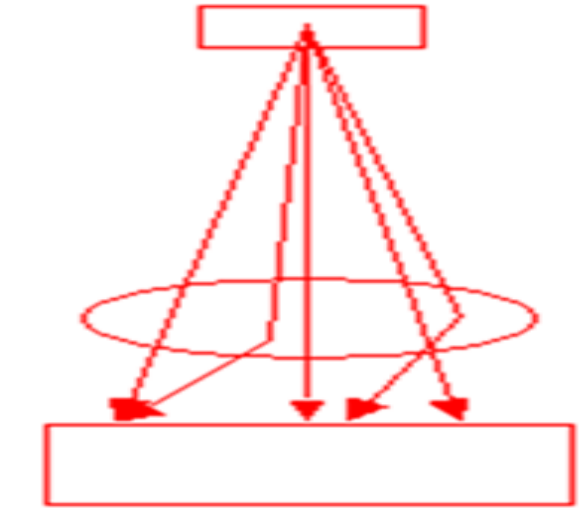
"Scatter Radiations and its Control"



SCATTER RADIATIONS

- Radiation which deviates from the primary beam both in direction and wavelength after interacting with a medium or a patient being exposed to x-rays.
- Forward scatter: if angle of scattering from primary beam is less than 90^0
- Back Scatter: if angle of scattering from primary beam is more than 90^0
- Scatter radiations are also hazardous to person working in radiology section

Filters

- It is placed in between the patient and x-ray tube to remove less energetic (soft) x-rays from the primary beam which have no chance to reach the film.
- Filtered x-ray beam decreases the exposure dose of the patient and scatter radiation.
- **Components of filtration**
  - Inherent filtration: Glass envelope, insulating oil, backelite window.
  - Added filtration: Aluminium and Copper filters.
- **Wedge Filters:**
  - It is made of aluminium or lead acrylic i.e. 30% lead by weight
  - Used in the situation where there is large variation in thickness of tissues.

Scatter Radiation Control Devices

Beam Collimators

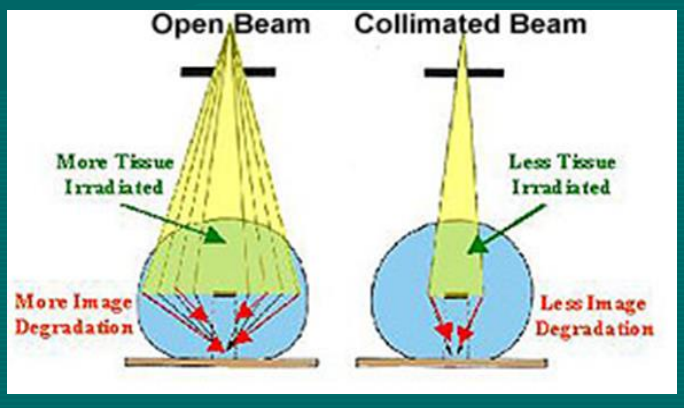
Collimation- regulation of x-ray beam, by beam restricting devices to restrict it to the part of the patient under examination.

