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Chest X-ray Taking Procedures Training for X-ray technicians/ Radiographer

"X-ray Production"

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Content

Introduction

"X-rays are used in medical imaging to produce the images by penetrating the high energy x-rays photons into the internal structures of the body and captured on the image receptor (Analog and Digital acquisition)."

Reference:X-ray technician/radiographer TB Chest X-ray Training Curriculum by Prof U Khin Hla

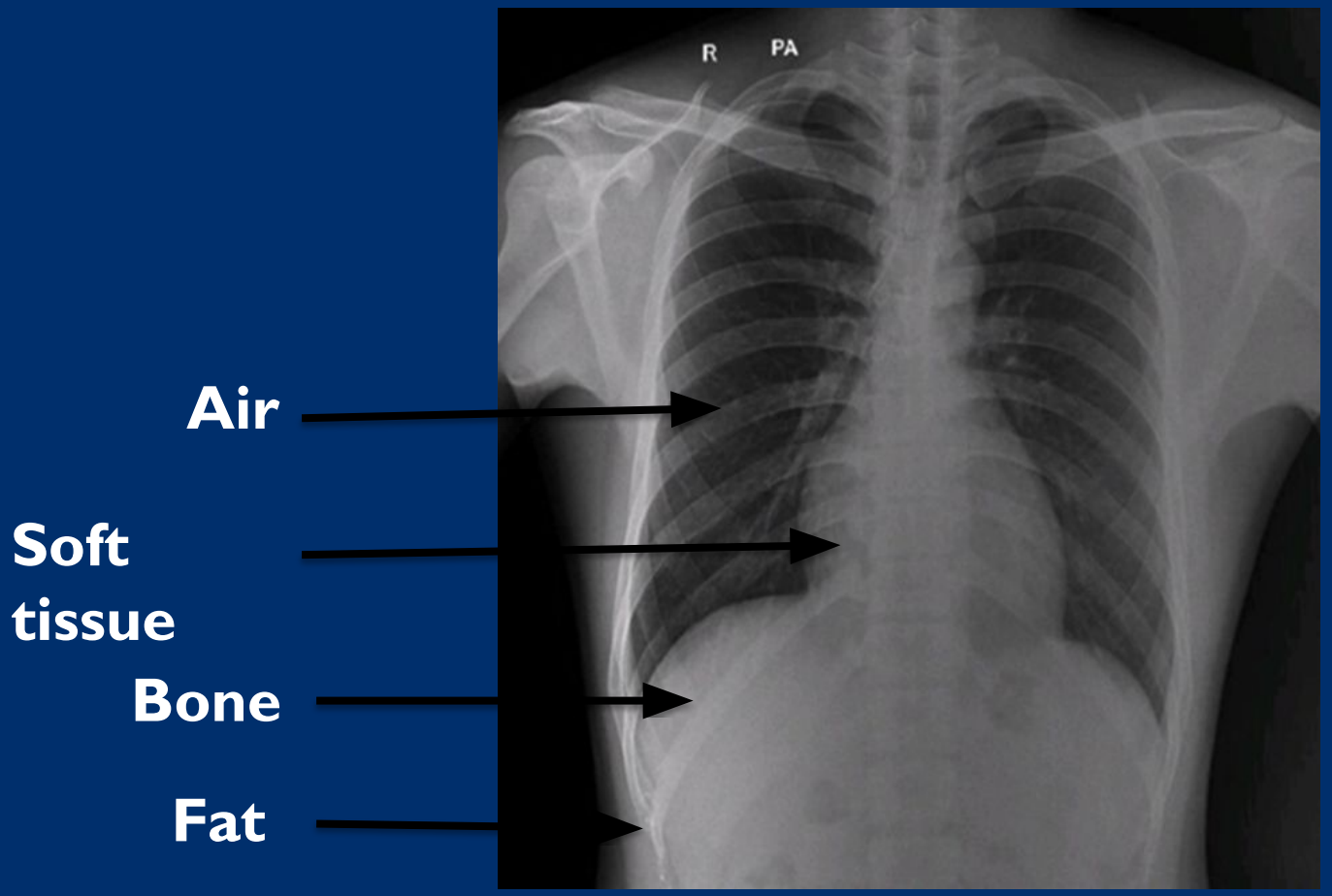
Introduction – Cont.

