*Chapter 9

Scatter Radiation and Its Control

*Learning Objectives

- List and explain three types of interactions between radiation and matter that produce scatter radiation
- Explain the problems caused by scatter radiation in radiography
- List factors that affect the quantity of scatter radiation fog on a radiograph
- Identify scatter radiation fog on a radiograph

*Learning Objectives

- List four measures that can be taken to reduce the quantity of scatter radiation fog on radiographs
- Define *grid ratio*, *grid frequency*, and *grid radius*
- List common grid ratios and state the appropriate application of each

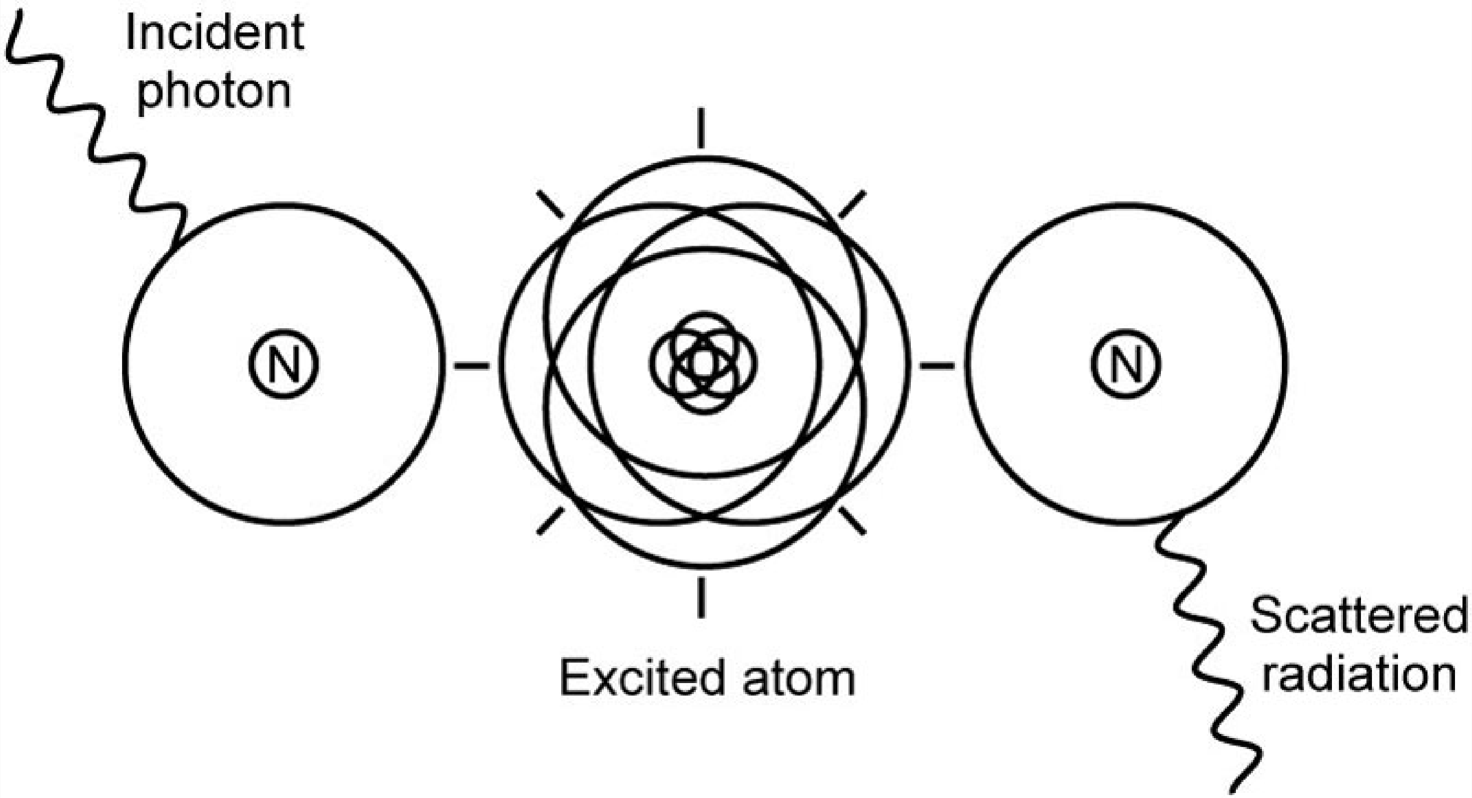
*Learning Objectives

- Define what is meant by *grid cutoff* and list four causes of this phenomenon
- Explain the difference between a Bucky and a stationary grid
- State the criteria for determining whether grid use is appropriate

*Scatter Radiation

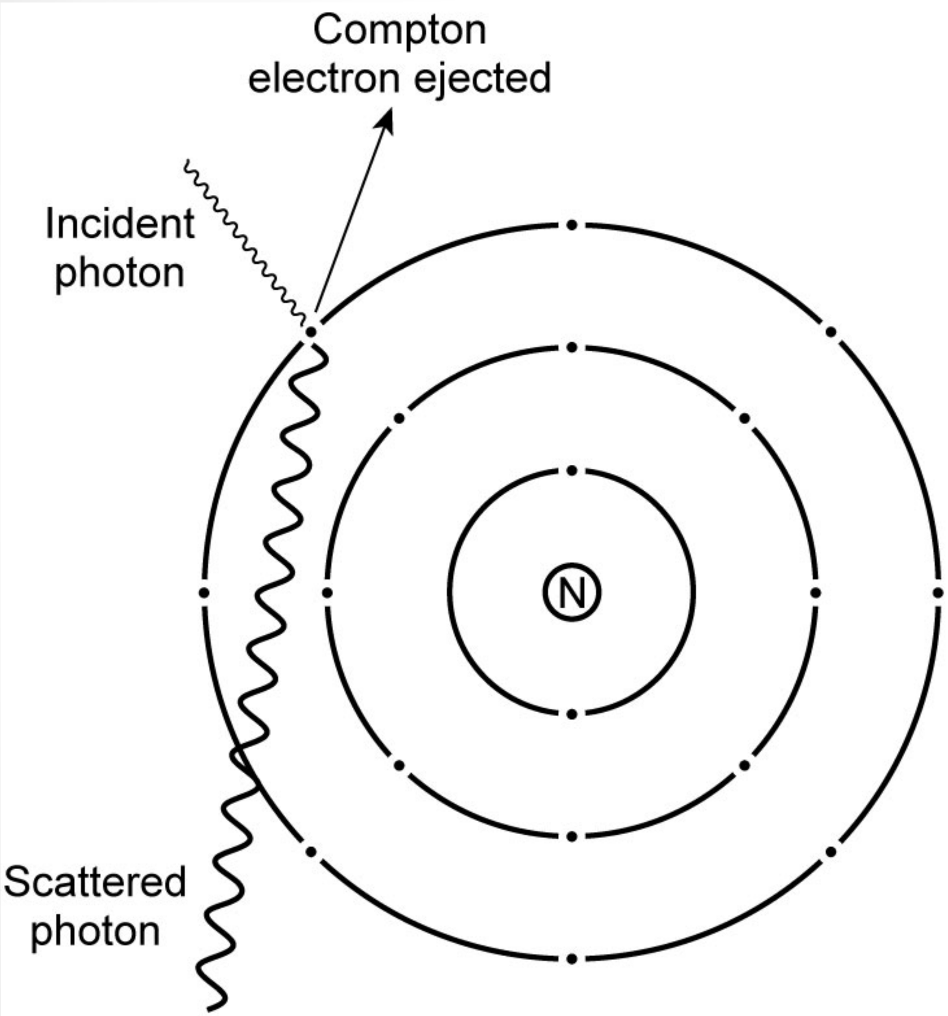
- Refers to x-rays that expose the film but do not contribute to image formation
- Produced by x-ray interaction with the
  - Patient
  - X-ray Table
  - Cassette
  - Other objects in the path of the x-ray beam
- Interactions may be termed
  - *Coherent scatter*
  - *Compton effect*
  - *Photoelectric effect*

