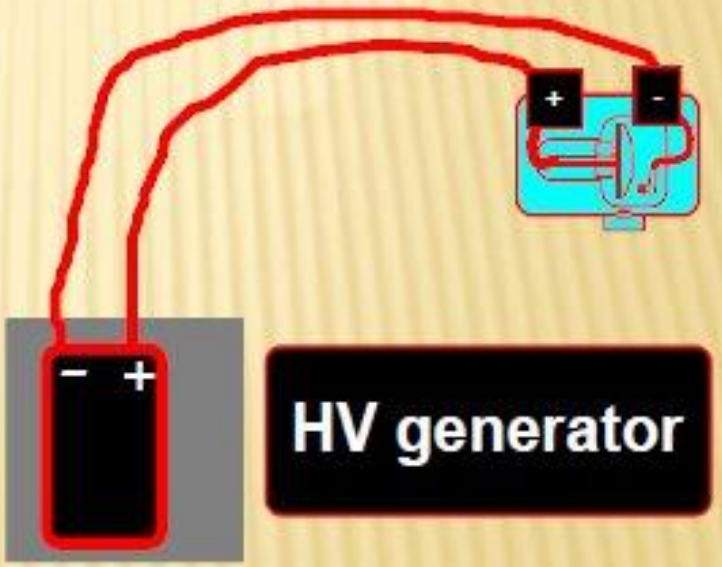
HIGH VOLTAGE GENERATOR

- provides power to move (accelerate) electrons from cathode to anode
- 40,000 to 150,000 volts (40 TO 150 KVp)

  1,000 volts = 1 KVp

  V to kV ÷ 1000

  kV to V × 1000
- connected to x-ray tube with high tension cables



CONTROL PANEL (CONSOLE)

- MANY VARIATIONS
  - knobs vs. buttons, etc.
- Touch-screen type control panel

CONTROL CONSOLE OR PANEL

- MAIN ELEMENTS
  1. main power switch (circuit breaker near console)
  2. ON/OFF (on the console)
  3. Technique controls (kV, mA, t, etc.)
  4. Exposure controls
  5. Equipment operation indicators

KVP SELECTION

- KVp used to control ENERGY LEVEL of x rays
- PENETRATION (QUALITY) OF BEAM
- main control for image CONTRAST
- selection in unit value range from ~40 KVp to 150 KVp

  - Increments: major = 10 KVp minor = 1 KVp

major	40	50	60	70	80	90	100	110	120	130
minor	0	1	2	3	4	5	6	7	8	9

MA SELECTION

- MILLIAMPERAGE

  1A =1000 mA [A × 1000 = mA]

  1mA =0.001 A [mA ÷1000 = A]

- Amperage # of e- flowing in a current
- Controls # of x rays produced
- QUANTITY OF X RAYS IN BEAM
- Main control for image DENSITY

50	100	200	300	400	600	800	1000

TIME SELECTION

- length of time machine produces x rays
- range of selections usually at specific values
  - not same all machines

.003	.006	.008	.011	.014	.017	.022	.02	.04	.05	.062	.08
.1	.13	.16	.2	.25	.33	.5	.7	1	2	4	6

MA & TIME WORK TOGETHER

combined for total control on QUANTITY

- mA = # of e- (per second of time)
- time = duration

Relative value for total # of x rays

- mAs = mA X t
- when ↑ mAs = similar ↑ in # of x rays
- 2x mAs = 2x # of x rays

WHAT IS THE MAS FOR 300 MA AT 6 MS?

mAs = mA x T

T = 6 ÷1000 = .006 s

= 300mA x .006 s

= 1.8 mAs

FOCAL SPOT SELECTION

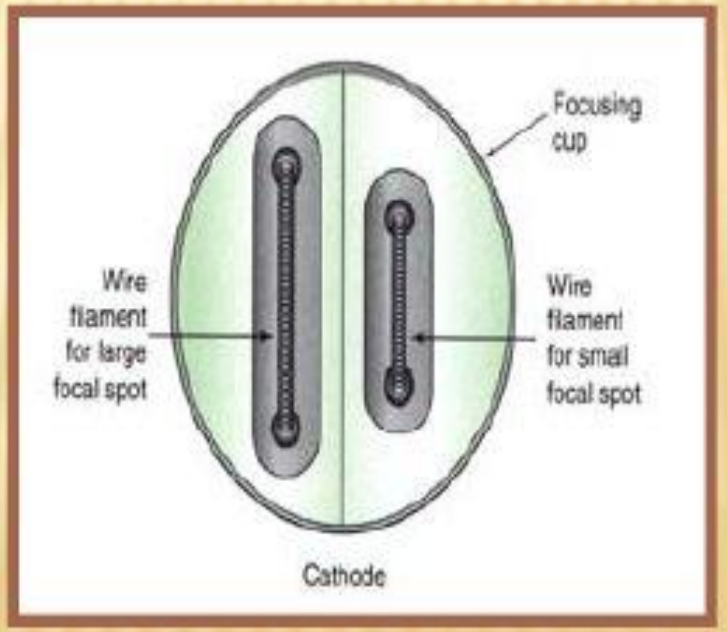
activates small or LARGE filament in cathode

↓ or ↑ size of focal spot emitting x rays

small FS = sharper image /more tube wear

LARGE FS = less sharp image / less tube wear

As the focal spot size decreases, local heating of the X-ray tube target increases and can eventually be so high as to vaporize the material, leading to tube failure .