Advantages

– Reduction in scatter radiation

– Improves the radiographic quality

– Decrease in patients dose by reducing the area being exposed



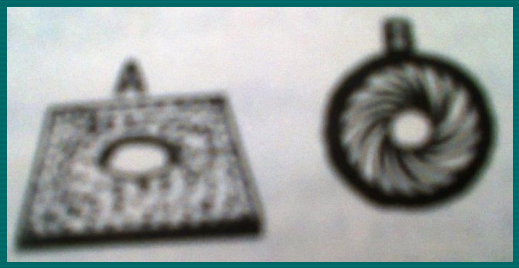
Types

– Aperture diaphragm

– Cones and cylinders

– Variable aperture collimator

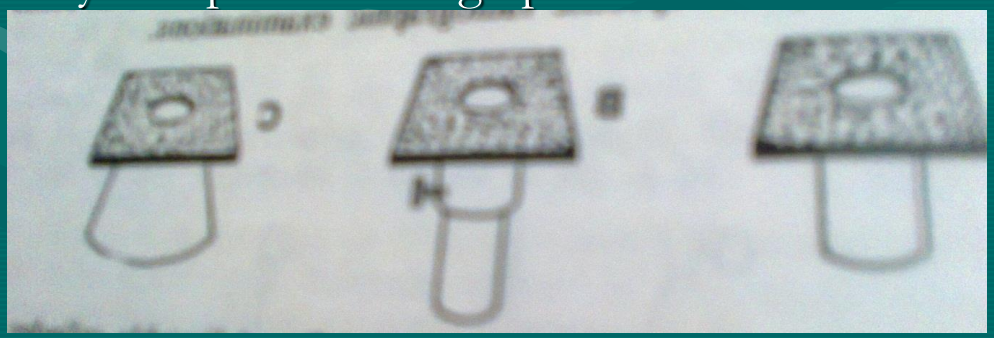
Aperture Diaphragm



- Simplest collimator
- Made up of sheet of lead with circular, square or rectangular hole in the centre.
- Disadvantages:
  - Fairly large penumbra formation at the periphery.
  - Inconvenience: separate size of diaphragm is required for each size of the film.

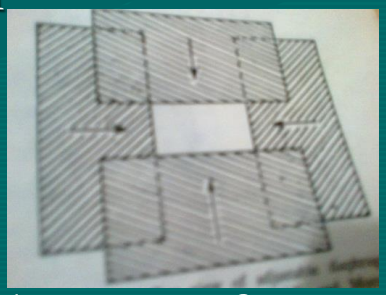
Cones and Cylinders

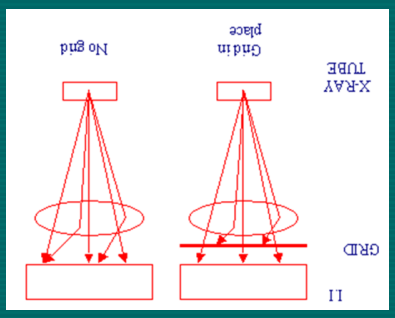
- Conical or cylindrical metal tubes that channel an x-ray beam to the required field size.
- Base is made up of lead to absorb x-rays
- Both are ineffective in removing penumbra
- Cylinder producing comparatively less penumbra because beam collimation takes place at its far.
- Since size of cones and cylinders is fixed, these are appropriate only for specific radiographic examinations.



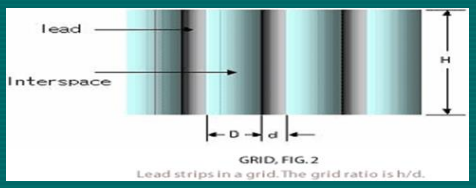
Variable Aperture Collimator

- Beam restricting device with adjustable lead shutter.
- **Advantages**
  - X-ray beam can be adjusted to a variety of rectangular shapes and sizes
  - Exposure field can be illuminated to permit its visualization
  - Penumbra is greatly reduced
  - Adjustable lead shutter exposes only the area of interest, thus reducing the patient dose.





Grid



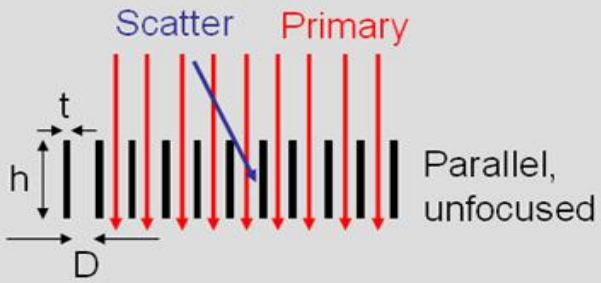
- Grid is a flat plate of alternating radioopaque (lead) and radiolucent (plastic or aluminium) strips encased in a protective covering of thin aluminium.
- Improve contrast by reducing scatter radiation
- Used when thickness of the part being radiographed measures ⇑ 10cm.
- It is placed between the part to be examined (patient) and cassette so as to absorb scatter radiation falling on the film.
- Grid removed large quantity of x-rays required to produce desired radiographic density and thus exposure factors have to be increased to compensate for the loss by grid.

Grid Ratio

Grid characteristics:

t = thickness of lead strips
h = height of lead strips
D = distance between lead strips

Grid Ratio = $\frac{h}{D}$



It is the ratio of the height of lead strips to the distance between the strips.

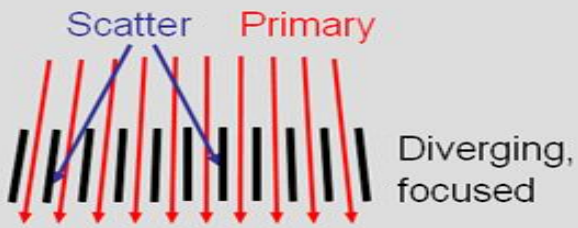
- It expresses grid's ability to absorb scatter radiations
- High ratio grids absorb more scatter radiation
- Higher ratio grids are recommended for higher kVp range
- If exposure made under 90kVp grid ratio 8:1 or 10:1 preferred.
- In general, grid ratio ranges from 4:1 to 16:1.

