Fundamentals of Radio-physics

First Semester

Practical part –Experiment -2

Week6: Heat rating

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Tube ratings :are the defined input parameters (kVp, mA, exposure) that can be safely used during its operation without causing damage to the x-ray tube itself and unique to each individual x-ray tube model.

An x-ray tube rating is the maximum allowable kilowatts (kV) in 0.1 second .

Radiologic technologists: are guided in the use of x-ray tubes by x-ray tube rating charts. It is essential that technologists be able to read and understand these charts

Three types of x-ray tube rating charts are particularly important:

1- The radiographic rating chart
2- The anode cooling chart.
3- The housing cooling chart.

Exposure factors that determine radiographic output:

1. Operating voltage (kV)
2. Tube current (mA)
3. Exposure time (sec)

- These factors determine radiographic output and heat generated on tube anode
- Anode should not be heated above the melting point of target material (about 3000o C for tungsten)
- Tube rating charts curves help to avoid thermal damage to x-ray tube.

- **Radiographic Rating Chart**

-For a given mA, any combination of kVp and time that lies **below the mA** curve is **safe.** Any combination of kVp and time that lies **above** the curve representing the desired **mA is unsafe**.

Example:

Tube A: a 300 mA, 0.5 s, 90 kV procedure would damage the system operated from a 1-phase half wave rectified generator (unacceptable) (unsafe)

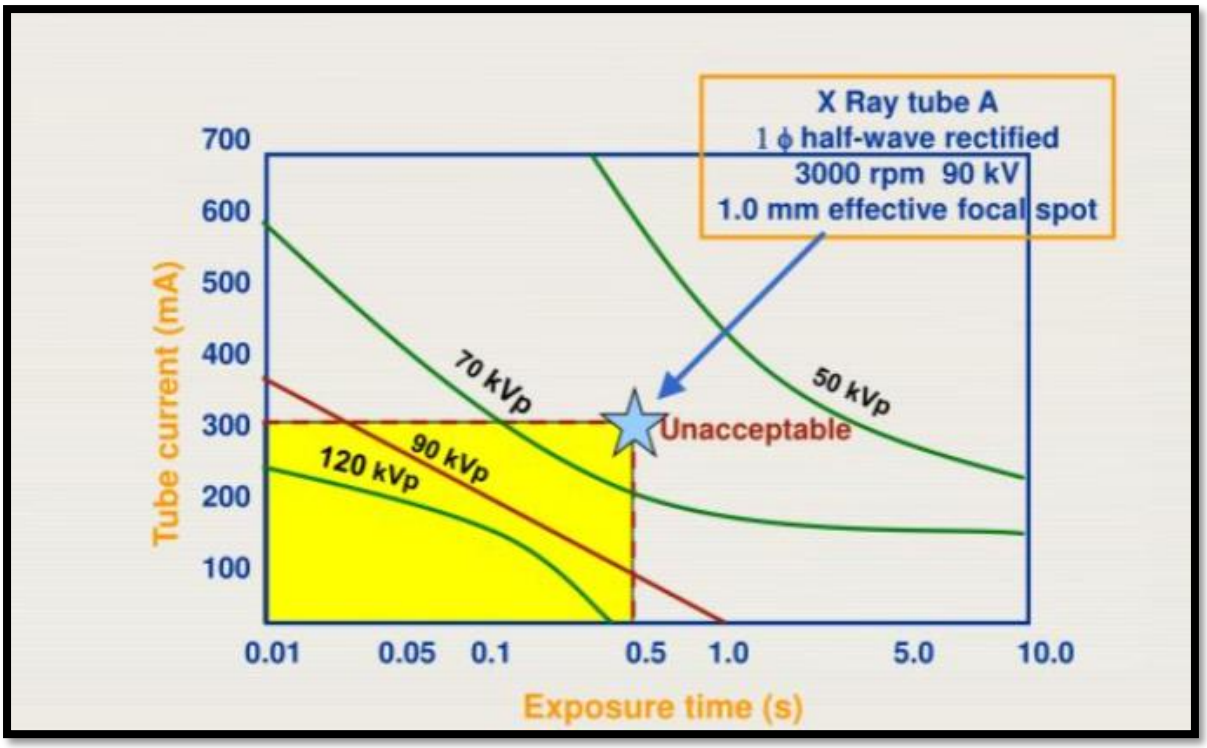

Figure1

Tube B: a 200 mA, 0.1 s, 120 kV procedure comply with the technical characteristics of the system operated from a 3-phase fully rectified generator (acceptable)(safe)