After passing the X radiation

through the body:

Bone (dense) - white
Fat - dark
Soft tissue - grey
Air - black

CXR PA View



Reference:X-ray technician/radiographer TB Chest X-ray Training Curriculum by Prof U Khin Hla

Equipment Used in the Production of X-rays

1. Autotransformer (A variable transformer)
2. Voltmeter
3. Timer
4. X-ray tube
5. Focal spot
6. Exposure switch
7. Glass envelope
8. Tube housing

Reference: 10e **RADIOLOGIC SCIENCE FOR** TECHNOLOGISTS: PHYS, BIOL PROTECTION By **Bushong** ScD FACR FACMP, Stewart.

Equipment Used in the Production of X-rays – Cont.

Autotransformer (A variable transformer)

Voltmeter

Timer

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Equipment Used in the Production of X-rays – Cont.

Electronic timer

- Contained in most radiographic equipment
- Allows exposure times of 1 ms (0.001 second)

Automatic exposure control (AEC)

- To terminate the exposure when a predetermined amount of exposure has been reached
- To provide consistent exposure (film, digital detector)
- Shortest time with an AEC is 1 ms (0.001 second)
- AEC sensor is placed between the patient and the image receptor

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Equipment Used in the Production of X-rays – Cont.

X-ray tube

Focal spot

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Equipment Used in the Production of X-rays – Cont.

Exposure switch

Glass envelope

Tube housing

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Production of X-rays

Three types of conditions:

i. Source of electrons
ii. Acceleration of electrons
iii. Sudden stoppage of electrons against target material

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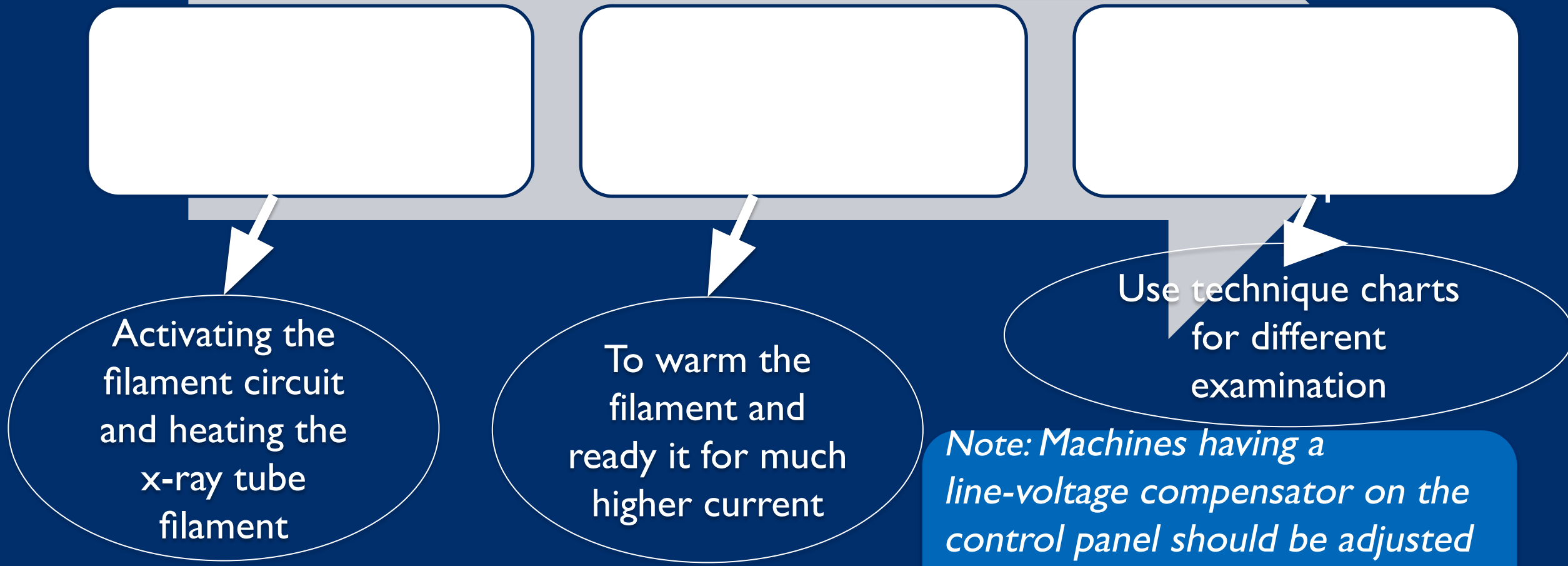
Production of X-rays – Cont.