Grid Frequency

- It is the number of lead strips per inch in a grid.
- Most grids have frequencies in the range 60-110 lines/inch
- Aa

$$\text{Grid Frequency} = \frac{1}{t + D}$$

Focal range: determined by geometry of lead strips



- High frequency grid produces less grid lines on radiographs but less effective in absorbing high energy scatter radiation.

- Grid selectivity-Ratio of transmitted primary radiation to transmitted scatter radiation.

  -High ratio grids have higher grid selectivity
- Contrast improvement factor of a grid-Ratio of contrast of a radiograph with grid to contrast without grid.

  -Radiographic contrast is almost double with the use of grid.
- High ratio grid CIF higher.

- Bucky factor-Ratio of incident radiation falling on grid to radiation transmitted through grid.

-It measures total quantity of radiation absorbed by grid.

-High ratio grid having higher value of bucky factor.

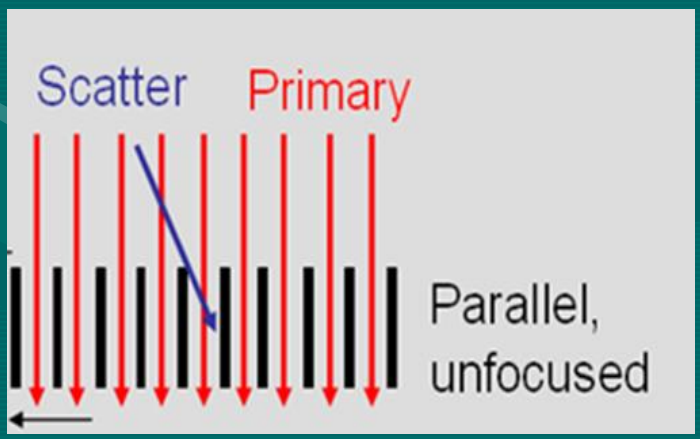
-Higher bucky factor results in more radiation exposure to the patient.

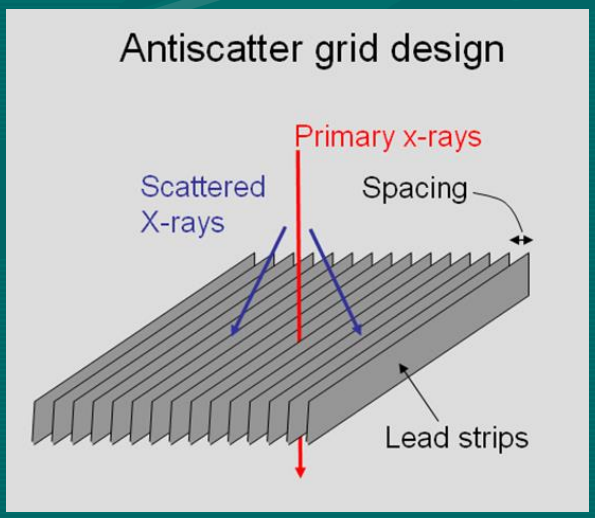
Grid Cut-Off-Loss of primary radiation as a result of undesirable absorption.

-Grid cut-off higher with higher ratio grid.

Types of Grids

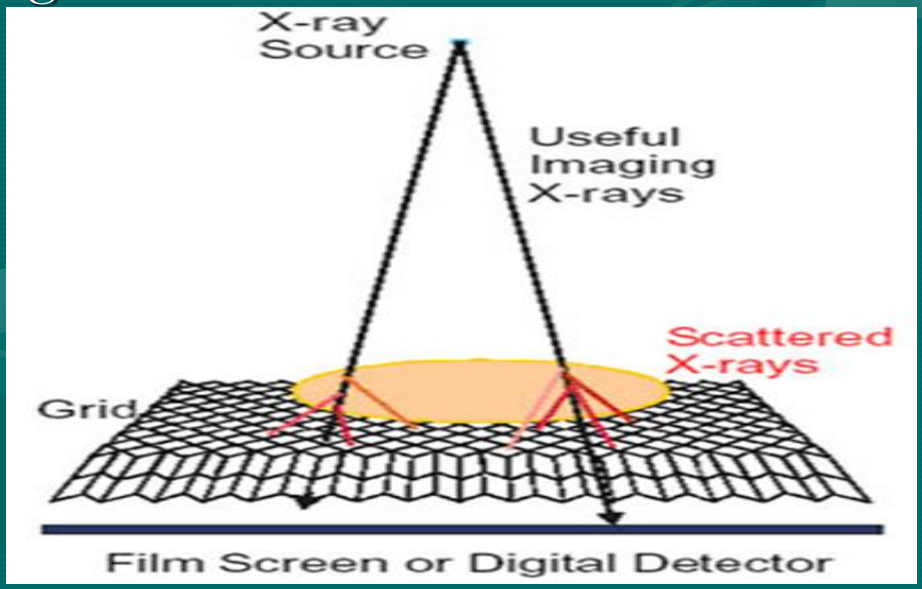
- **Parallel Grid**
  - Lead strips are placed parallel to each other.
  - Advantage- X-ray tube can be angled along the length of the grid without grid cut-off.
  - Limitation- FFD must be 120cm or more which is undesirable.