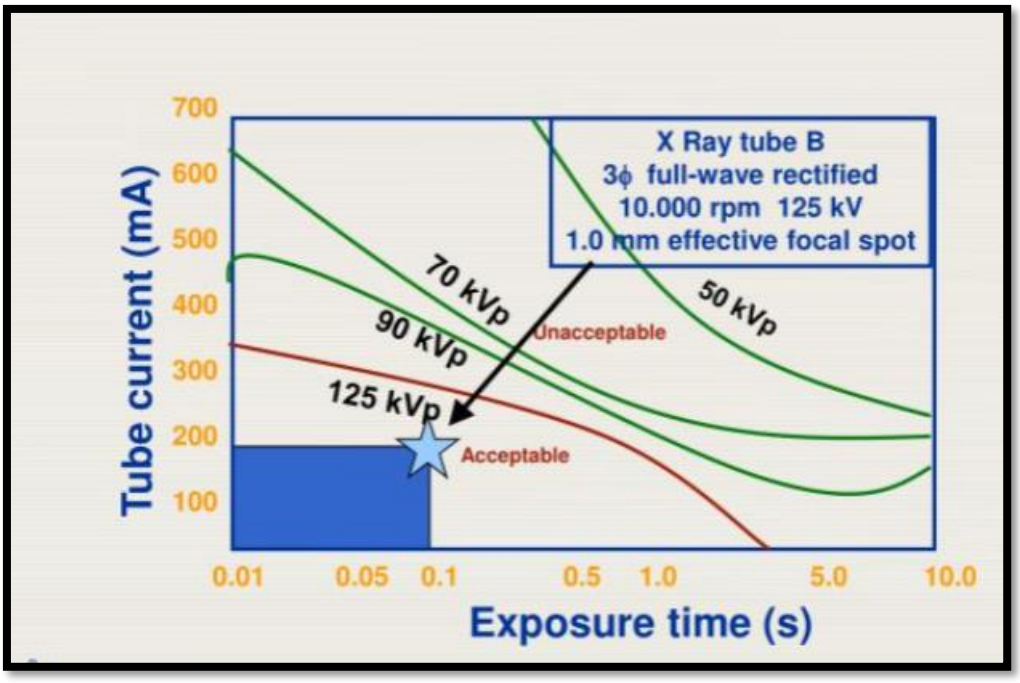

Figure2

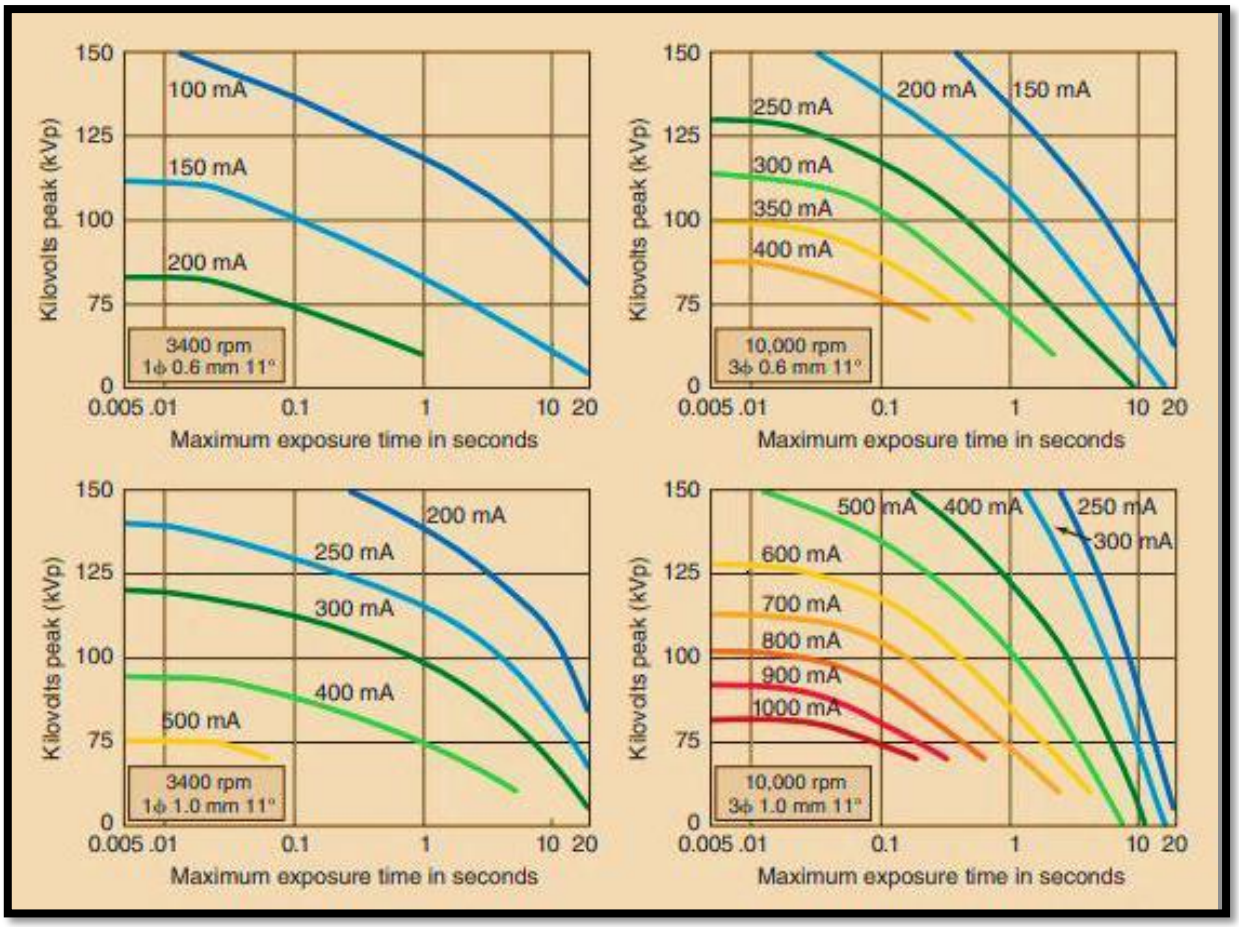

Figure3: Representative radiographic rating charts for a given x-ray tube. Each chart specifies the conditions of operation under which it applies.

Question: With reference to Figure3, which of the following conditions of exposure are **safe**, and which are **unsafe**?

A- Radiographic examination with a tube that has a 0.6-mm focal spot and anode rotation of 3400 rpm requires technique factors 95 kVp, 150 mA, 1 s.

Sol: Operating conditions is unsafe for the tube