EXPOSURE ACTIVATING SWITCH

Two Position Safety Control

1. Step .1

   prepares tube for x-ray production By

   a. rotates anode to correct speed

   b. heats selected cathode filament (release e^-)

2 Step .1

   Exposure to produces x rays

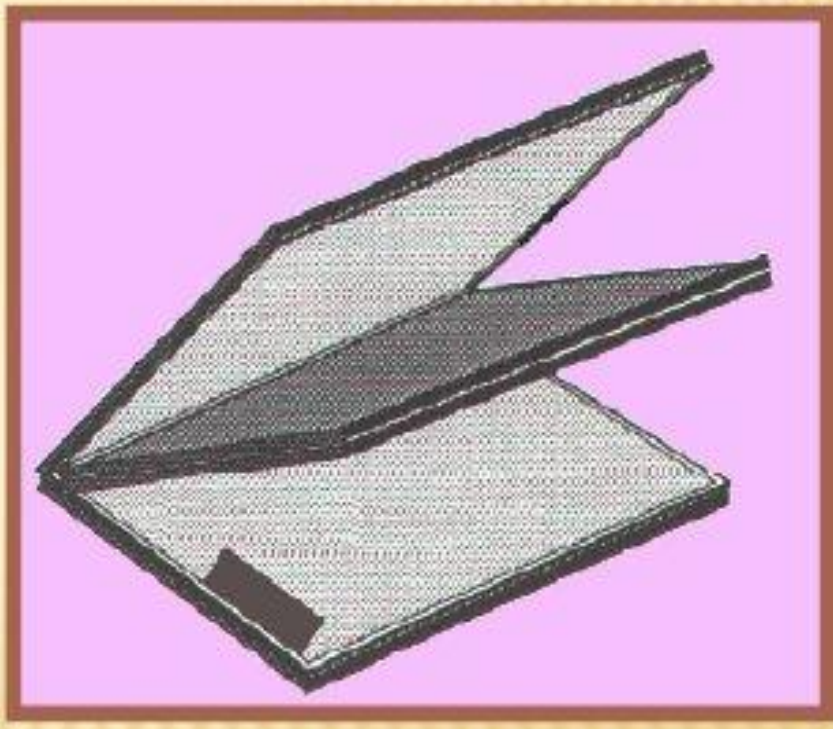
IMAGE PRODUCTION EQUIPMENT

1. FILM
   - SPEED
     - SLOW = ↑ X RAYS & ↑ DETAIL
     - FAST = ↓ X RAYS & ↓ DETAIL
     - numerical values indicating relative change in radiation needed (inverse relationship)

       100 200 300 400
   - SIZES 8X10, 10X12, 7X17, 14X17, . . .
   - TYPES single vs. double emulsion

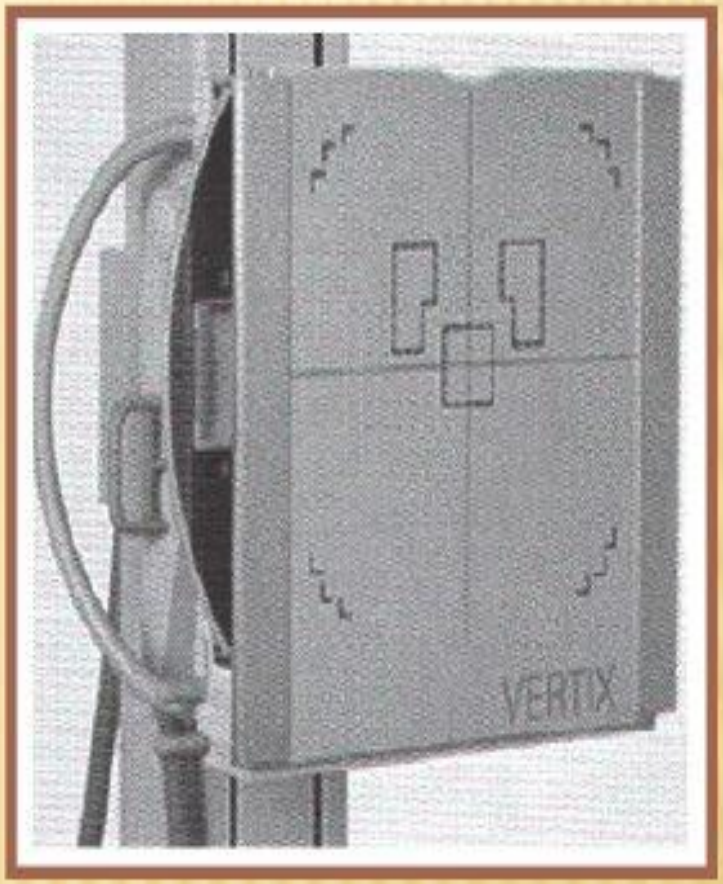
2 CASSETTES

- light tight holders for film
- sized for film
- FRONT vs. BACK
- ID window
- Types
  - cardboard vs. screen