Note: If the machine has been off overnight; warm-up exposures are needed to warm the anode throughout (anode cracking can occur when surface heat is applied to a cold anode)



Note: Machines having a line-voltage compensator on the control panel should be adjusted to compensate for any incoming voltage fluctuation

Production of X-rays – Cont.

two-stage exposure button

It is the induction motor bringing anode rotation up to speed

Then the filament is heated to maximum (thermionic emission) and produces an electron cloud

The first click heard after partial depression

It leads to the exposure being made

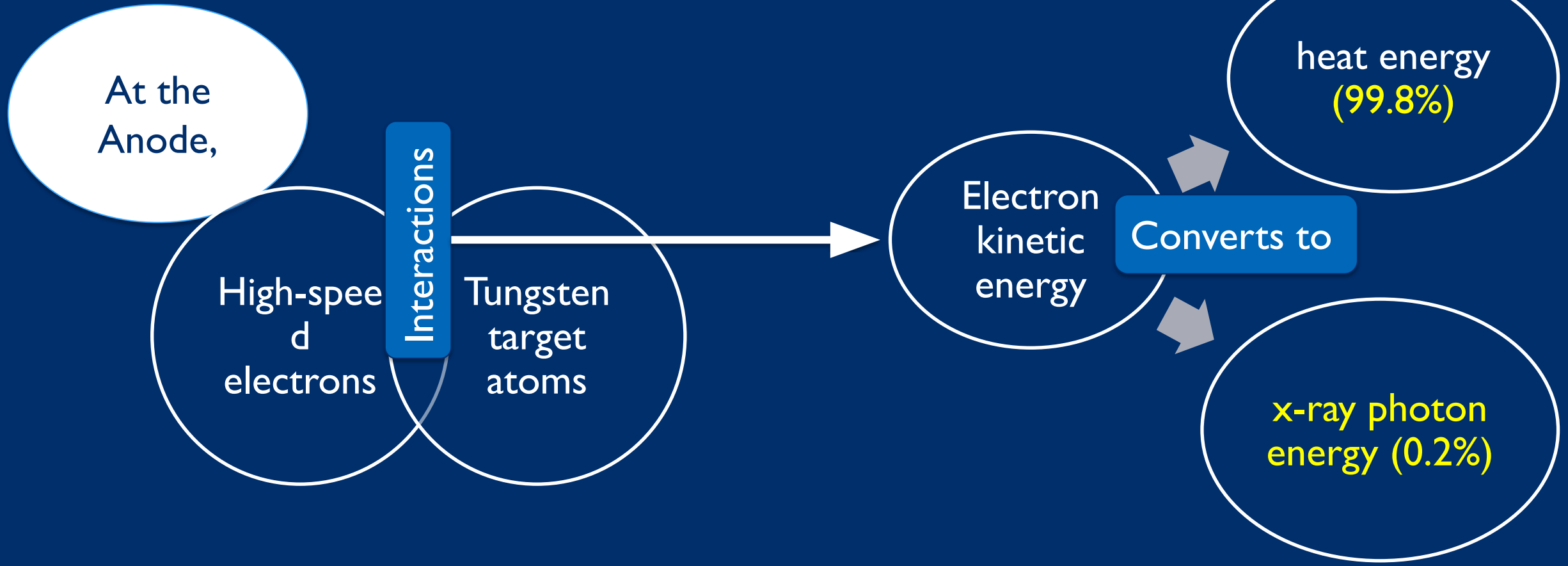
The second click - after complete depression of the rotor/exposure switch

- Voltage selected by the autotransformer is sent to the step-up transformer
- Converted to the high voltage (kV)
- Low amperage (mA) required

- High-voltage current then passes through the rectification system that changes AC to pulsating DC

- Applied high voltage (potential difference) propels the electron cloud to the anode

Production of X-rays – Cont.



Types of Technique Charts

(a) Fixed kVp–variable mAs	(b) Variable kVp–fixed mAs	(c) Variable technique (vary both mAs and kVp)
Assumes optimal kVp for the part being radiographed	kVp is varied according to part thickness	Provides for alteration of routine techniques because of pathologic conditions, patient age, body mass index, contrast media
mAs is varied according to the part thickness		

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Control Console

Production of X-rays – Cont.

