Name: _____ Date: _____ Team: _____

Q.A. Lab Experiment # 7

Light Field–Radiation Field Alignment (Congruence)

Purpose

To determine whether the light field and radiation field of a radiographic unit are congruent and if the beam is perpendicular.

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
- Beam alignment tool
- Eight or nine pennies

Pre-Lab Discussion

The beam restriction system is responsible for regulating the size of the x-ray field area. It therefore plays a significant role in patient dosing (because it controls the amount of patient anatomy exposed to radiation) and image contrast (because an increase in the area of the field increases the production of scattered radiation). Performance of the beam restriction system should be evaluated on installation and then at least annually or whenever work is performed on

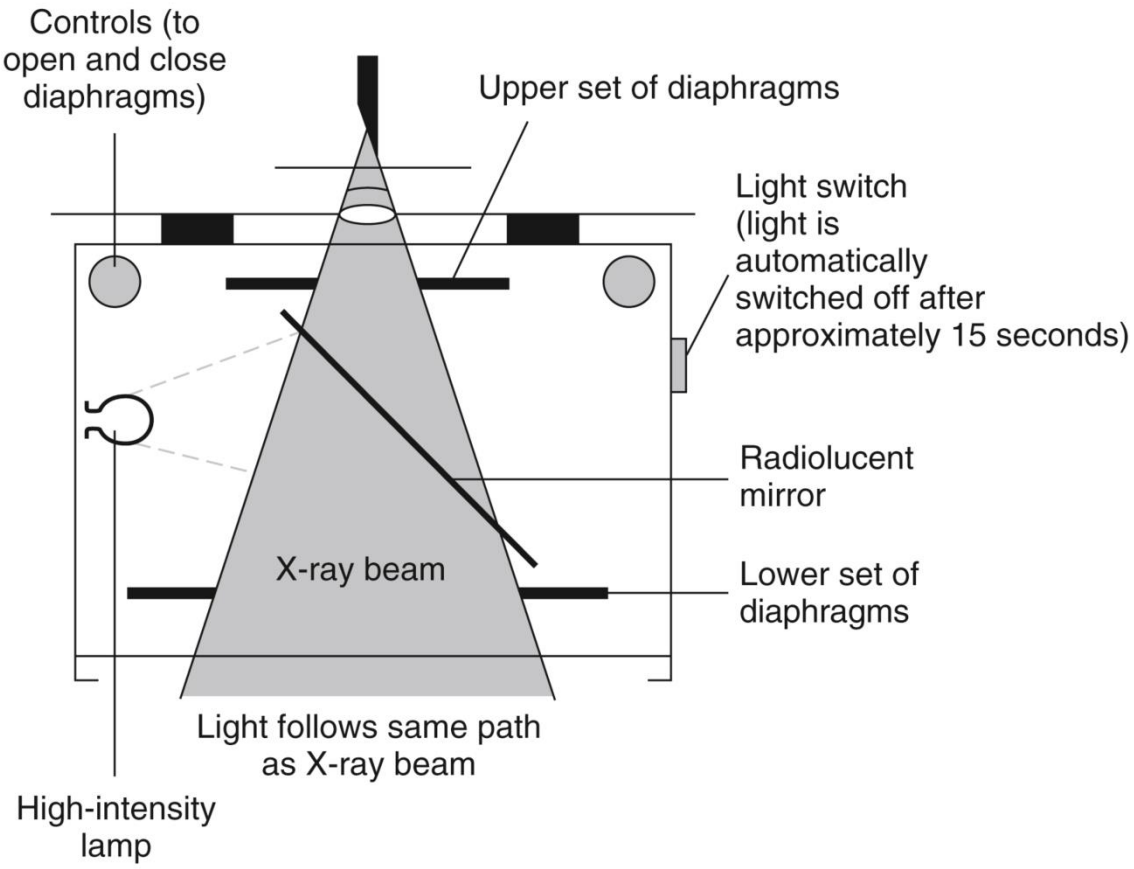
the system. Older systems may require more frequent evaluation. The factors to evaluate in the beam restriction system include light field–radiation field alignment (congruence), positive beam limitation systems, accuracy of the x–y scales, and illuminator bulb brightness, and are covered in (1020.31(e), (f), (g), 1020.32(b)), 21 CFR Subchapter J.