AUTOMATIC EXPOSURE CONTROL (AEC)

- electronic method to stop x-ray production
- stops when preset film density achieved (i.e. # of x rays)
- small sensor areas measure amount of radiation exiting patient



GRID

- Device used to ↓ the effect of scattered x rays on the film

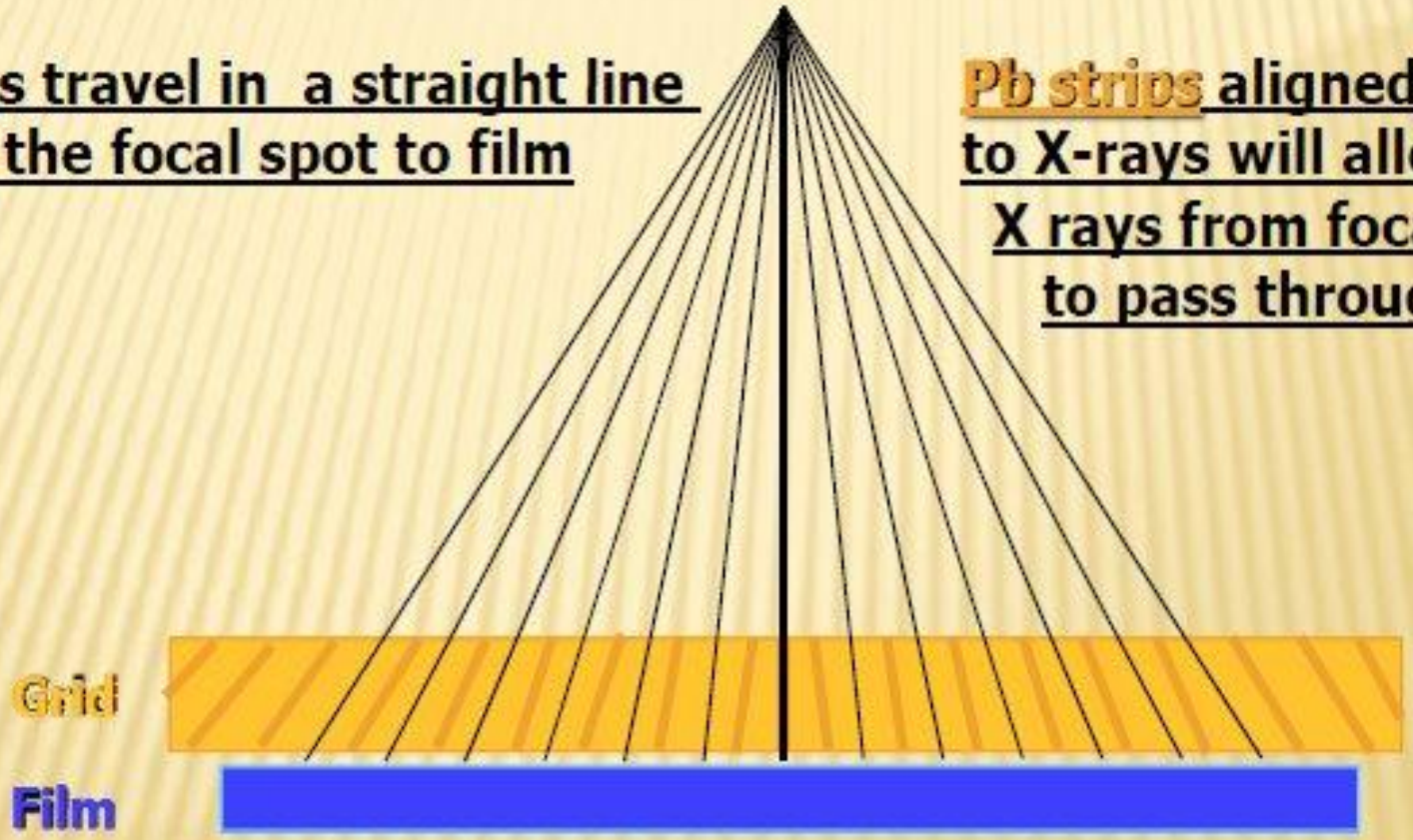
Theory

- thin strips of x ray absorbing material are placed between the patient & the film
- arrangement of strips allows transmitted x rays to pass through to the film but absorbs scattered x rays
- "CLEANS UP" film fog caused by scatter