B- 10,000 rpm; 1-mm focal spot, technique factors 125 kVp, 500 mA, 0.1 s;

Sol: Operating conditions is safe for the tube

H.W /C/ 125 KVp ,400 mA ,0.1 s ,10000 rpm , 6mm focal spot.

H.W/D/ 85 KVp ,400 mA ,0.5 s , 3400rpm , 1 mm focal spot

H.W/E/ 88 KVp ,400mA ,0.1 s , 10000 rpm ,0.6 mm focal spot

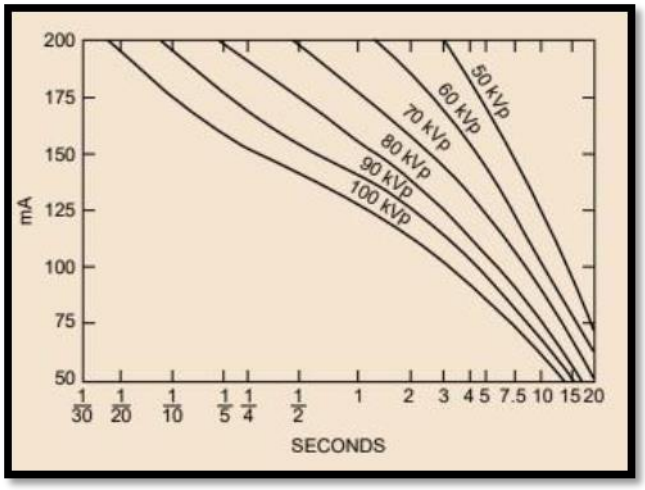

Figure4

Figure4: Rating chart for a Machlett Dynamax "25" x-ray tube with a 1-mm focal spot and single-phase, fully rectified voltage.

(H.W) From the rating chart in Figure 2 is a radiographic technique of 100 mA, 1.5 seconds at 100 kVp permissible?