Coherent Scattering



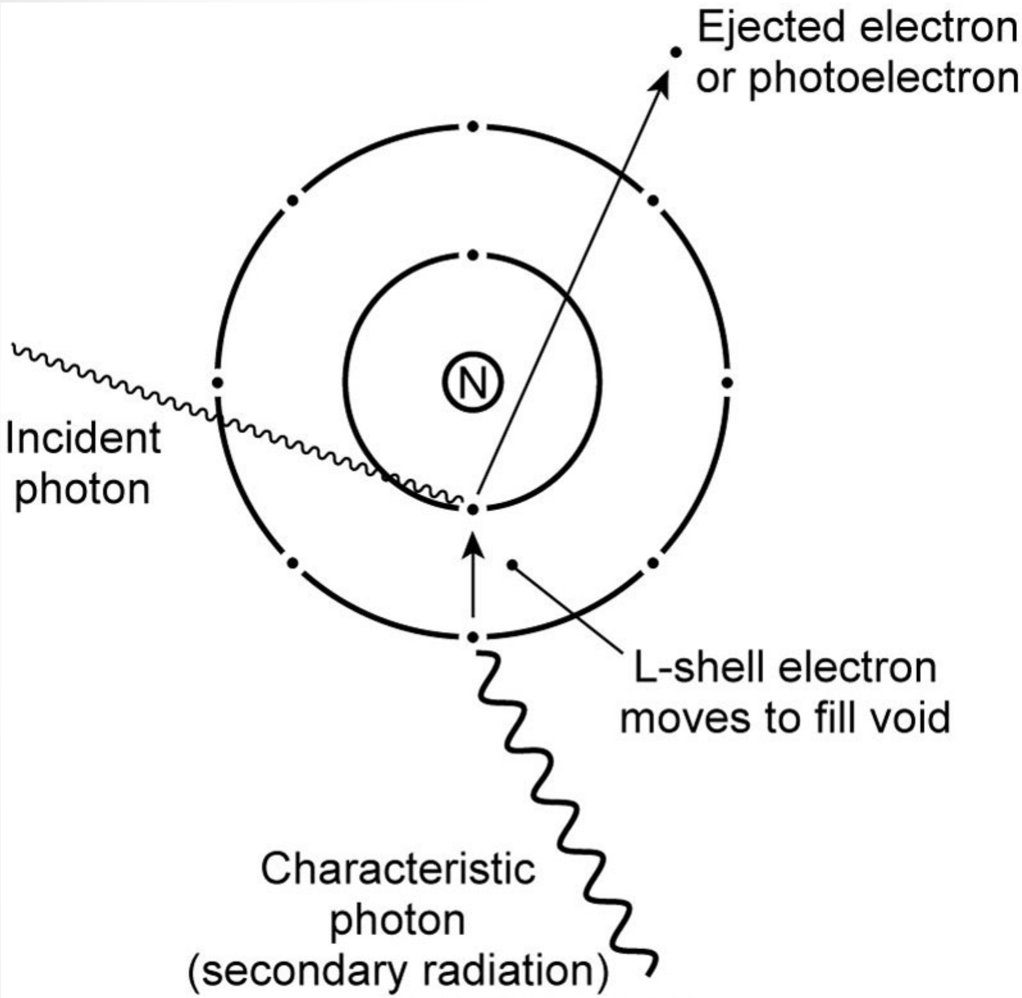
- Also known as *Thompson scatter*
- Occurs at low energy levels
- Has no significance in diagnostic imaging

Compton Effect



- Occurs between 40 kVp and 125 kVp range
- Incoming photon interacts with outer orbital electon
- Compton scatter moves in all directions unless it is directed back toward the x-ray tube (backscatter)
- The majority of radiation interactions in the body are Compton