GRID CROSS SECTION /THEORY OF OPERATION

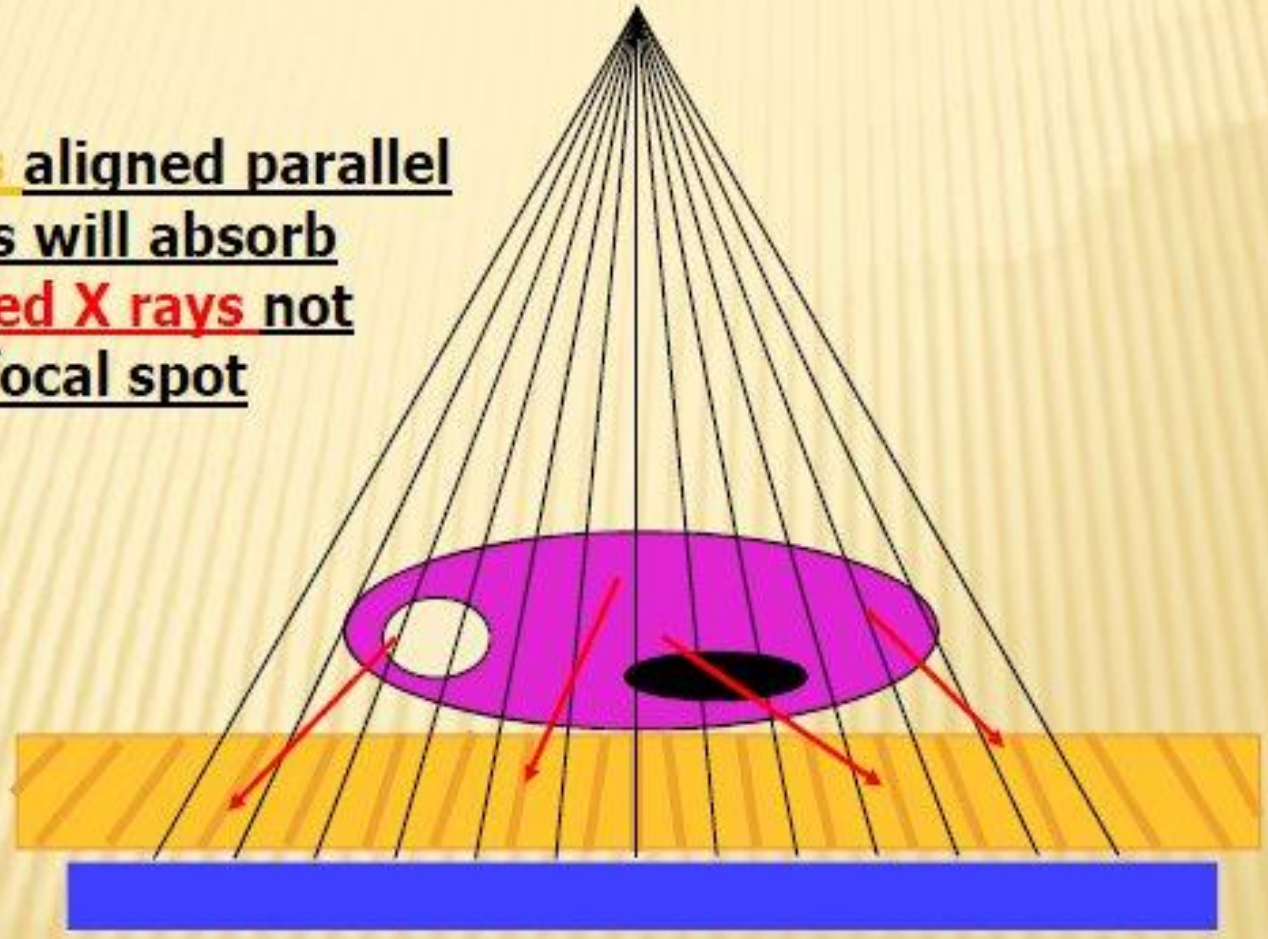
X rays travel in a straight line from the focal spot to film

Pb strips aligned parallel to X-rays will allow X rays from focal spot to pass through



GRID - SCATTER REDUCTION

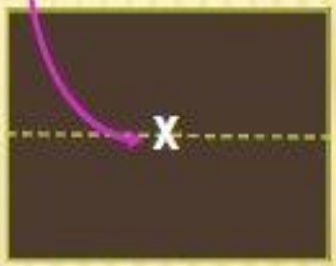
Pb strips aligned parallel to X-rays will absorb scattered X rays not from focal spot



