

## **Causes of X-ray Tube Failure**

- \* All causes of tube failure relate to the thermal characteristics of the tube.
- \* When the temperature of the anode during a single exposure is excessive, localized melting and pitting occurs.
- \* These surface irregularities lead to variable and reduced radiation output.
- \* If the melting is severe, the tungsten vaporizes and can plate the port. This can cause added filtering or interference with the flow of electrons.
- \* If the temperature of the anode increases to rapidly, the anode can crack and then become unstable in rotation.

### **COMMON CAUSES OF TUBE FAILURE**

- Extremely high voltage
- Excessive heat generation
- Poor cooling system
- Rough-handling/ Careless
- Aging

### **COMMON FAULTS, THEIR CAUSES & REMEDY**

#### **1. Cracking of x-ray tube housing**

##### **Causes**

Expansion of air & oil present inside it and increased in its internal pressure.

##### **Results**

- Escape of oil from the housing.
- Insulation level & cooling rate are reduced.

## 2. Radiation leakage

### Causes

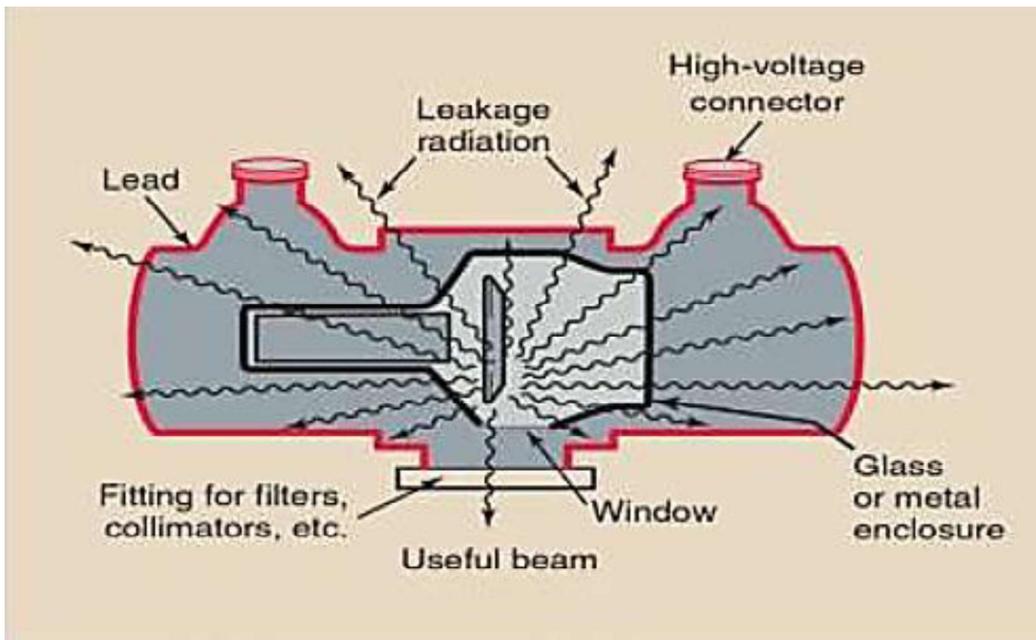
- Cracking of the tube housing.
- Improper shielding.

### Results

- Increases patient's as well as personnel radiation dose.
- Should not exceed 100 mR/hr

### Remedy

- Proper shielding should be done.
- Replace the tube with new one as soon as possible.



## 3. FAULTS IN GLASS/METAL ENVELOPE (Loss of vacuum).

### Causes

- Crazeing of the glass enclosure due to difference in coefficients of expansion of glass and metal.

### Results

- Production of secondary electrons

- Result in the variation in the number, reduced speed of electrons impinging on the target, energy of x-ray produced
- Production couldn't be controlled independently.

### **Remedy**

Use of special alloys having the same coefficients of linear expansion as Pyrex glass is used.

### **4. FAULTS IN FILAMENT (Vaporization of filament).**

#### **Causes**

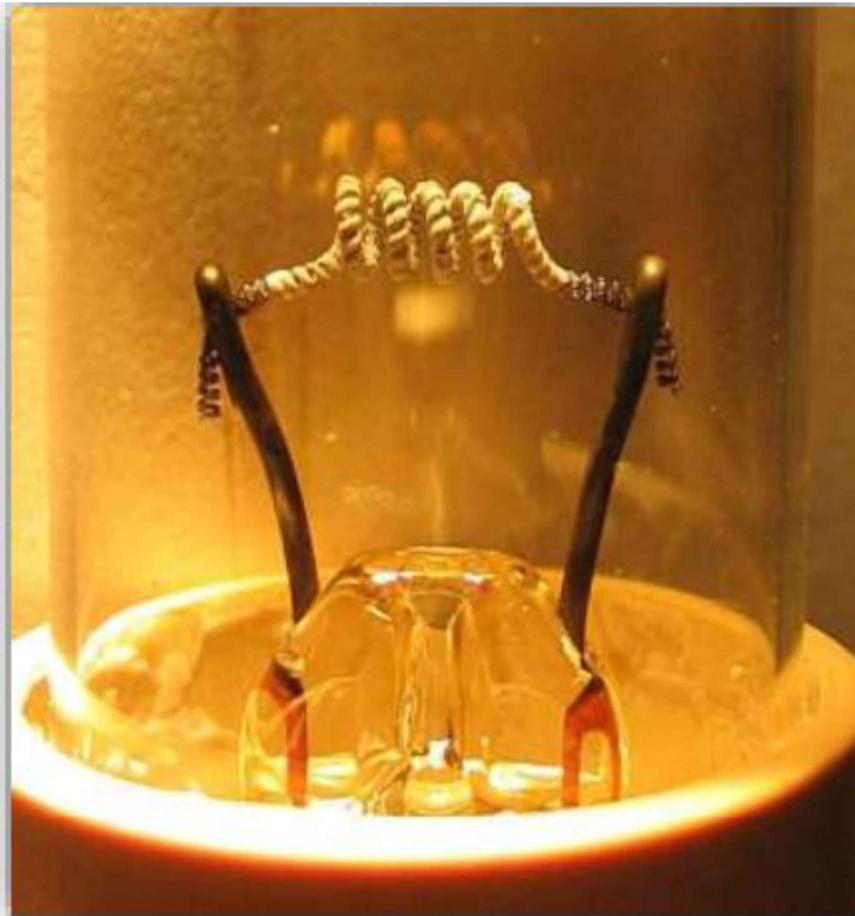
Excessive heating of filament for the longer period of time.

