

Q.A. Lab Experiment # 5

HVL Check

Purpose

To determine adequate filtration of the radiographic unit.

Learning Objectives

After completing this lab, you should be able to:

1. Use the laboratory equipment properly.
2. Set up the control console and ceiling tube mount correctly.
3. Function effectively in group work.
4. Perform the experiment independently.

Materials Needed

- Radiographic unit
- Dosimeter
- 0.5 mm and 1 mm Aluminum plates
- Lead apron

Pre-Lab Discussion

Proper filtration is necessary to remove low-energy photons from the x-ray beam (1020.30(m), 21 CFR Subchapter J). A patient's skin dose can increase by as much as 90% if the photons are not removed. This test should be performed after installation and then annually or whenever service is performed on the x-ray tube or collimator. The best method to determine whether adequate filtration exists is to measure the half-value layer (HVL), which is the amount of filtration that reduces the exposure rate to one-half its initial value, because it is not usually possible to measure inherent filtration. The reason the measurement is not easily acquired is a

result of filament evaporation that takes place continually, which adds a layer of tungsten to the inside of the x-ray tube window. By measuring the HVL (which measures beam quality) instead of the total amount of filtration, it does not matter how much material is in the path of the beam, as long as sufficient beam quality is measured and obtained. Using HVL for determining sufficient filtration is also relatively easy and is noninvasive. The HVL should not vary from its original value (which is established after installation) or its value at the beginning of the quality control program. It is dependent on the kilovolts (peak) used, the total beam filtration, and the type of x-ray generator.

Figure 1

Minimum HVL Values for Diagnostic Units

X-ray Tube Voltage (kilovolt (peak)) Designed Operation Range	Measured Operating Potential	Minimum HVL (mm aluminum)	
		Specified Dental Systems	Other X-ray Systems
<50	30	1.5	0.3
	40	1.5	0.4
	49	1.5	0.5
50-70	50	1.5	1.2
	60	1.5	1.3
	70	1.5	1.5
>70	71	2.1	2.1
	80	2.3	2.3
	90	2.5	2.3
	100	2.7	2.7
	110	3.0	3.0
	120	3.2	3.2
	130	3.5	3.5
	140	3.8	3.8
	150	4.1	4.1