GRID USAGE RULES

2. use correct SID for grid

3. center x-ray beam to grid



1. grid placement

4. beam angles
beam angle OK

no beam angle across grid

GRID TYPES

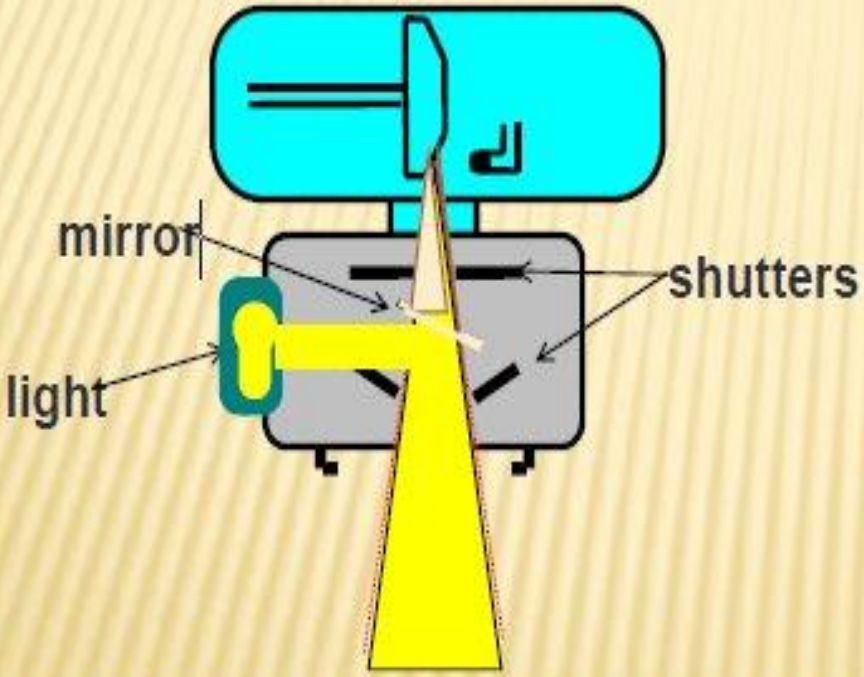
- Stationary
  - image of grid superimposed on radiograph
- Reciprocating
  - Bucky or Potter-Bucky
  - grid moves back/forth during exposure
  - blurs image of grid
  - requires more radiation to use

BEAM RESTRICTION DEVICES

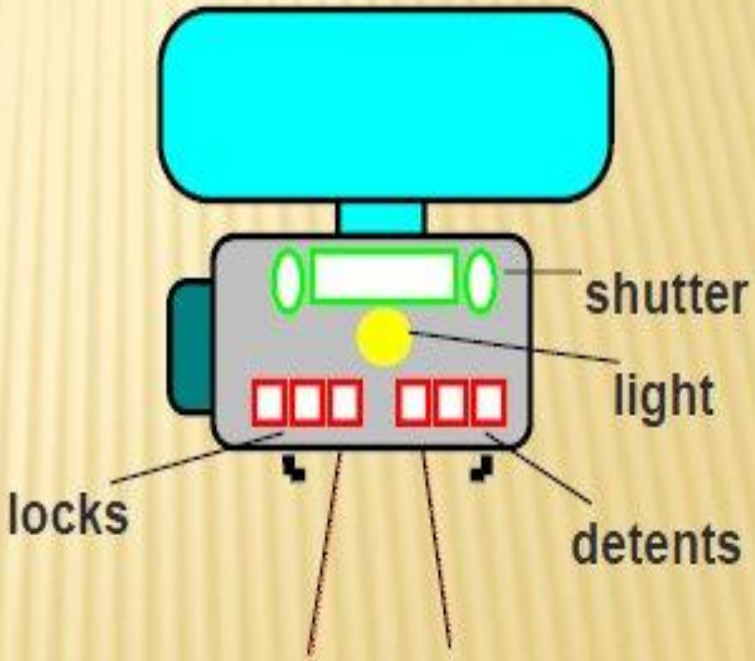
- Item used to shape the x-ray beam to fit the part of the body
- device types :
- collimator or Light beam diaphragm
- cone
- diaphragm

COLLIMATOR

Box like beam restricting device with adjustable lead shutters attached to the x-ray tube housing port

