MODEL L-706
PATIENT PENETROMETER KIT

May 2019

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Overview

Standards for Entrance Exposure Rate Limits, originally published in CFR 21, Part 1020.32, also describes equipment with AEC (Automatic Exposure Control), indicating that equipment "shall not be operable at any combination of tube potential and current, which will result in an exposure rate of 10 R/min at the point where the center of the useful beam enters the patient."

Equipment that does is not provided with AEC rate controls, and "shall not be operable at any combination of tube potential and current, which will result in an exposure of 5 R/min at the point where the center of the useful beam enters the patient."

Where the source is below the table, "the exposure rate shall be measured 1 cm above the table top." If the source is above the table, "exposure rate shall be measured at 30 cm above the table top."

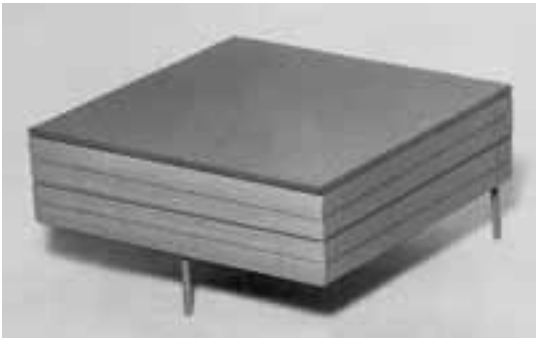
Introduction

The Ludlum Patient Penetrometer Kit provides the necessary (patient phantom) attenuation material to test the exposure rate of any standard or digital fluoroscopic system. The penetrometer kit is designed to work with most any X-ray exposure or multimeter exposure measurement device.

The four 17.8 x 17.8 x 0.95 cm (7 x 7 x 0.38 in.) high-purity (type 100 A1) blocks (plates) simulate the attenuation of a 26 cm (water) large adult abdomen at 90 kVp. Using two of the plates will simulate a child abdomen or adult chest. The supplied 0.32 cm (one-eighth inch) thick lead "stop plate" allows the user to evaluate the automatic brightness control at maximum output. Also included in the kit is a 0.079 cm (0.031 in.) thick aluminum (penetrometer) plate with evaluation, when imaged. The area of each hole is twice the area of the next smaller one.

There are also four copper plates, all of which are 17.8 x 17.8 cm (7 x 7 in.) in size, with two of them 0.5 mm (0.02 in.) thick and the other two 1.0 mm (0.04 in.) thick.

The total weight of the kit is approximately 4.31 kg (9.5 lb).



General Procedure

Note: Use of a patient penetrometer phantom is generally described in the AAPM Report #4, "Basic Quality Assurance in Diagnostic Radiology."

- **General Procedure for Under Table Fluoroscopic Exposure Measurement:**

  1. Position the aluminum plates (with the penetrometer plate between them) onto the tabletop so that it is centered to the X-ray field. The latter is best performed under fluoroscopy. When properly centered, lock the tube carriage.
  2. Place the exposure meter on top of (and centered to) the penetrometer plate(s). Lower the tube carriage to its minimum height, but **not** below 30 cm from the tabletop.
  3. Turn on the exposure meter (multimeter). Set the fluoroscopic controls to maximum with the automatic brightness controls on. Maintain a 10-second exposure. It is suggested to use a stopwatch for this process since most fluoroscopic timers are not accurate for such short exposure times. The resulting exposure rate indicated by the exposure meter represents the maximum tabletop output for the equipment when operating in the automatic brightness mode.
  4. To find maximum recommended exposure rates, see NCRP Report #33 (Table 2).

Note: NRCP Report 33 Section 3.2.1(a): When the fluoroscope is operated at 80 kVp, the exposure rate in air at the position where the beam enters the patient shall not exceed 3.2 R/mA-min at 30 cm and should not exceed 2.1 R/mA-min at 38 cm.

- **Contrast Gradient Evaluation:**

  Using the above procedure (1), evaluate the (viewed) fluoroscopic image and record which of the penetrometer plate holes are visible. The average system should be able to display the 0.64 cm (0.25 in.) diameter and the 0.45 cm (0.18 in.) diameter holes through the inherent noise of the system. The exceptional systems should be able to display the 0.16 cm (0.063 in.) holes. The penetrometer plate holes should also remain visible after the placement of the stop plate (utilized to test ABC [AEC] functionality.)