

Radiation Exposure and Risk

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Evaluation of Radiation Exposure Levels in Cine Cardiac Catheterization Laboratories

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Introduction

- High exposure values are due to high exposure times.

Excessive Radiation in the Cardiac Cath Lab

- Traced to improper adjustment and use of:
 - 1) cine imaging chain
 - 2) automatic cine film processor
 - 3) selection of cine fluoro techniques
 - 4) excessive beam “on” times
 - 5) improper room layout

Cine Imaging Chain

- Measurement of image intensifier input exposure sensitivity (IIIES)
- Use lower frame rates
- Higher speed cine film (obsolete)
- reduce scatter from machine
- reduce scatter from patient

System Description

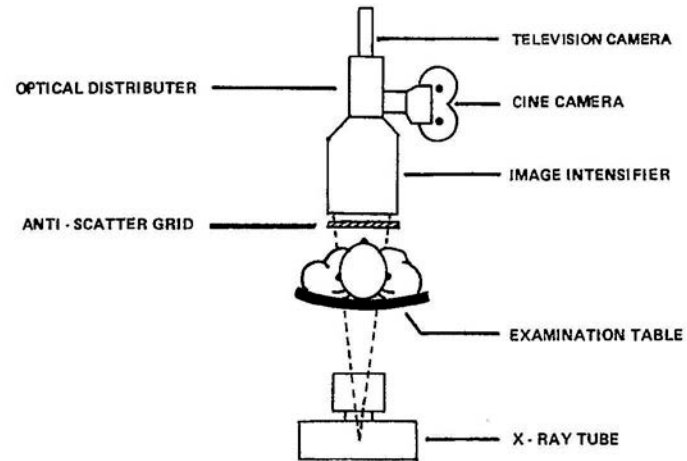


Figure 1. Schematic Illustration of A Cine Fluorographic Imaging System.

Cine Camera

- Camera or recording speed is selected by operator at 15-90 frames per second
- Film is no longer used but frame times remain unchanged
- Cine run times are set by us now. The longer and greater the exposure time, the greater the radiation time

Automatic Exposure Control System

- Designed to maintain constant light level at the image intensifier output phosphor during filming

Radiation Exposure

- Physical factors which are primary interest include:
- Cine film image quality
- Radiation exposure to the patient
- Exposure to personnel

Radiation Exposure

- One equipment setting that affects radiation levels as well as image quality
- Image Intensifier input exposure sensitivity
- (IIIES)

IIIES

- Determined by a number of factors
- 1) Cine Film Sensitivity(film speed)
- 2) The f-stop setting of the Cine Camera Lens
- 3) Image Intensifier Conversion Factor and Quantum Detection Efficiency (QDE)
- Light Transmission of Optical Distributor

IIES level Adjustment

- Obtained typically at 80 kVp tube potential
- 9" mode-10-20 uR/frame
- 6" mode-20-30 uR/frame

- This is set by the operator at the AEC control

Patient Exposure

- Total amount of exposure received by the patient is accumulated from the fluoro exposure.
- Proportional to the field size selected and the total fluoro “on” time and the output at the entrance site.
- Typically 1-5 R/min. If a case lasts 2 minutes of fluoro then 2-10 Rads per case

Patient Exposure

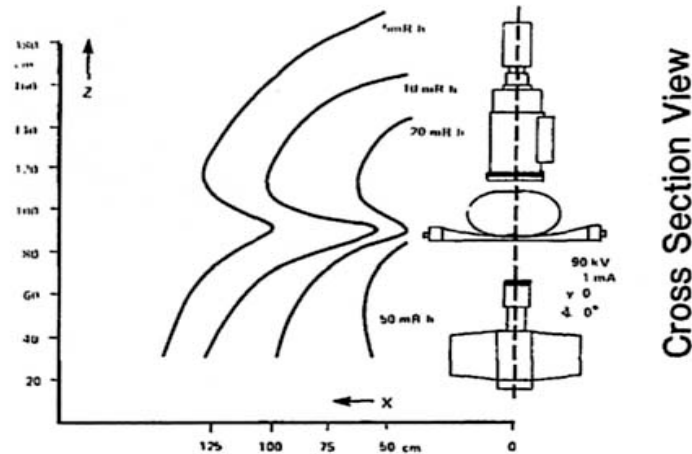
- Cine exposure is related to number of frames taken and duration of on time
- Minimized by selecting the lowest filming rate to adequately image patient.
- If typically 10-25 mR/frame for each view, exposure/frame times total number of frames taken

Patient exposure

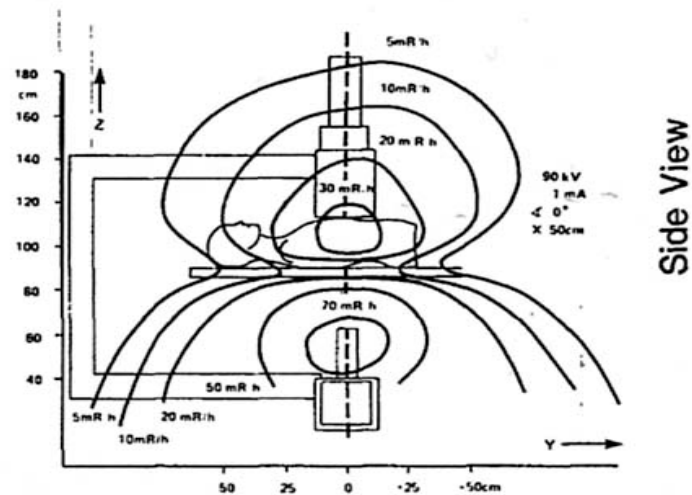
- Affected by :
 - 1) filtration
 - 2) anti-scatter grid

Personal exposure

- 1) Orientation of the x-ray beam, patient and personnel
- 2) Distance between the patient and the location of the personnel
- 3) Radiation field size/collimation
- 4) patient size
- 5) X-ray technique factors



Cross Section View



Side View

STRAY RADIATION LEVELS

Figure 4. Iso-exposure Curves Around A Cine Imaging System Equipped with A U-arm Type Geometrical design.

Iso-exposure curves are obtained with fluoroscopic technique factors of: 90 kVp, and 1.0 mA, Field Size (entrance): 8.5 cm x 11 cm, Tabletop Exposure Rate is not Specified. (Courtesy of J.A. den Boer, and H. Mohr and MEDICAMUNDI. Adapted from Ref. # 7.)