The light field–radiation field congruence value measures how well the collimator regulates the field size and whether the area illuminated by the positioning light and the area exposed by x-rays are the same. The collimator is made up of two sets of lead shutters that can be opened and closed, along with a small light bulb mounted on the outer edge and a mirror mounted in the center to reflect the light from the bulb through the shutter opening (Figure 1 below). Over time, this mirror may shift or the mechanism that moves the shutters can malfunction, causing improper performance, which leads to greater patient dosing and repeat images. The edges of the light field and the radiation field must be congruent to within **±2%** of the SID. Evaluation can be performed by using either a collimator test tool with the manufacturer's instructions or the eight-penny (or nine-penny) test.

The x-ray tube must be mounted in its housing so that the central ray of the x-ray beam is within **1°** of perpendicular. If not, the image demonstrates shape distortion. With age and use, the x-ray tube can shift in its housing, causing a lack of perpendicularity (mainly from the heat inside the housing causing a breakdown of the rubber O-rings that support the x-ray tube on either side). Rough handling of the housing during x-ray examinations can also cause the x-ray tube to shift slightly within its housing.

Figure 1

Variable Aperture Collimator



Instructions The light field–radiation field congruence check Eight Penny Test:

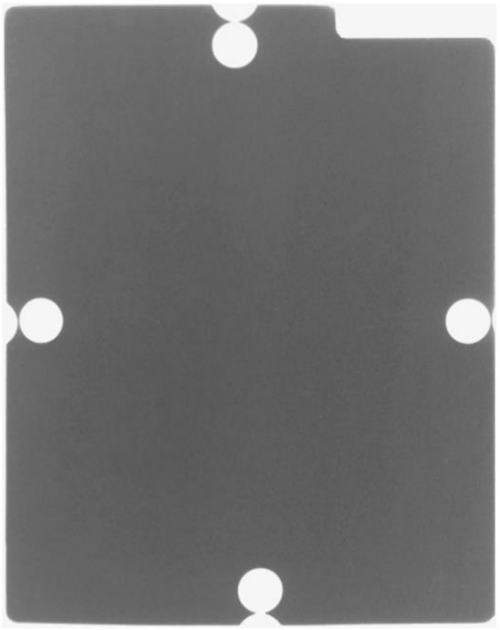
- The eight-penny or nine-penny test involves laying eight pennies on a 10-inch × 12-inch (25-cm × 35-cm) cassette placed on a tabletop but collimated to an 8-inch × 10-inch field size at a 40-inch SID.

- Four of the pennies are placed on the inside edge of the light field at the center of each dimension, and the other four are placed on the outside edge in contact with the inner pennies, meeting at the edge of the light field. A ninth penny may be included (hence, the alternate name, nine-penny test), and may be placed in the light field toward the cathode end of the x-ray field to demonstrate on the resulting image the direction of any error in x-ray field/radiation field congruence (see Fig 2 below). If CR is used, set preprocessing image data recognition to fixed mode (the CR image receptor acts like a film/screen cassette).

- When a radiograph is made and the image is processed, the collimation line of the x-ray field also should fall between the pairs of pennies or at least within the shadow of the pennies, because the diameter of a penny is 0.8 inch (which is exactly 2% of 40 inches).

Figure 2

Eight Penny Test



Instructions the perpendicularity check and the light field–radiation field congruence check:

- Place an image receptor on the radiographic tabletop and center the x-ray beam, using a 40-inch SID.

- Place the beam alignment tool on top of the image receptor and collimate to the area on the template.

- Make an exposure using 60 kVp and milliampere-seconds appropriate to the speed of the image receptor being used. If CR is used, set preprocessing image data recognition to fixed mode (the CR image receptor acts like a film/screen cassette).

- Process the image. Within the test tool, a steel ball is mounted in the center of a disk at each end of the 15-cm-tall plastic container. When the balls are positioned over one another and at a right angle to the image receptor, their images appear as one, if the central ray is perpendicular to the image receptor. If the image of the upper steel ball (which is magnified because it is farther away from the image receptor) intersects the image of the first disk (appears as a ring), the central ray is approximately 1.5° away from perpendicular