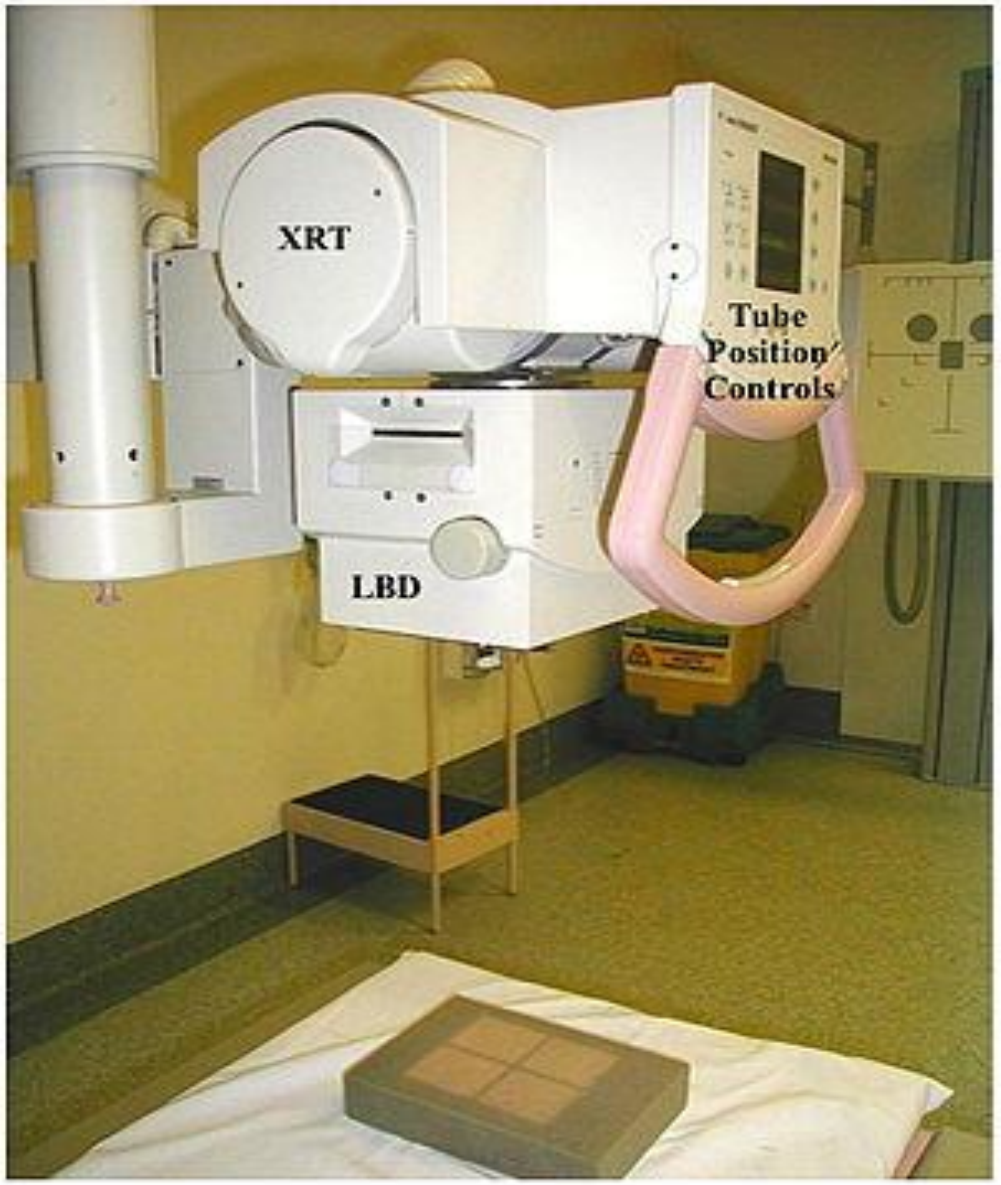


cross section



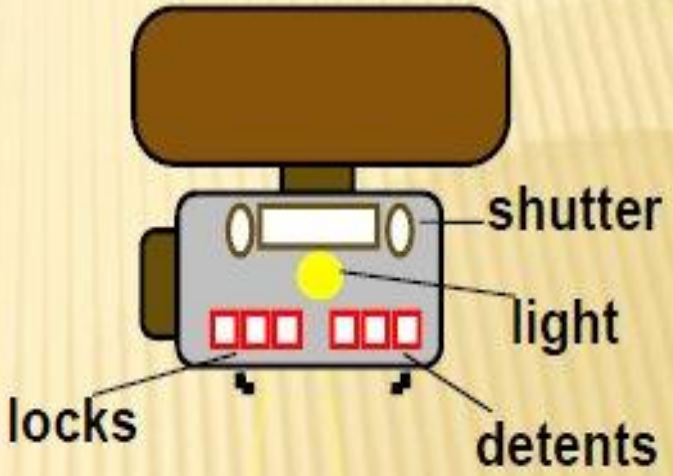
controls

Light beam diaphragm(LBD) or collimator



COLLIMATOR FUNCTIONS

- shape & size beam
- light localization of beam
- tube locking controls
- detent controls
- accessory attachments



"COLLIMATION RULE"

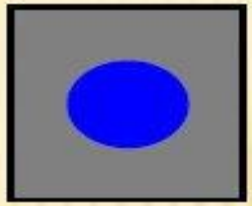
- The size of the collimated x-ray field should be adjusted to
  - the smallest reasonable size that will include the portion of the body to be imaged
  - but never larger than the size of the film.

POSITIVE BEAM LIMITATION DEVICE (PBL)

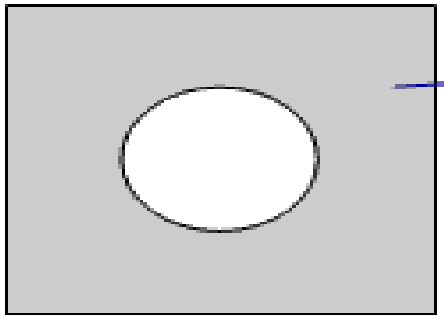
- automated collimation system used with Bucky tray (table or upright)
- automatically adjusts field size to film size
  - will not allow larger fields
  - will have a method to reduce field size

