

X-RAY MACHINE ACCESSORIES

Dr. S. P. Tyagi

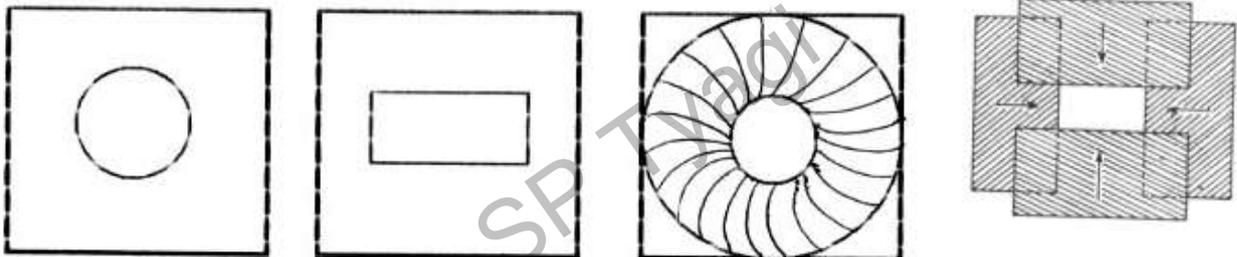
(A) X-RAY BEAM COLLIMATORS:

These are the devices made of lead and are used to restrict x-ray beam up to a desired area. In diagnostic radiology their use offers advantages of minimizing x-ray dose to the patient. Following two types of collimators are used-

- (i) Aperture diaphragm
- (ii) Cones and Cylinders

Aperture diaphragm:

This may be fixed aperture size type or adjustable variable aperture size. The aperture shape may be square or rectangular.



Fixed circular aperture diaphragm	Fixed rectangular aperture diaphragm	Adjustable circular aperture diaphragm	Adjustable rectangular aperture diaphragm
-----------------------------------	--------------------------------------	--	--

Cone and Cylinders:

As the name indicates these devices are either conical or cylindrical shaped.

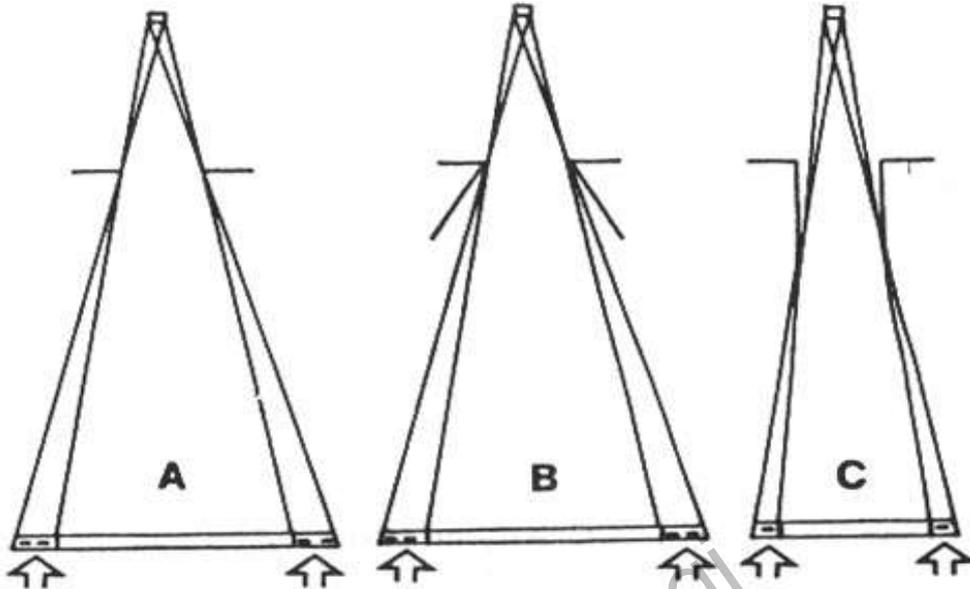
All the collimators are fixed at the exit point of x-ray beam from the window of x-ray tube. There is disadvantage in use of fixed aperture or cone and cylinder type collimators as they have to be changed every time a different area has to be exposed.



Non adjustable cylinder	Adjustable cylinder	Cone
-------------------------	---------------------	------

Penumbra formation:

Penumbra is the lighter shadow formed towards the edges of a dark shadow. It is formed by overlapping of light or x-ray originating in one direction from the different source. The penumbra is less with cylinder type collimator and more with aperture diaphragm.



(B) X-RAY BEAM FILTERS:

These filters have thin layer of aluminum (0.5-1.0 mm) inside them and are used to absorb lower energy photons of x-ray beam. As we know that diagnostic x-ray beam is consisting of a spectrum of different energies in which the lower energy photons do not contribute towards diagnostic quality of a radiograph (and rather increase the radiation dose of patient unnecessarily). Therefore, these aluminum filters are placed between x-ray beam and the patient so that primary beam comprises only useful photons.

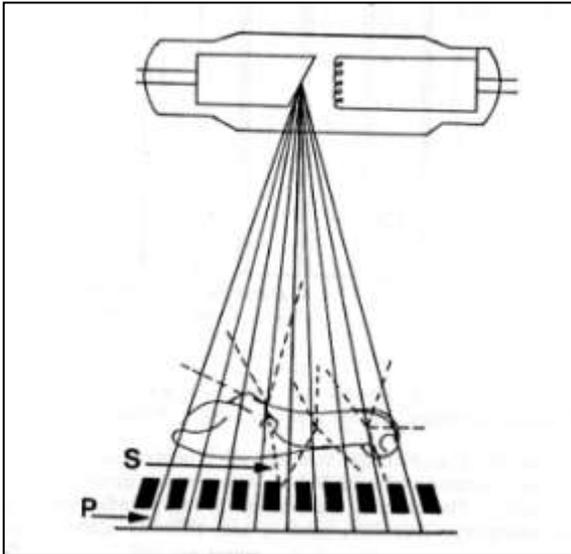
General recommendations for the use of filters-

- 0.5 mm for < 50 kVp
- 1.5 mm for 50-70 kVp
- 2.5 mm for > 70 kVp.