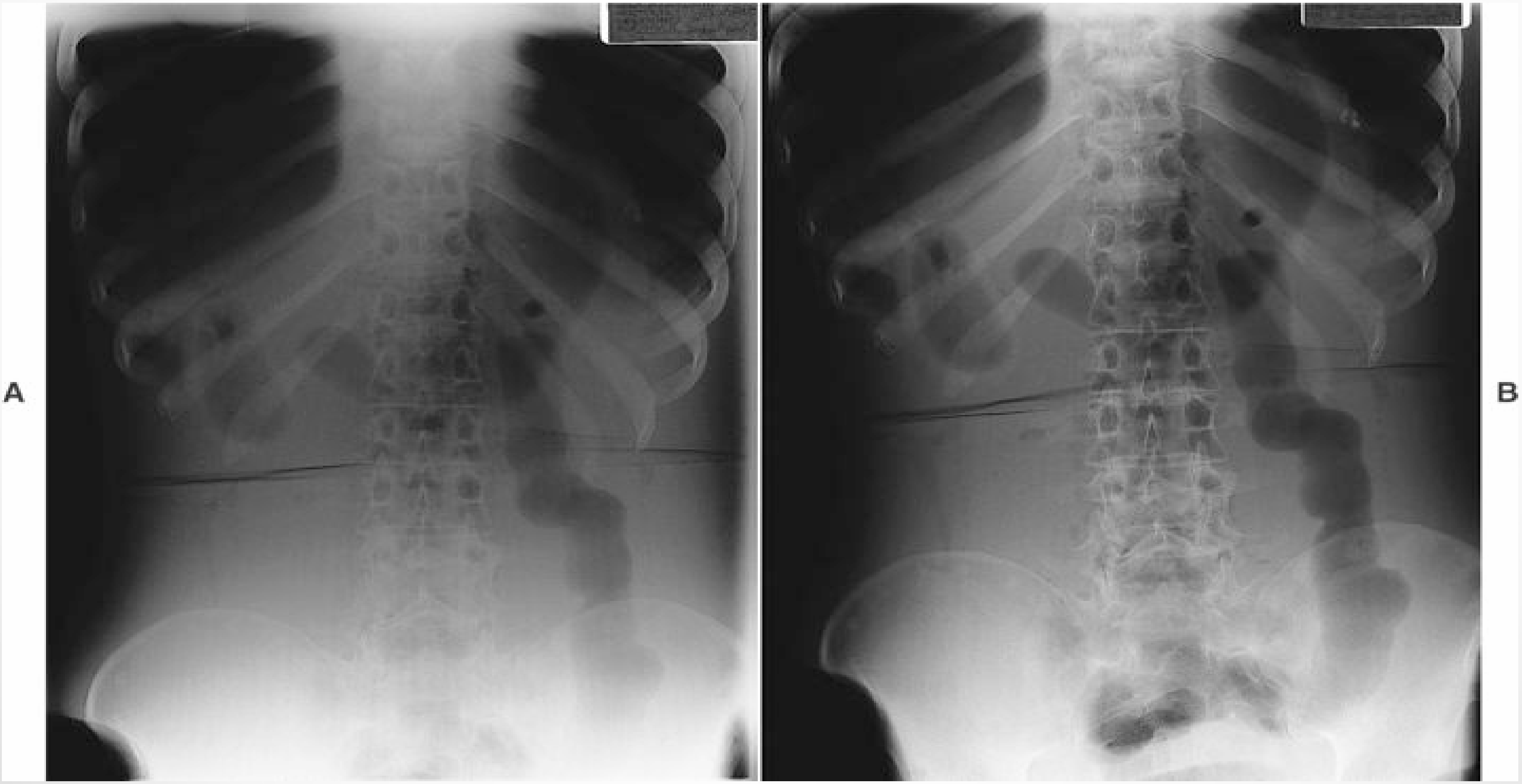
Photoelectric Effect



- Similar to characteristic radiation
- Incoming photon coliides with inner orbital electron
- Creates an absorbed dose in the patient
- Considered *secondary radiation*

*Effects of Scatter Radiation

- Increased density (fog)
- Decreased contrast resulting in more gray shades
- Reduced visibility of detail

