APPH 226:
Tube Conservation

Objectives 2.5

MRT Program

X-Ray Tube Rating Chart

- 3 types of charts:
  - Radiographic Rating Chart
  - Anode Cooling Chart
  - Housing Cooling Chart

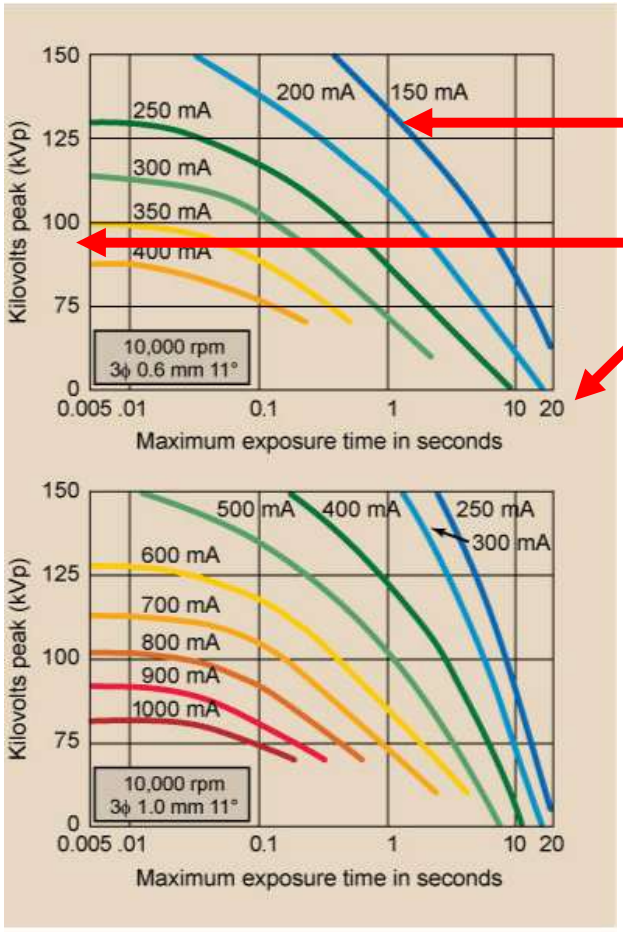
Radiographic Rating Chart

- Considered the most important
- Provides information about which radiographic techniques are safe for the x-ray tube
- All x-ray tubes come with their own series of charts
  - A replacement tube will be supplied with a chart, and can be different from that of the original tube

Radiographic Rating Chart

- Depends on many factors of tube design:
  - Focal spot
  - Speed of anode rotation
  - Target angle
  - Voltage rectification
- For a given mA, any combination of kVp and time that lies below the curve is safe
  - Most equipment will not allow you to take an unsafe exposure

Radiographic Rating Chart

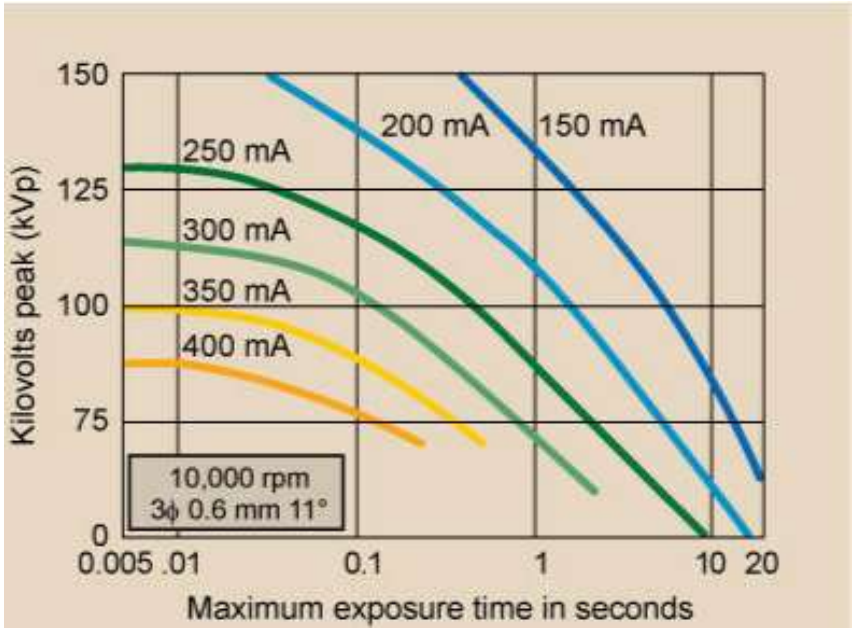


healthcare

- mA indicated by a curve
- kVp and time on the x and y axis
- Any combination of kVp and time that falls **below** the curve is safe to use

Radiographic Rating Chart

- An exposure is taken at 200 mA, 0.1 s and 125 kVp. Is this a safe exposure for the tube?