OTHER BEAM RESTRICTORS

2. DIAPHRAGM
   - lead cut out
   - unique shapes

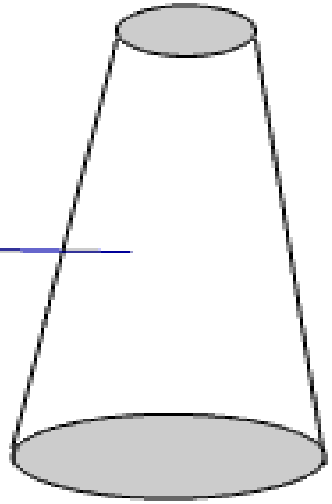


3. CONES
   - lead extension
   - **conical** or **tubular**



Aperture diaphragm

Cone



ACCESSORY DEVICES

Items used to:

- immobilize/support patient or part
  - sponges
    - (can be in image area)
  - sandbags
    - (cannot be in image area)

SPONGE SET

SANDBAG SET

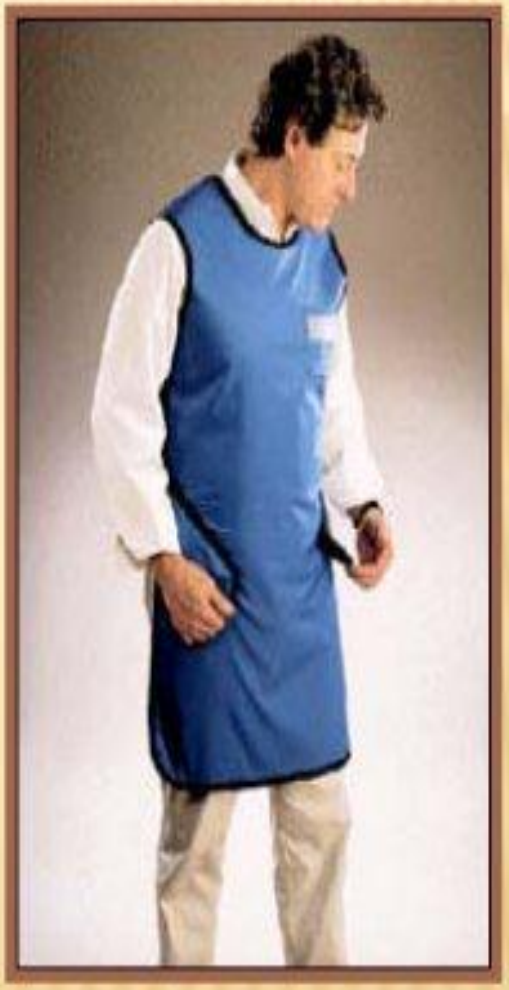
ACCESSORY DEVICES

Items used to:

- shield patient or others from exposure
  - lead aprons, gloves, glasses, shields

Pb shield drape

Pb glove



Pb apron

THIROID ,GONADAL

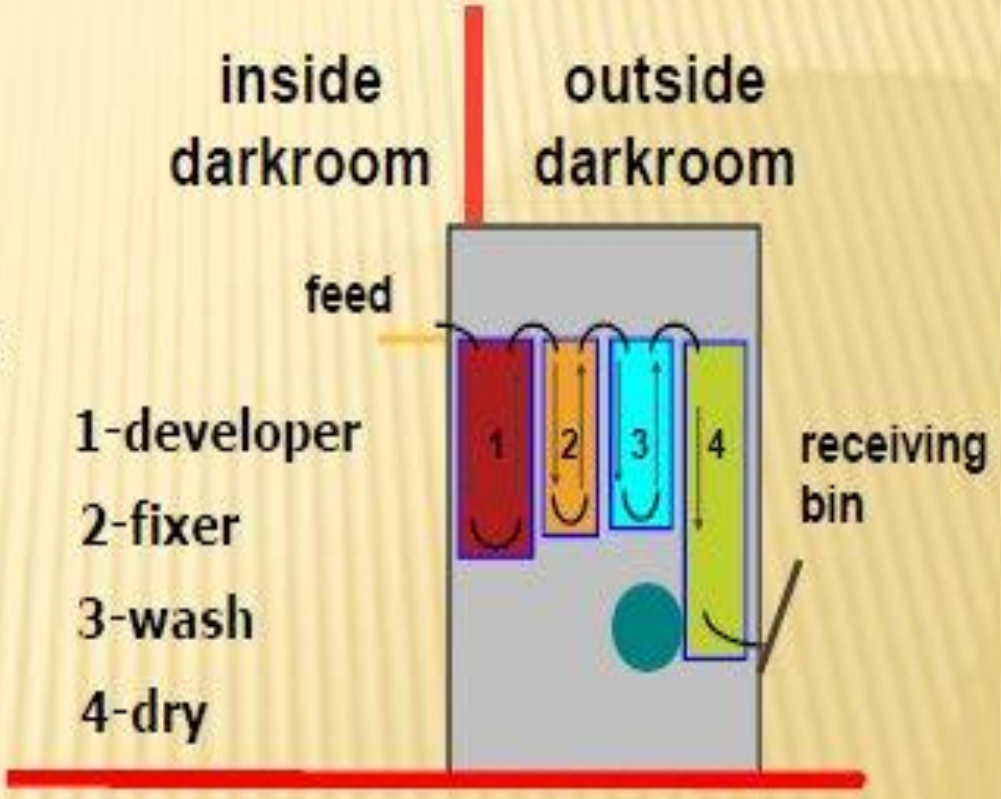
DENTAL

MARKER

Most important to mark the part which you do x-ray for it , mark right or left .