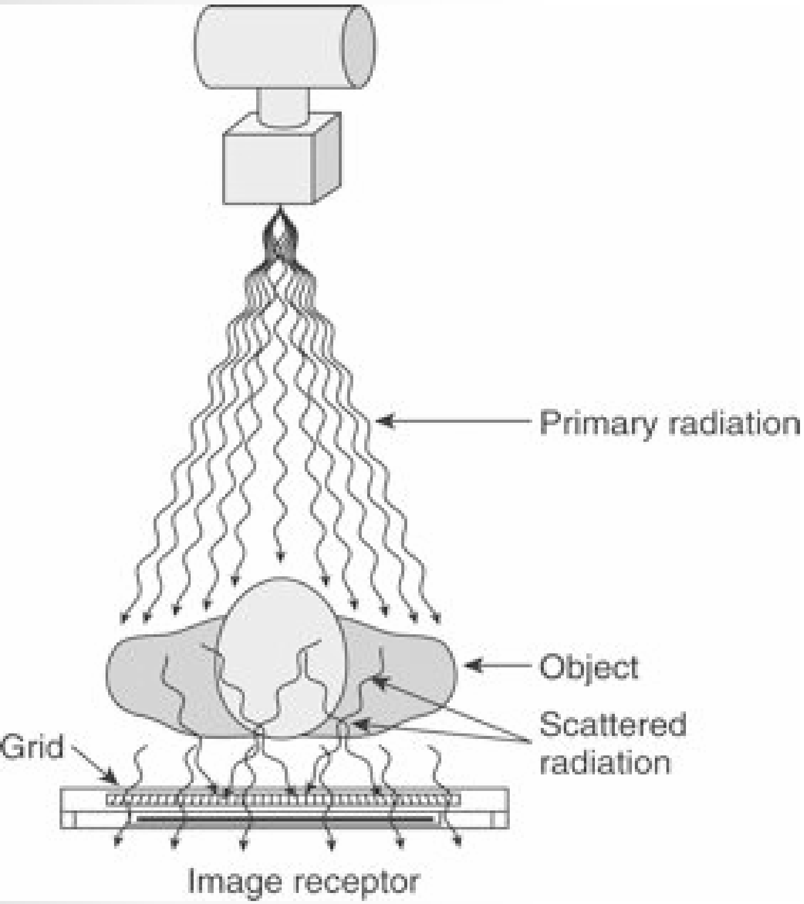


*Factors Affecting Quantity of Scatter Radiation

- The amount of scatter radiation is affected by
  - Tissue volume or thickness
  - Tissue density (atomic number)
  - Kilovoltage
  - Field size

- Control scatter radiation by
  - Limiting x-ray field size to area of interest
  - Using an appropriate kilovoltage
    - higher kVp creates more scatter radiation
  - Using a grid when appropriate

*Grids



- Placed between the patient and IR to absorb scatter radiation
- Composed of alternating strips of lead and radiolucent interspace material
- May be moving (Bucky) or stationary
- Characteristics include
  - Grid frequency
  - Grid radius
  - Grid ratio

*A grid is used when part thickness is greater than 10 to 12 cm or kVp settings are greater than 60 kVp