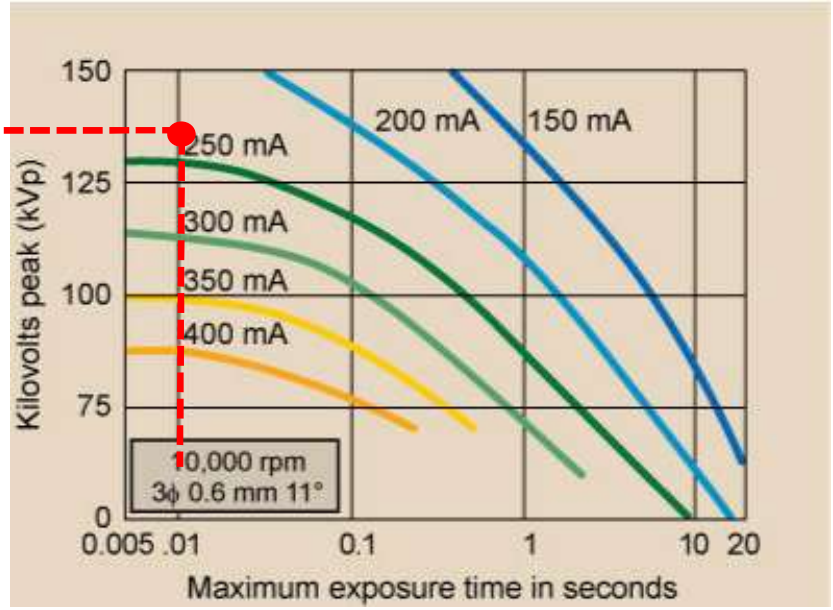
Radiographic Rating Chart

- An exposure is taken at 200 mA, 0.1 s and 125 kVp. Is this a safe exposure for the tube?

Answer:

<u>Yes</u>

After drawing a line a 125 kVp and 0.1 s, the intersecting point falls below the 200 mA curve, so this is a safe exposure



Anode Cooling Chart

- Anode has a limit for how much heat can be stored
- Heat will be dissipated to the oil bath and tube housing, but will still build up on anode
- This chart shows thermal capacity and heat dissipation characteristics of the anode
- Does not depend on filament size or speed of rotation

Anode Heat Monitoring

- Indicates the percentage of heat units (HU) that are used, or still available
  - Differs from unit to unit depending on the model
- Built in indicator
- The units in the MRT lab have thermometer icons
  - Starts out as green
  - As heat builds up, it will color in and become yellow, then red

Anode Cooling Chart

- Chart used to determine:
  - How much time is required for the anode to be completely cooled
  - Maximum heat capacity of anode
- Rate of cooling is rapid at first, and slows as the anode cools
- More heat is generated with 3 phase and high frequency units

Anode Cooling Curve

- To use this chart, the heat units (HU) must be calculated first
- A modification factor is needed
- Heat Units (HU) are calculated by:

HU = kVp x mA x time x modification factor

Modification Factor

Generator Type	Factor
Single Phase	1.0
3 Phase	1.4
High Frequency	1.4

*Factors can be found on page 120 of Bushong

Calculating Heat Units

- How many HU are generated by an exposure of 80 kVp, 200 mA and 0.2 s on a single phase unit?

HU = kVp x mA x time x modification factor

HU = 80 kVp x 200 mA x 0.2 s x 1.0

HU = 3200 HU

Calculating Heat Units

- How many HU are generated by three exposures of 60 kVp, 400 mA, 0.5 s on a three phase unit?