Brems

- X-rays produced by slowing of incoming electrons by the target atoms; slowing releases energy in the form of x-rays

Characteristic

- X-rays produced when incoming electrons at the anode dislodge orbital electrons from the target material, and outer shell electrons fall in to fill the hole created; this movement releases energy in the form of x-rays

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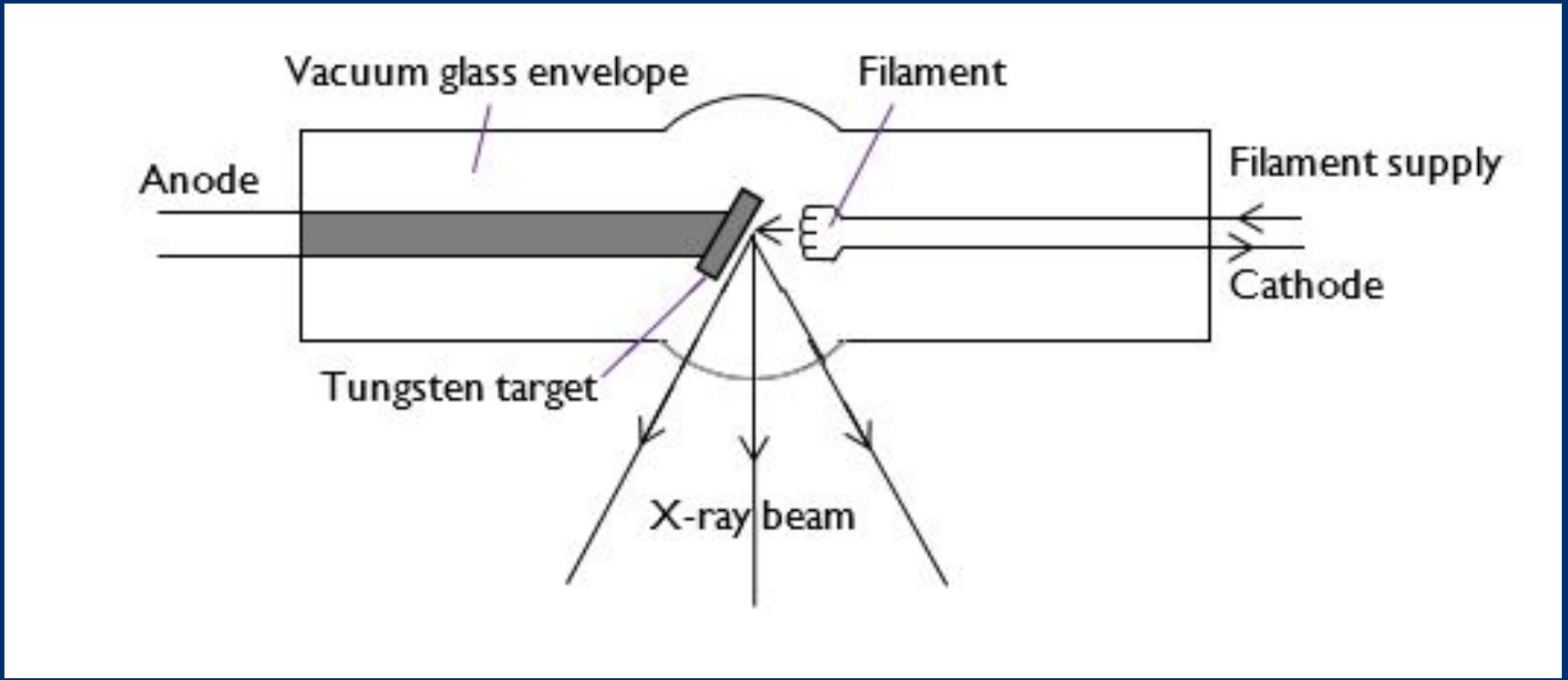
Production of X-rays – Cont.



Production of X-ray beam

Reference:X-ray technician/radiographer TB Chest X-ray Training Curriculum by Prof U Khin Hla

X-ray Beam Characteristics

- The resultant x-ray beam contains many different energies and is heterogeneous

- The maximum energy an x-ray photon can have corresponds to the kVp that was used

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X-ray Beam Characteristics – Cont.

- **Beam characteristics may be altered by using filtration:**

Inherent filtration	Total beam filtration
• the oil and glass envelope of the x-ray tube	• equals inherent filtration plus added filtration (at least 2.5-mm aluminium equivalent)

Advantages: Filtration removes the low-energy (long-wavelength) rays from the beam and reduces the patient dose

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X-ray Beam Characteristics – Cont.