*Grid Frequency and Radius

- Frequency refers to the distance between lead strips
  - Frequency ranges between 60 and 196 lead lines per inch
- Radius refers to the alignment or focusing of the lead strips to diverging primary x-ray beam at a specific SID
  - Focused grid ranges are usually 40 to 72 inches
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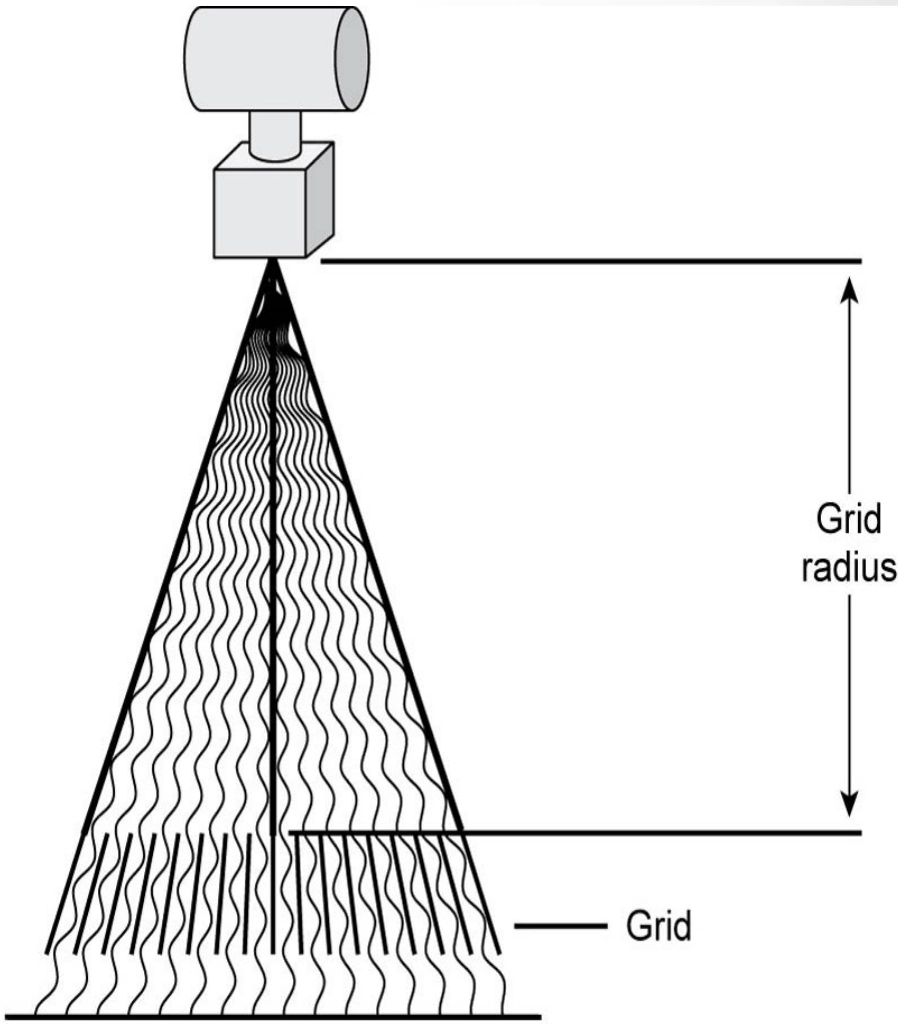
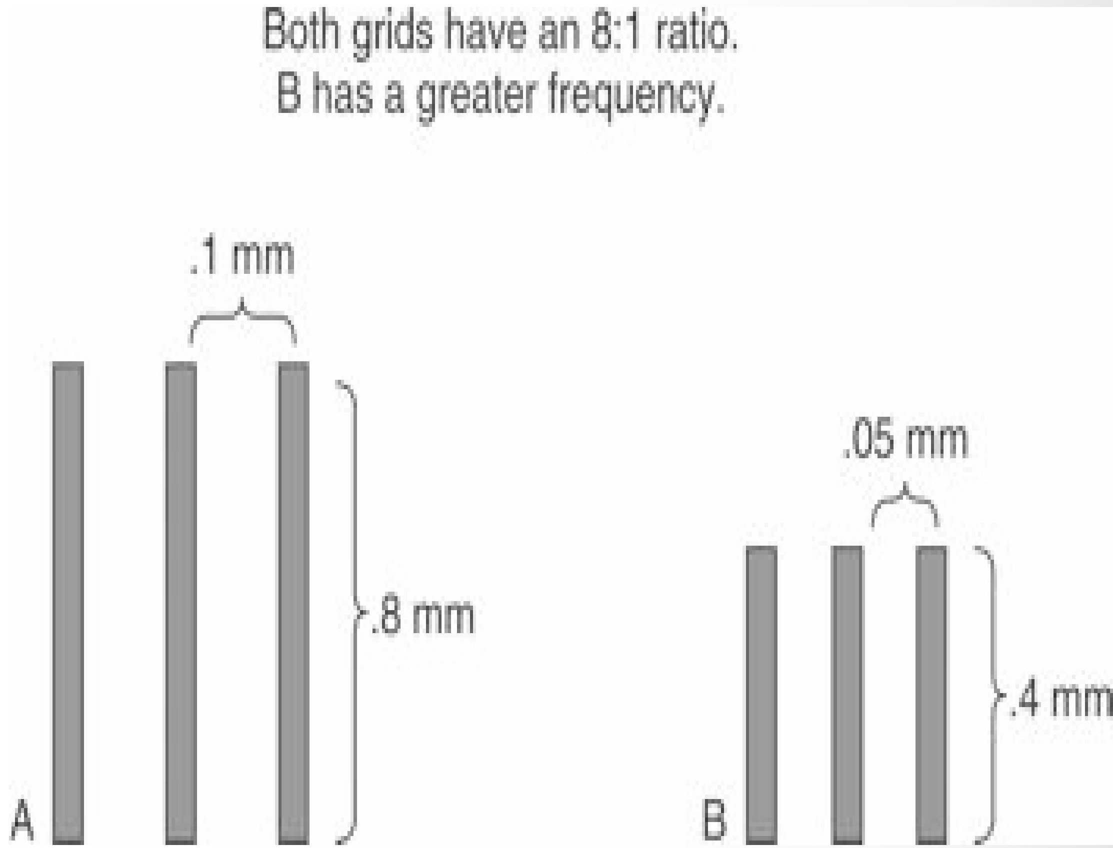