HU = kVp x mA x time x modification factor

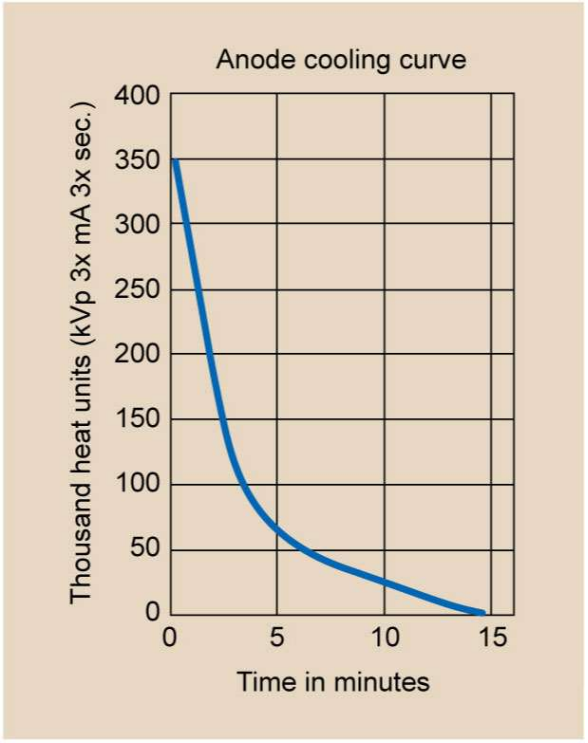
HU = 60 kVp x 400 mA x 0.5 s x 1.4

HU = 16800 HU for 1 exposure

- 16800 HU x 3 exposures = 50400 HU

Anode Cooling Chart

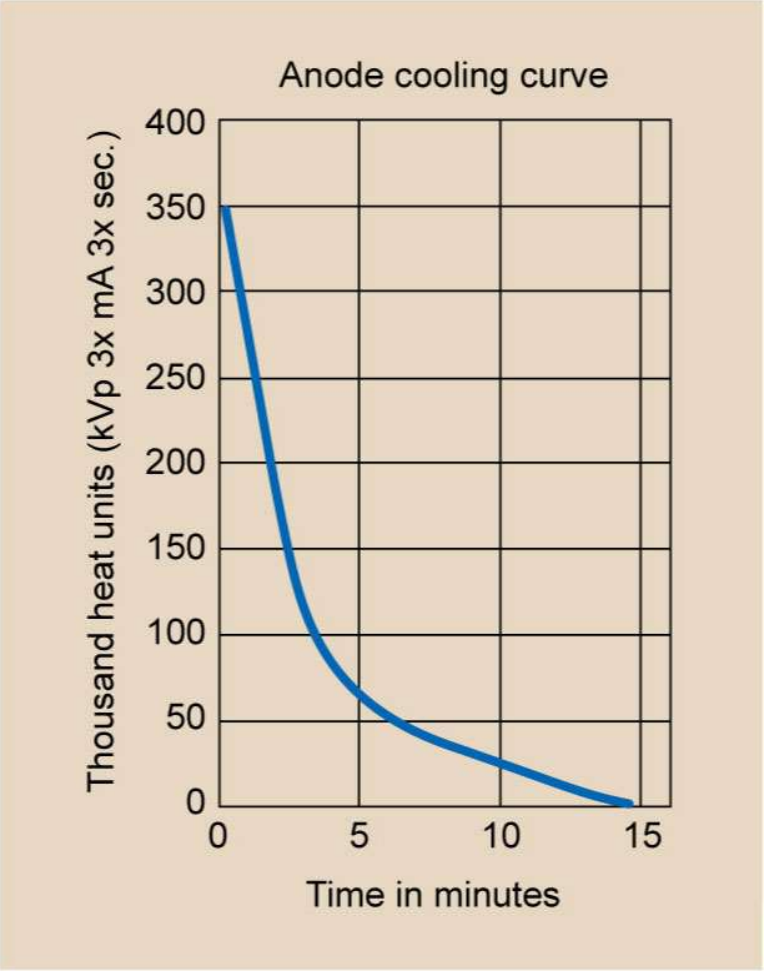
- Y-axis: HU
- X-axis: time for the anode to cool
- Draw a horizontal line at the number of HU to the curve
- Draw a vertical line down
- Then determine the total amount of time for the heat to reach 0
- Find the difference between the 2 values to determine the time for complete cooling



Courtesy GE Healthcare.

