Name: _____ Date: _____ Team: _____

Q.A. Lab Experiment # 3

mAs Reproducibility

Purpose

To check the radiation reproducibility 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
- Ionization chamber
- Lead apron

Pre-Lab Discussion

Much of the data obtained during performance testing includes radiation measurement; therefore some type of radiation detector is a standard piece of equipment for many of these tests. The more common type of detector used in performance testing is the gas-filled chamber. As radiation enters this chamber, it ionizes the gas along its path (Figure below), which produces a trail of ions that allows the flow of current through the chamber for a split second. This current is converted to a voltage pulse that is amplified and counted. The size of the voltage pulse is proportional to the energy expended in the chamber by the incident radiation.

Figure 1

Radiation Measurement Using Ionization Chamber

The reading obtained from the radiation detector is most often the radiation intensity, which can be measured in a special unit called the roentgen (R), in an International System of units called coulomb per kilogram (C/kg), or in air kerma which uses an International System or units called the gray (Gy). KERMA is an acronym for kinetic energy released in matter and measures the amount of kinetic energy transferred into charged particles (such as electrons) by x-rays or gamma rays. It is expressed in units of J/kg or gray. Air kerma is often used instead of the traditional SI unit of C/kg to express radiation intensity.

1 roentgen = 8.76 mGy of air kerma.

K_{air} (Gy) = 0.00876 (Gy/R) × (R); so 1 Gy is approximately equal to 100 roentgen.

Because both units measure a relatively large amount of radiation, smaller increments of milliroentgens or microcoulombs per kilogram are most often obtained during performance testing. Some detectors are designed so that the exposure rate (intensity of radiation per unit of time) can be displayed in addition to the radiation intensity, and they are known as rate meters. Detectors also can be calibrated to measure absorbed dosage in rads or grays (Gy). One rad is equivalent to 0.01 Gy or 1 cGy.

An x-ray generator should always produce the same intensity of radiation each time the same set of technical factors is used to make an exposure. For example, if 80 kVp, 500 mA, and 0.02 s yields 100 units of radiation when measured with a dosimeter, then at any future time when the same technical factors are entered into the same x-ray generator, the yield, when tested, should also be 100 units. This concept is known as **reproducibility**.

The maximum variability allowed in reproducibility is **±5%** according to (1020.31(b)), 21 Code of Federal Regulations Subchapter J. Evaluation of reproducibility variance requires a dosimeter, unless a computerized noninvasive system is used. Reproducibility testing should be performed after equipment installation, after a major system repair, and then annually.

Instructions:

- Place a lead apron on top of a radiographic tabletop with the center of the lead apron in the approximate center of the tabletop. Place a dosimeter on top of the lead apron. The lead apron absorbs backscatter from the tabletop material, which reduces the accuracy of any readings obtained. If a lead apron is unavailable, substitute a sheet of lead vinyl.

- Center the central ray of the x-ray beam on the dosimeter using a SID of 40 in. Collimate the beam so that the x-ray field is just slightly larger than the dosimeter or remote probe.

- Make a series of three to five separate exposures of the dosimeter at 80 kVp and 10 mAs. Clear the dosimeter (reset to zero) after each exposure. Record each reading on some type of documentation form.

- With the readings obtained, use the following equation to determine reproducibility variance

$$\text{Reproducibility variance} = \frac{(\text{Exposure or air kerma}_{max} - \text{exposure or air kerma}_{min})}{(\text{Exposure or air kerma}_{max} + \text{exposure or air kerma}_{min})}$$

Corrective Action:
Any units that are found to exceed 0.05 (5%) variance in reproducibility will need to be corrected or repaired.