#### **Results**

The vaporization of filament or breakage of filament lead to no exposure takes place.

#### **Remedy**

Use of 1-2 % Thorium with tungsten filament.



## **5. FAULTS IN ANODE**

### **A. Kinking of the target material**

#### **Cause**

Difference in thermal expansion of metal on the surface & metal immediately beneath the surface.

#### **Result**

Results in distortion of the anode angle, narrowing of the beam, greater geometric unsharpness.

#### **Remedy**

- 10% Rhenium is added to 90% of tungsten target.
- Manufacture anode disc with slits in the target surface to allow the material in the focal track to expand without producing the mechanical tension.

### **B. Roughening and pitting of anode surface**

#### **Cause**

Excessive thermal stress.

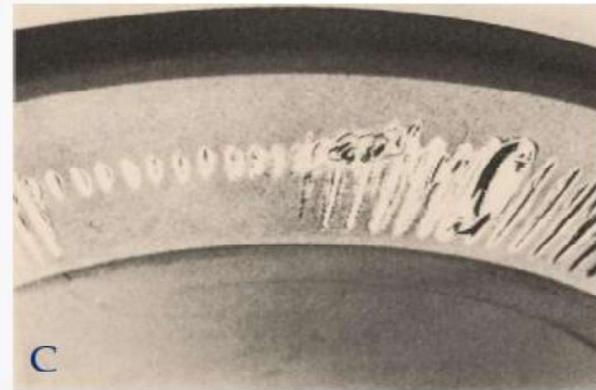
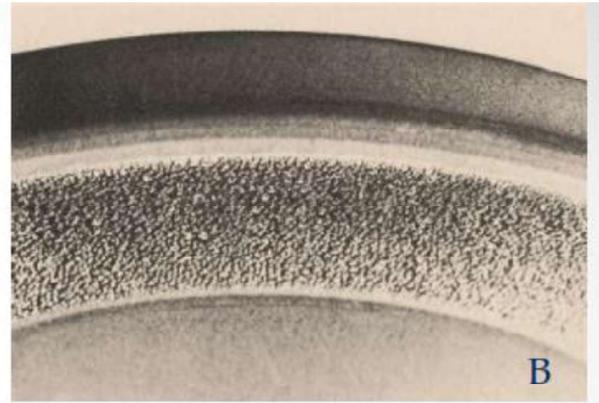
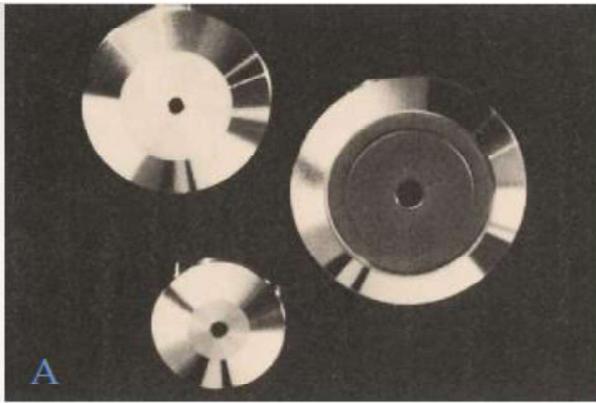
#### **Results**

- Scattering of the x-rays
- Absorption of x-rays by the target itself.
- Results in diminish x-ray output.

#### **Remedy**

- Use of lowest necessary power
- Largest possible focal spot
- Longer exposures at reduced power.





Comparison of smooth, shiny appearances of rotating anodes when new (A) versus their appearance after failure (B,C,D).

### **CARE OF THE X-RAY TUBE**

#### **1. WARM UP THE ANODE FOLLOWING MANUFACTURER'S RECOMMENDATIONS.**

Performed if the system not been energized for  $\geq 2$  hrs, to prevent tube damage from thermal shock.

#### **2. MINIMIZE FILAMENT BOOST TIME**

Current applied for too long will shorten filament life and will lead to unstable operation.

#### **3. USE LOWER TUBE CURRENT (mA)**

- High tube current will cause evaporation of the tungsten.
- Whenever possible, use a lower mA station and a longer exposure time to arrive at the desired mAs.