Anode Cooling

- If a series of exposures produces 200 000 HU, how long will it take to cool the tube completely?



Courtesy GE Healthcare.

Anode Cooling

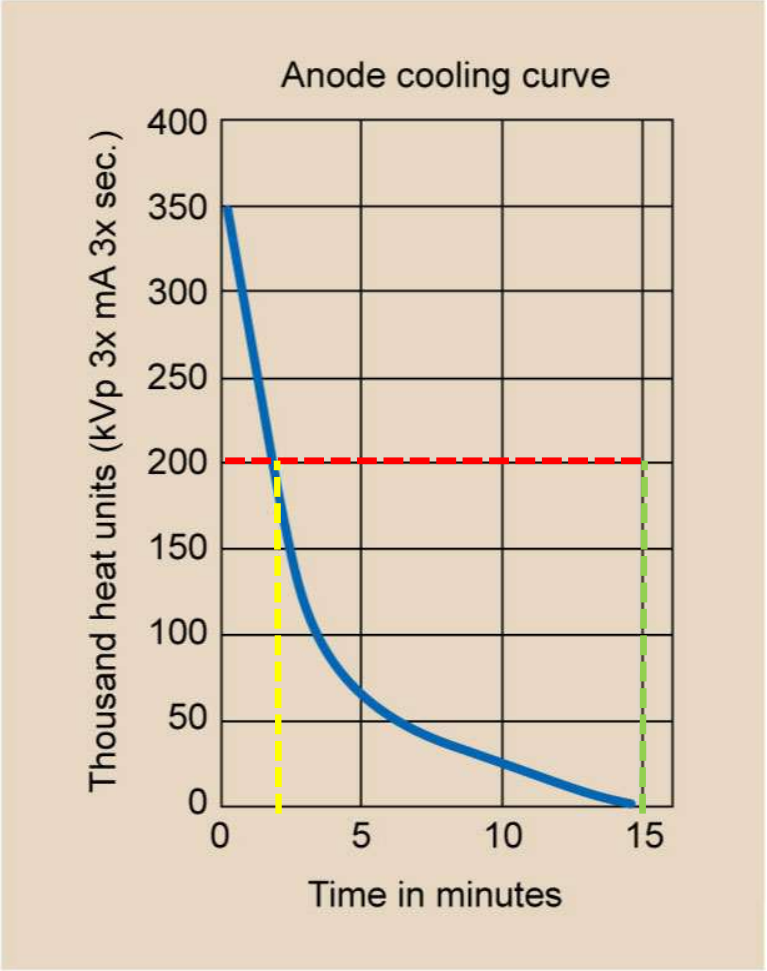
- If a series of exposures produces 200 000 HU, how long will it take to cool the tube completely?

Answer:

Draw horizontal line first, then the vertical lines and find the difference

15 – 2 min =

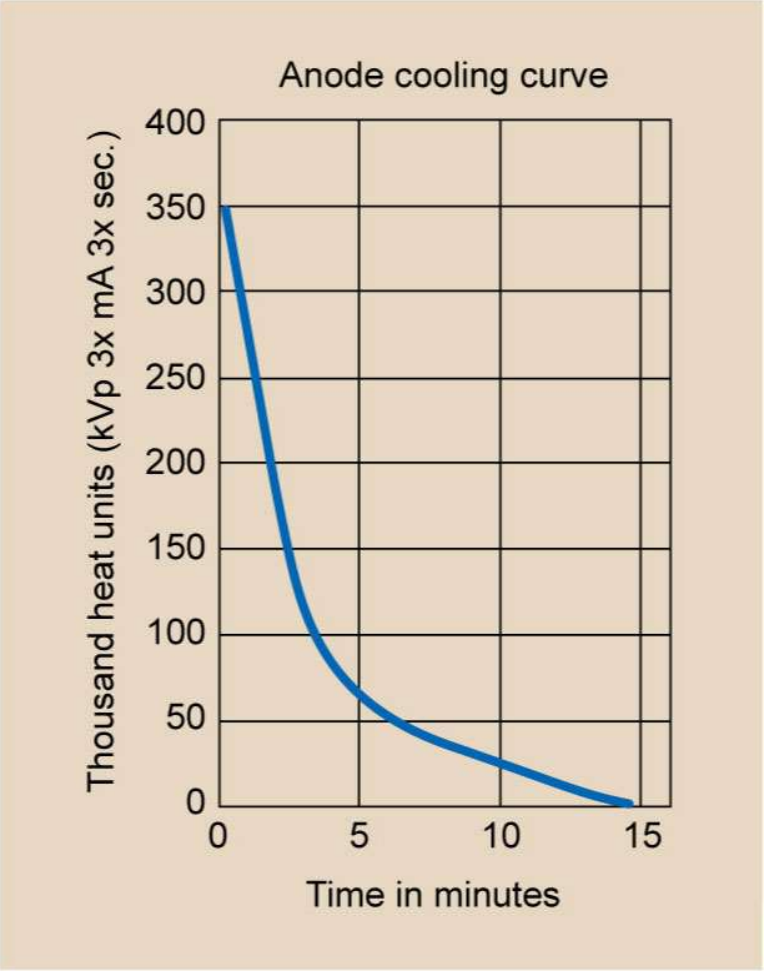
13 min



Courtesy GE Healthcare.

Anode Cooling

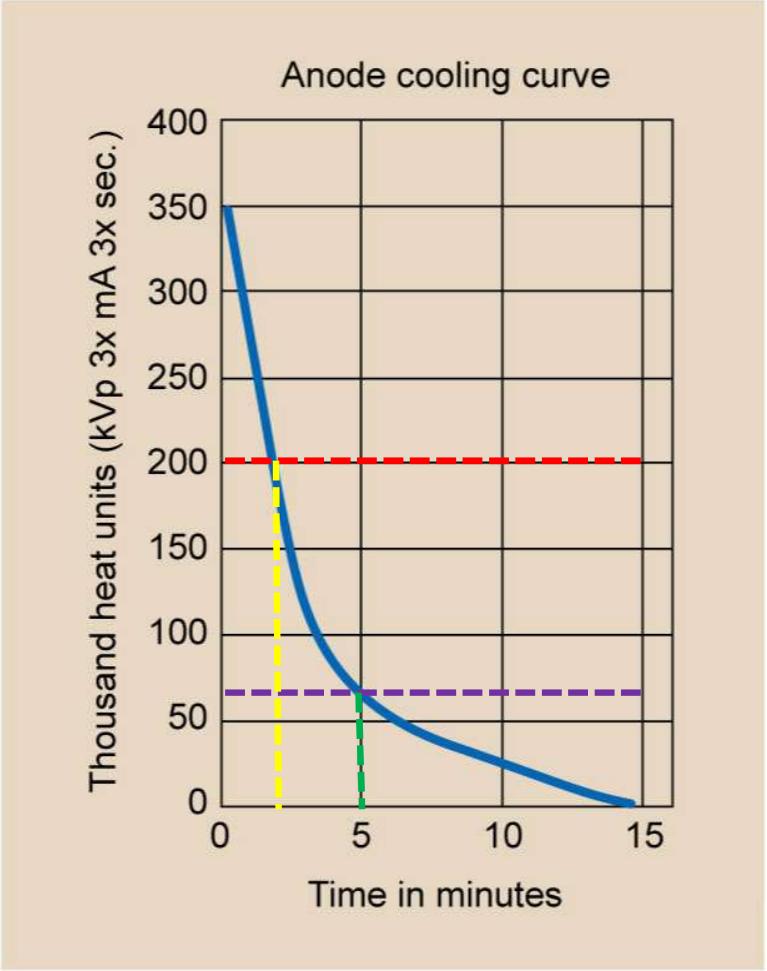
- How long will it take for the anode to cool from 200000 HU to 70 000 HU?



Courtesy GE Healthcare.

Anode Cooling

- How long will it take for the anode to cool from 200000 HU to 70 000 HU?
- Answer
  - Draw horizontal line at 200000 HU and another at 70000 HU
  - Then draw vertical lines down from where they meet the curve
  - Find the difference
- 5 – 2 min = 3 min



Courtesy GE Healthcare.

Housing Cooling Charts

- Similar appearance to the anode cooling chart and used the same way
- Anode will reach its limit before the tube housing will
- Maximum heat capacity for the tube housing is in the range of several million heat units as compared to the anode which is in the range of several hundred thousand heat units

Readings

- Bushong: Radiologic Science for Technologists 11th Edition
  - Pg 118-120