*Grid Ratio

- Refers to the ratio of the height of the lead strips to the distance between them
- Absorption of scatter radiation increases as grid ratio increases



*Applications for Common Grid Ratios

Ratio	Application
5:1 and 6:1	Grid cassettes, mobile radiography
8:1	General purpose
12:1	General purpose, chest radiography
16:1	High kVp radiography only

*Grid Cutoff

- Grid cutoff
  - Appears as decreased density on the side of the image
  - Is caused by any misalignment between the grid and x-ray beam
- Misaligned grids result in
  - Visible grid lines and decreased density
- Grid misalignment includes
  - Angling the x-ray tube toward one side of the grid
  - Off-centering the x-ray tube
  - Placing the grid off-level
  - SID outside grid focal range
  - Placing grid up side down

*The higher the grid ratio, the more precise the alignment must be

Visible grid lines on image

*Specialty Grids

- Parallel
  - Lead strips are parallel to each other
  - Use when a long SID is necessary
- Crosshatch or crossed grid
  - Two sets of lead strips that are at right angles
  - More likely to produce grid cutoff

Grid Conversion

- Calculating mAs change when a grid is used

$$\frac{mAs_1}{mAs_2} = \frac{GCF_1}{GCF_2}$$

mAs_1 = Original mAs
mAs_2 = New mAs
GFC_1 = Original Grid Ratio
GFC_2 = New Grid Ratio

Grid Ratio	**GCF**
No grid	1
5:1, 6:1	2
8:1	4
10:1, 12:1	5
16:1	6

*Summary

- Scatter radiation refers to x-rays that expose the film but do not contribute to image formation
- Scatter radiation is produced when x-rays under go a coherent, Compton, or photoelectric interaction with matter
- Increased density from scatter radiation results in lower contrast and loss of detail visibility

*Summary

- The effects of scatter radiation can be controlled by limiting x-ray field size to area of interest, using an appropriate kilovoltage, and using a grid
- Grid characteristics include frequency, radius, and ratio
- Grids are manufactured with different ratios

*Summary

- As grid ratio increases, the absorption of scatter radiation also increase
- Misalignment of a grid may result in visible grid lines and a lose of density or grid cutoff
- General purpose grids are typically focused to the SID
- Specialty grids include parallel and crosshatch