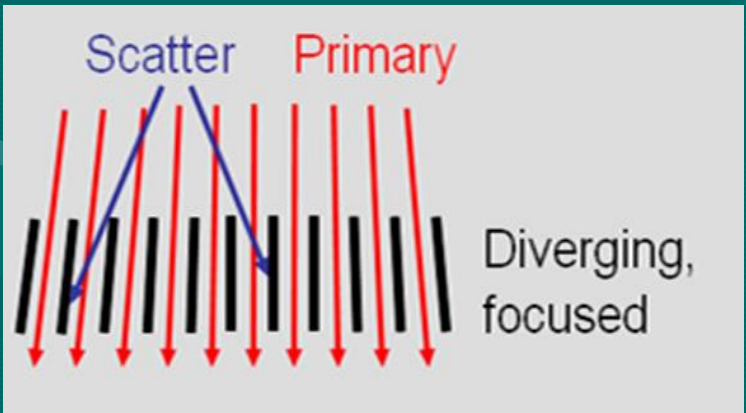
Crossed Grid

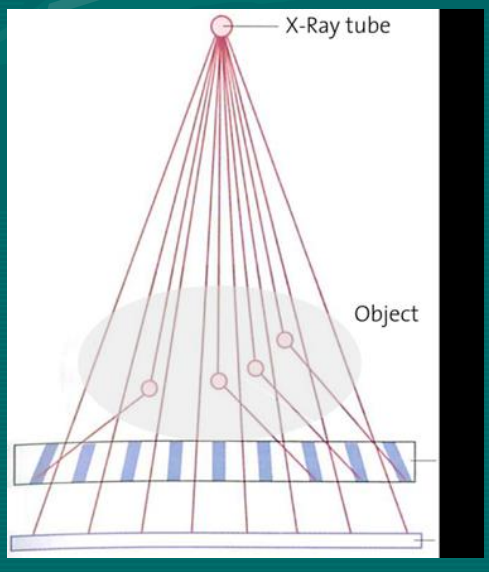
- It consists of two superimposed parallel grids placed at right angle to each other.
- More efficient in absorbing scatter radiations
- X-ray beam must be centered at right angle to a crossed grid.



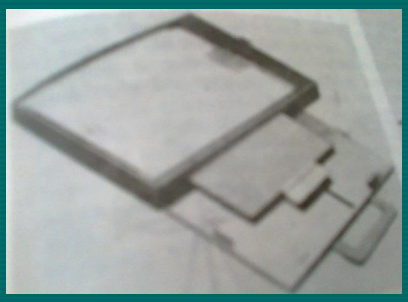
Types of Grids

- **Focussed Grid**
  - It may be parallel or crossed.
  - In this, lead strips are angled increasingly towards edges.
  - Perpendicular distance between surface of the grid and convergent point is called grid focal distance.





Moving Grid/ Potter-Bucky Diaphragm/ Bucky Diaphragm/ Bucky Grid



- It is a focussed grid that moves mechanically across the x-ray beam during a radiographic exposure.
- It moves at a uniform speed adjusted to exposure time.
- Grid is usually fixed underneath the x-ray table.
- Disadvantages- Cost, Mechanical failure, Noise, limitation of exposure time, Relatively more exposure due to increased grid cut-off.

Air gap Technique

- Distance between the patient and film which allows a quantity of scatter radiation to escape without interacting with the film.
- Genrally the distance kept between the patient and film for air gap technique is 6-9cm.

THE END