Figure 2

HVL Value Measurement

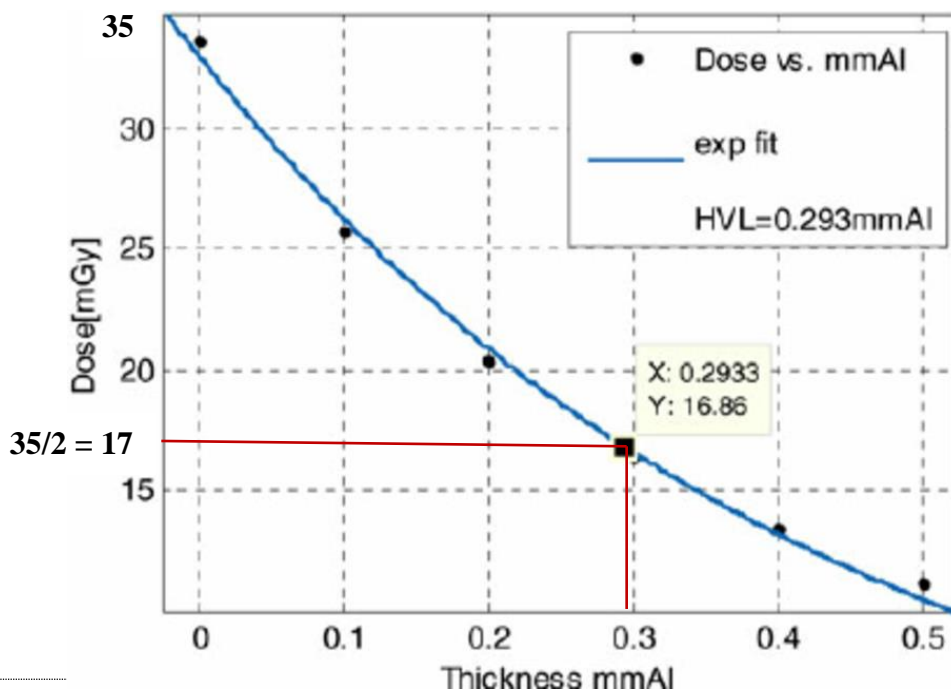


Figure 3

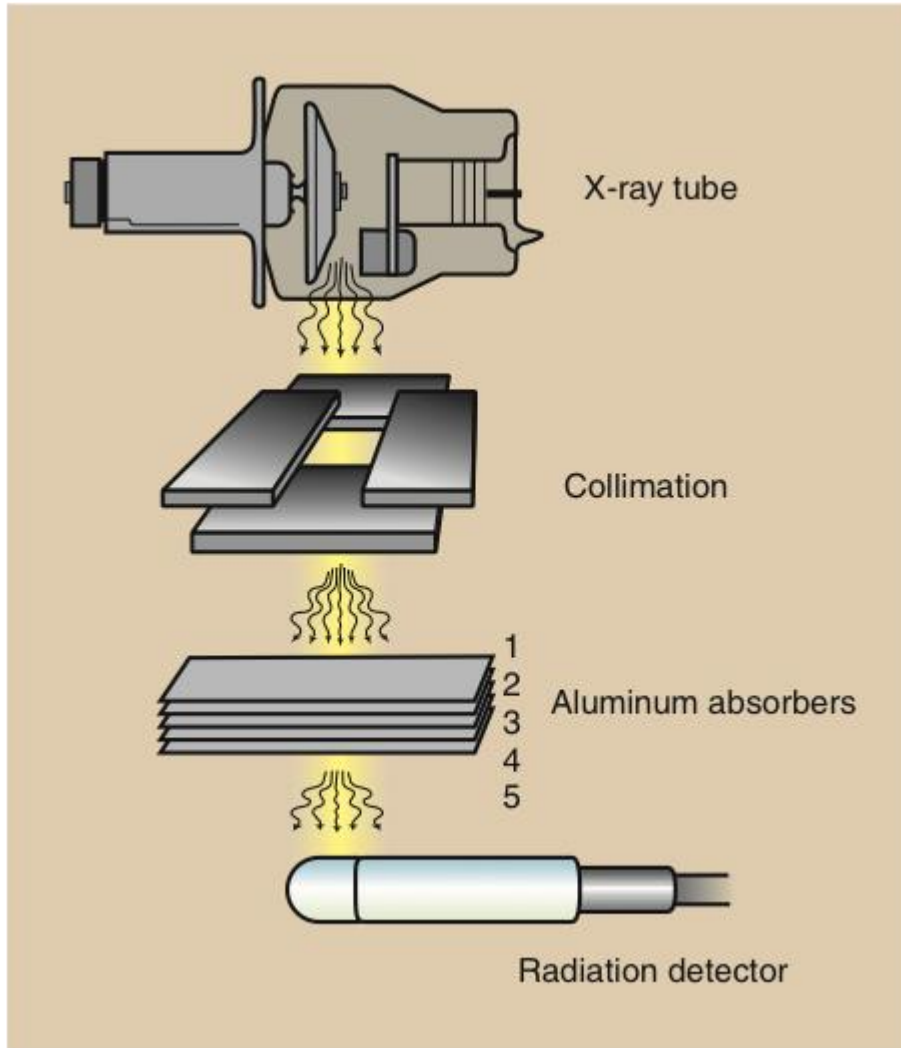
Lead Plates



Instructions HVL check:

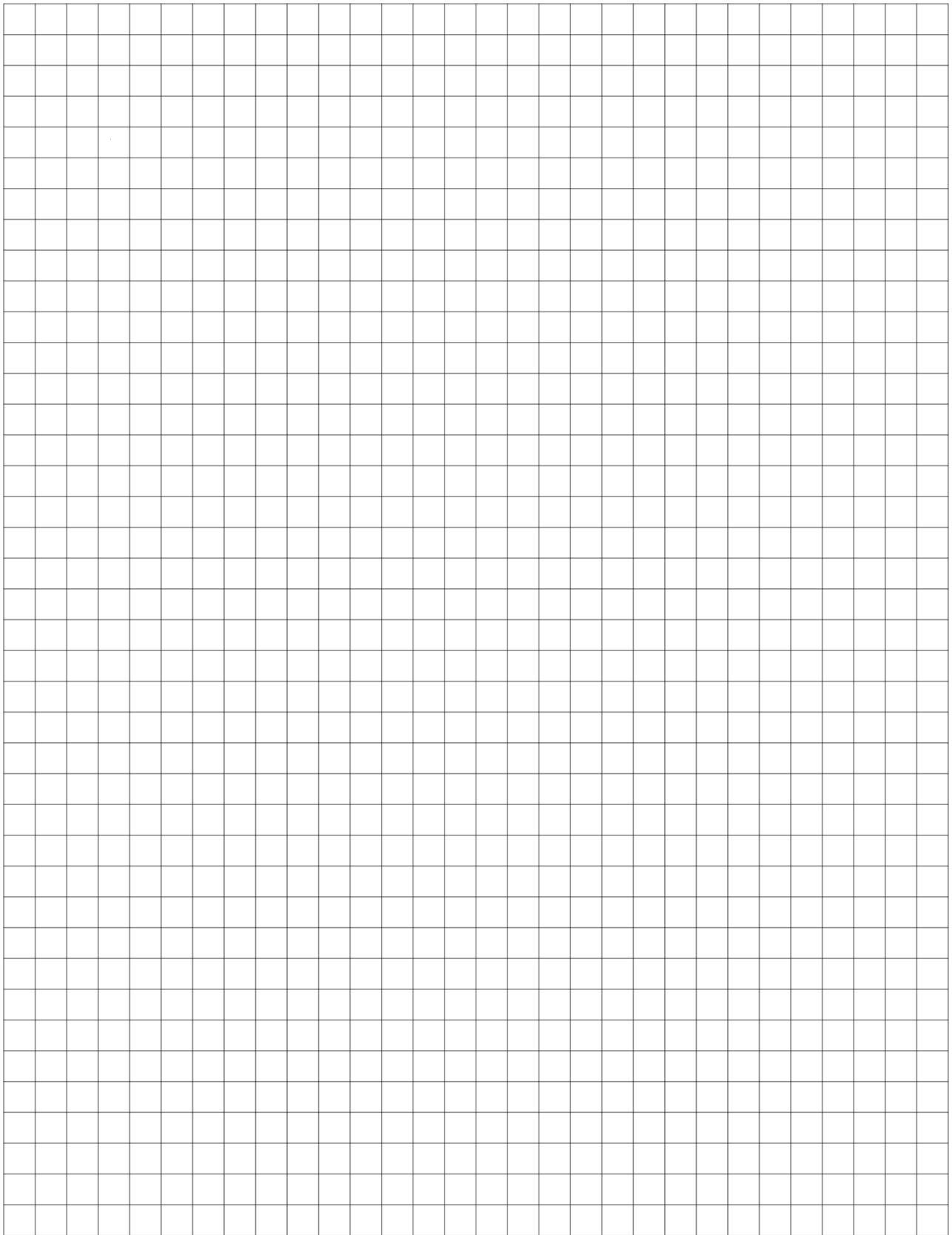
- Place a dosimeter on the radiographic tabletop on top of a lead apron or lead vinyl (to prevent backscatter).
- Adjust the tube-to-dosimeter distance to between 60 and 80 cm (24 -30”), and collimate the x-ray beam to an area slightly larger than the dosimeter.
- Make an exposure at 80 kVp and 50 mAs and record the amount of radiation from the dosimeter on a documentation form.
- Clear the dosimeter and add a 0.5 mm or 1-mm-thick aluminum plate between the bottom of the collimator and the dosimeter and expose it. Record the reading and clear the dosimeter. Repeat this procedure, adding aluminum plates in 1-mm increments until a total of 6 to 8 mm is in place.
- Use graph paper (provided below) and plot a graph of x-ray intensity (dosimeter readings) on the y-axis versus absorber thickness on the x-axis (see Figure 2). Draw a curve by connecting the dots in the graph. The HVL is determined by taking one-half the maximum dosimeter reading and then drawing a line from this point on the y-axis to the curve, and then drawing another line from this point on the curve down to the x-axis. This value on the x-axis represents the HVL, and it should be greater than 2.3 mm or more because this is the minimum HVL at 80 kVp, according to the FDA. HVL amounts at various kilovolt (peak) values are given in Figure 1.

Figure 4
HVL Procedure



Corrective Action:

Any radiographic unit that has insufficient filtration must be corrected or repaired.



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