Figure 2

Beam Alignment and the light-radiation Field Congruence Tool

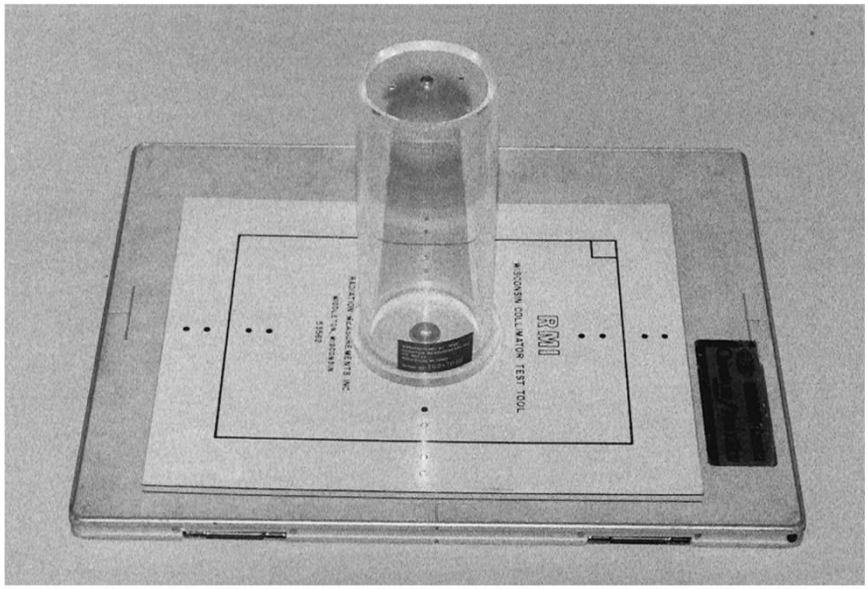
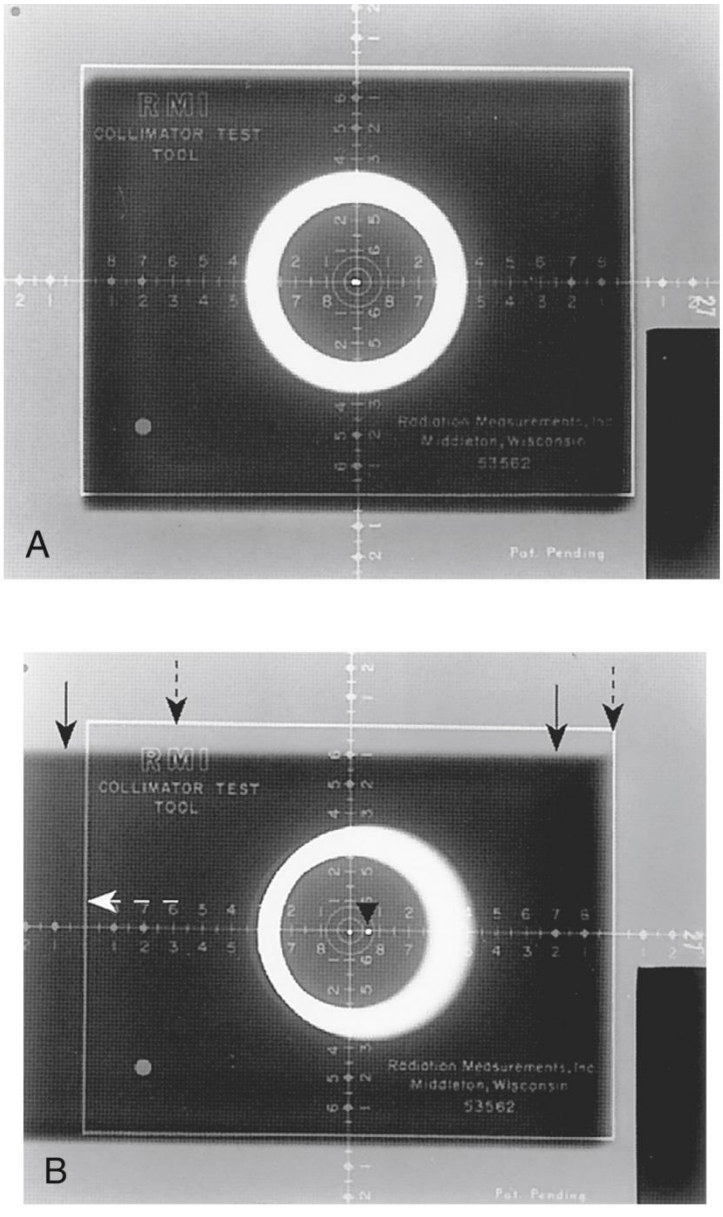


Figure 3

Beam Alignment and the light-radiation Field Congruence Test



Corrective Action:
Any unit with the light field–radiation field congruence exceeding 2% of SID must be corrected or repaired.

Any unit with central ray of the x-ray beam exceeding **1°** of perpendicular must be corrected or repaired.