Name: _____ Date: _____ Team: _____

Q.A. Lab Experiment # 7

Timer Accuracy

Direct Radiography Lab

Purpose

To determine whether the timer is accurate

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
- Synchronous spinning top
- DR image processing station

Pre-Lab Discussion

On systems with separate mA and time selection, exposure time affects directly the total quantity of radiation emitted from an x-ray tube; therefore an accurate exposure timer is critical for acquiring properly exposed image receptors and reasonable patient radiation exposure. The variability allowed for timer accuracy is ±5% for exposure times longer than 10 ms and ±20% for exposure times less than 10 ms. Timer accuracy should be determined on installation and then annually, or when service is performed on the x-ray generator or if technique problems arise suddenly. The easiest method to validate timer accuracy is the use of a digital x-ray timer available from various manufacturers. These timers usually incorporate a solid-state detector that

measures the total time of x-ray production and then displays the time by means of a digital LED readout. These devices cost several hundred dollars, and so other lower-cost methods can be used. One of the oldest methods is the spinning top test, which includes a spinning top consisting of a metal disk with a hole or slit cut into the outside edge. If a single-phase x-ray unit is being evaluated, a manual spinning top can be used. Single-phase generators emit x-rays in pulses, and therefore each pulse creates a dot on the radiograph made of the spinning top. The number of dots appearing on this radiograph is then compared with the number that should, theoretically, appear at the particular time station selected on the control panel for each exposure. The shortest exposure time available on most single-phase x-ray units is 1/120 s (8.3 ms). The number of dots that should, theoretically, appear is determined by the following equations:

Half-wave rectified:
Correct number of dots = Exposure time (s) × 60
Full-wave rectified:
Correct number of dots = Exposure time (s) × 120
Exposures should be made at 1/10, 1/20, 1/30, and 1/40 of a second for single-phase equipment.

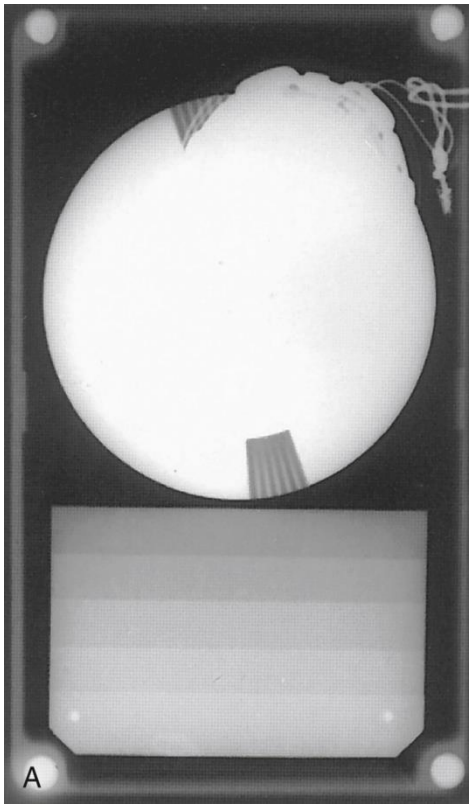
For three-phase and high-frequency generators, x-ray production is constant, and so a solid line or arc appears instead of a series of dots. For this reason, a manual spinning top cannot be used; a synchronous or motor-driven spinning top is used instead. The synchronous spinning top is also used to evaluate single-phase equipment. The electric motor in the synchronous spinning top rotates at a constant speed of 1 revolution per second (rps) so that at the end of 1 s, a 360° circle is made. When placed on an image receptor and exposed with a three-phase or high-frequency x-ray generator, this device creates an arc on the processed image that is some fraction of 360° at exposure times less than 1 s. These x-ray units are capable of creating exposure times as short as 1/1000 s (1 ms). The arc size on the image is measured with a protractor and then inserted into the following equation to determine the actual exposure time (as a fraction) that occurred:

$$\text{Actual exposure time} = \frac{\text{Arc size}}{360}$$

Arc size = 360° x exposure time

Figure 1

Synchronous Spinning Top



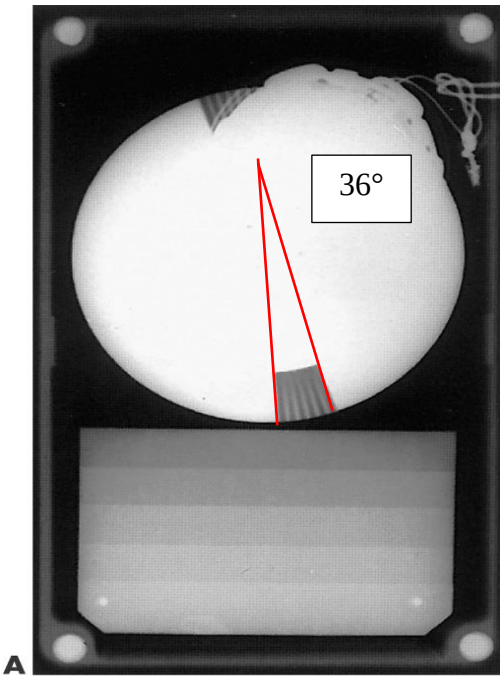
Instructions timer accuracy check:

- Determine the digital exposure needed to produce a radiograph in which the arc produced from the hole in the synchronous spinning top will be visible.
- Place the synchronous spinning top of the radiographic table and start it.
- Make radiographs of s synchronous spinning top at 0.3, 0.2, 0.1, and 0.05 sec using the same mA.

- Put your image in the editing mode.

ANALYSIS

Measure the size of an arc that appeared on the radiograph of the synchronous spinning top with the protractor or the post processing application that measures angles. Compare it with the arcs that should theoretically appear at the particular time station.



(From Ballinger PW: *Merrill's atlas of radiographic positions and radiologic procedures*, ed 9, St Louis, 1999, Mosby.)

Corrective Action:
Any units that has inaccurate timer must be corrected or repaired.