FILM PROCESSING

- Exposed film must be processed
  - makes the image visible
  - makes the image permanent
- Automated machines
  - "stand by" mode
  - replenishment



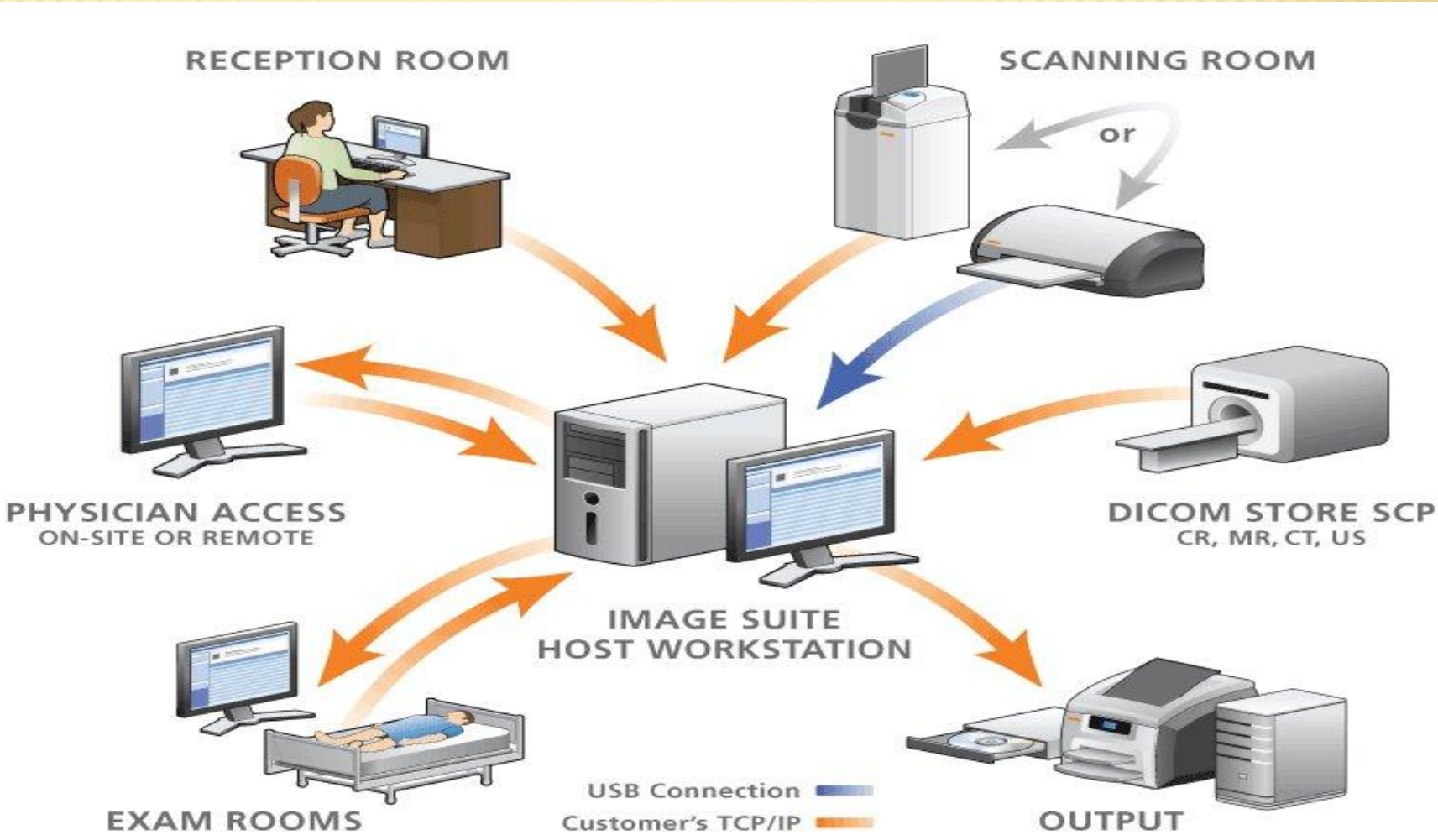
"DAY LIGHT" PROCESSING

- processing system that does not use darkroom
- specialized equipment
  - cassettes: end slots on cassettes for loading / unloading film
  - film loader: stores & loads film into cassette
  - film unloader: device on processor removes film from cassette

BUT THE MOST RESENT IS PACS SYSTEM

picture archiving and communication system (PACS)

- **PACS** : is a technology which provides economical storage and convenient access to, images from multiple modalities (source machine types).



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- **Useful Websites**
- http://www e-radiography net/