Aluminum filter

A filter is usually a sheet of aluminium placed in the primary beam just as it exits the x-ray tube and before it reaches the collimator

Other types of filters

Compensating filters (e.g., wedge, boomerang)

Half-value layer:

Amount of filtration that reduces the beam intensity by half

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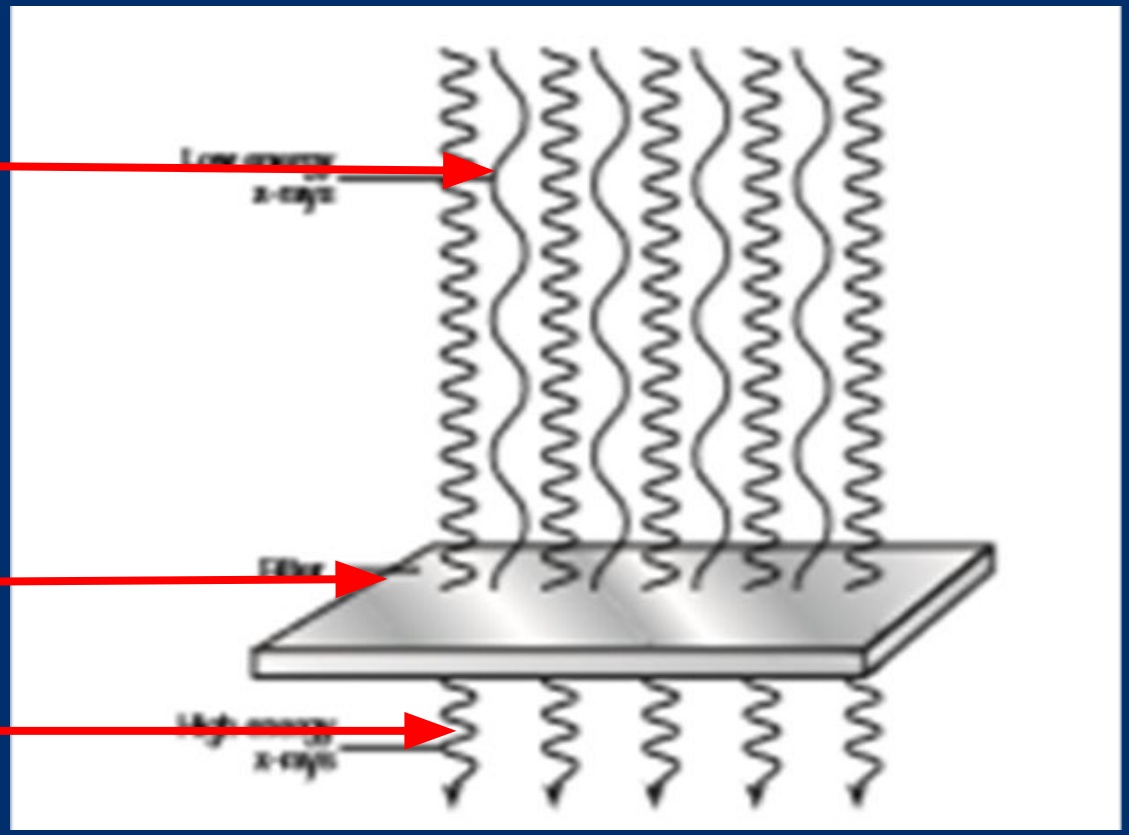
Low energy x-rays

Filter

High energy x-ray



Filtration

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Quality Control of X-Ray–Producing Equipment

To provide safe and reliable operation of equipment:

- *Filtration-beam quality:*

  Tested using a digital dosimeter

  Half-value layer measurement is required

- *Collimator/light field to radiation field alignment:*

  Must be accurate within 2% of SID (0.8” at 40” SID)

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Quality Control of X-Ray–Producing Equipment – Cont.

- *Effective focal-spot size:*
  - Should be within 50% of size stated in equipment specifications
- *kVp:*
  - Must be accurate to within 10% of that chosen
- *Timer:*
  - Should be within 5% of the time chosen for exposures over 10 milliseconds

Reference: 10e **RADIOLOGIC SCIENCE FOR** TECHNOLOGISTS: PHYS, BIOL PROTECTION By **Bushong** ScD FACR FACMP, Stewart.

X-ray Tube Faults

No	Faults	Symptoms	Possible Causes
1	Reduced insulation oil	- An arcing sound heard during an exposure	- Repeated over heating or leakage of oil (forming air bubbles)
2	Deposition of vaporized tungsten on the glass wall	- Glass wall becoming colored based on age of use	- Heavy exposure increases vaporization of tungsten

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X-ray Tube Faults – Cont.

No	Faults	Symptoms	Possible Causes
3	Glass puncture	- Oil entering the tube	- Electric discharge through oil at high kv when oil insulation is inadequate
4	Anode wobbling	- Apparent movement of light patch on fluoroscopic screen	- Anode stem being bent due to excessive heat conduction during prolonged fluoroscopy

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THANK YOU !