(C) GRID:

This is a flat plate containing a series of alternating strips of radiographic (lead) and radiolucent material (plastic or thin aluminum) enclosed in a protective covering of thin aluminum.

- The grid is placed between the part to be radiographed and cassette so as to absorb scatter radiation falling on the film.



Use of grid, however results in removal of large quantity of x-rays required to produce desired radiographic density and thus radiographic exposure factors have to be increased to compensate for the losses.

GRID RATIO: It is the ratio of the height of lead strips to the distance between the strips. Therefore, this ratio represents grid's ability to absorb scatter radiation.

- High ratio grid absorb more scatter radiation, but require more perfect centering, higher exposure and much narrower focal range.
- Different grid ratios are used in diagnostic radiography such as 4:1, 8:1, 10:1 and 16:1. Higher grid ratio is recommended for higher kVp range.

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

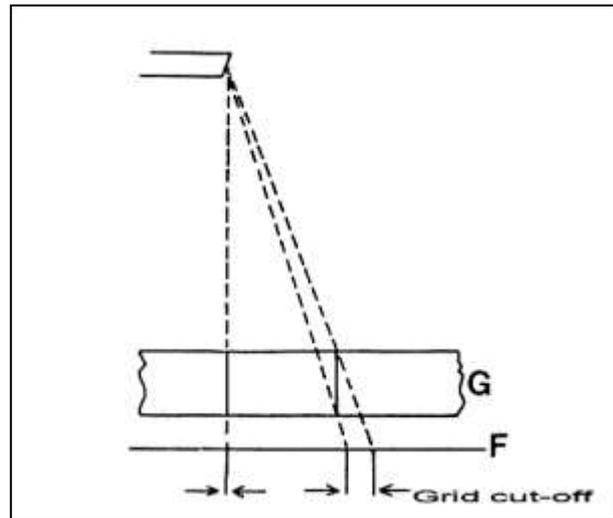
- Grid with higher frequencies show less distinct lines on radiograph but they require higher exposure and are less effective in absorbing high energy scatter radiation.

TYPES OF GRIDS

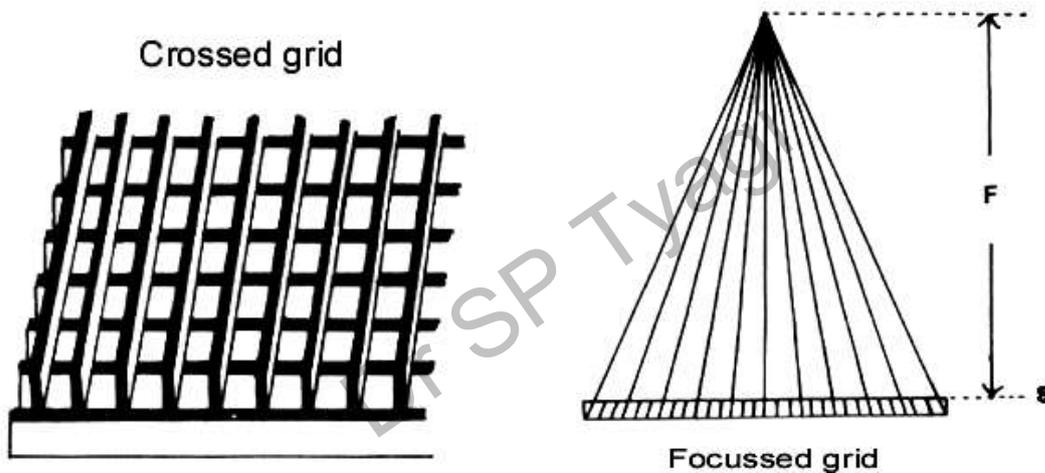
- (1) **Parallel Grid** (Linear grid): In this grid the lead strips are placed parallel to each other. The main advantage of this type of grid is that x-ray tube can be angled along the length of grid without **grid cut off**.



(Grid cut off: It refers to the loss of primary radiation as a result of undesirable absorption, and images of lead strips are projected wider than those with the ordinary magnification).



- (2) Crossed Grid: It consists of two superimposed parallel grids placed at angle to each other. It is more efficient in absorbing scatter radiation, however exposure factor are increased.



- (3) Focused Grid: In this lead strips are angled increasingly towards edges so that if planes of strips are extended, they meet along an imaginary line called convergent line. This may be parallel or crossed.
- (4) Moving Grid (Bucky Grid, Potter Bucky Diaphragm, Bucky Diaphragm): This grid moves mechanically during exposure thereby eliminating chances of appearance of any grid lines shadow over radiograph. Disadvantage include increased patient dose.

USE OF GRID:

- (i) Generally a grid should be used when thickness of the part to be radiographed measures over 10 cm.
- (ii) If grid is to be used, mas should be increased 3-4 tim
- (iii) An increase in kvp is not essential, however it can be increased to maintain low time factor to avoid motion unhappiness of the image.
- (iv) When kvp is increased by a factor of 10, mas is generally reduced by one half.
- (v) For proper functioning of grid, it must be positioned correctly relative to the central axis of the primary beam to reduce **grid cut off**.