Prepared for:

ICE IMAGING CONFERENCE & EXPO

X-Ray Tubes 101

February 22, 2022

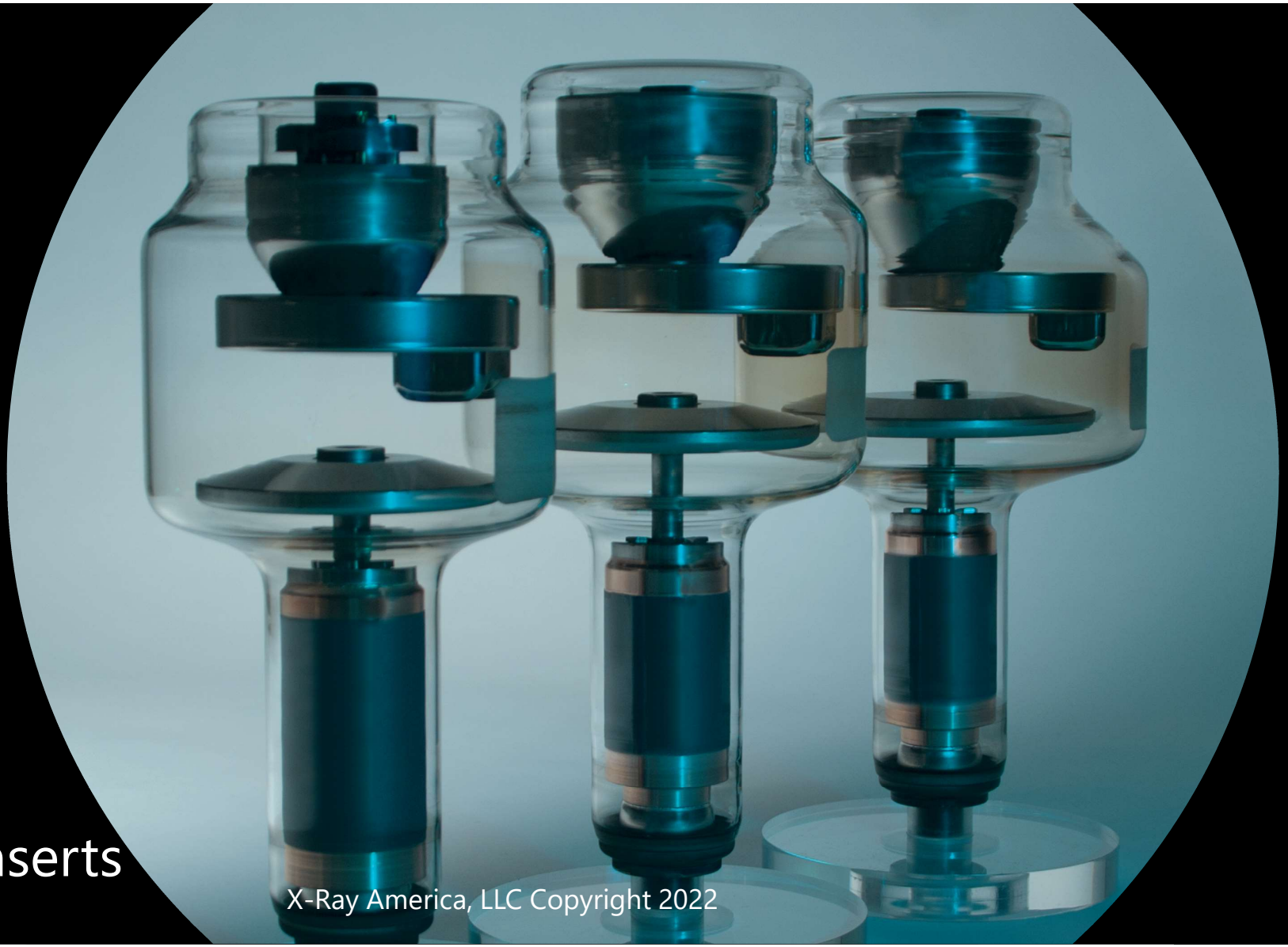
X-ray tube:

- Basic Theory
- Components
- Compatibility
- Common Tubes

David Hurlock
X-Ray America, LLC
MVS Consultants LLC

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X-ray Tube inserts

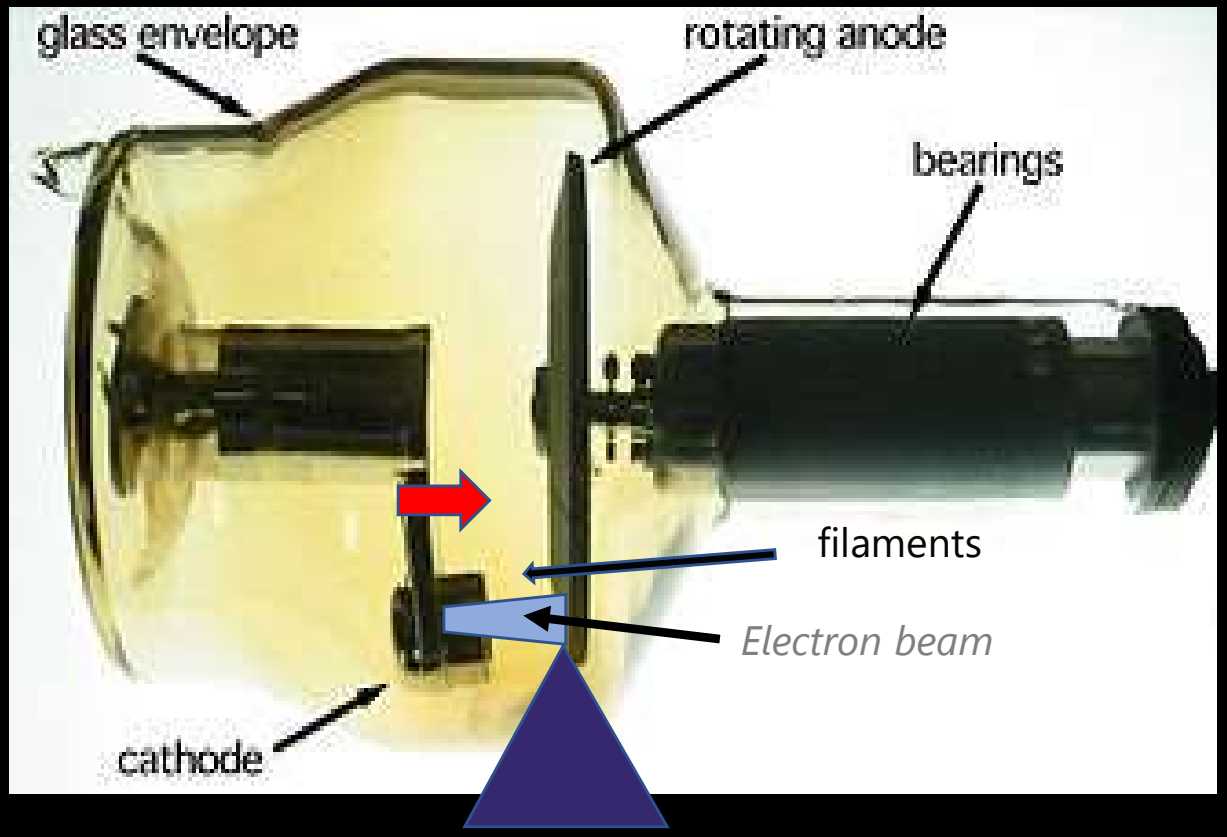


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Radiographic Insert

Energy Potential

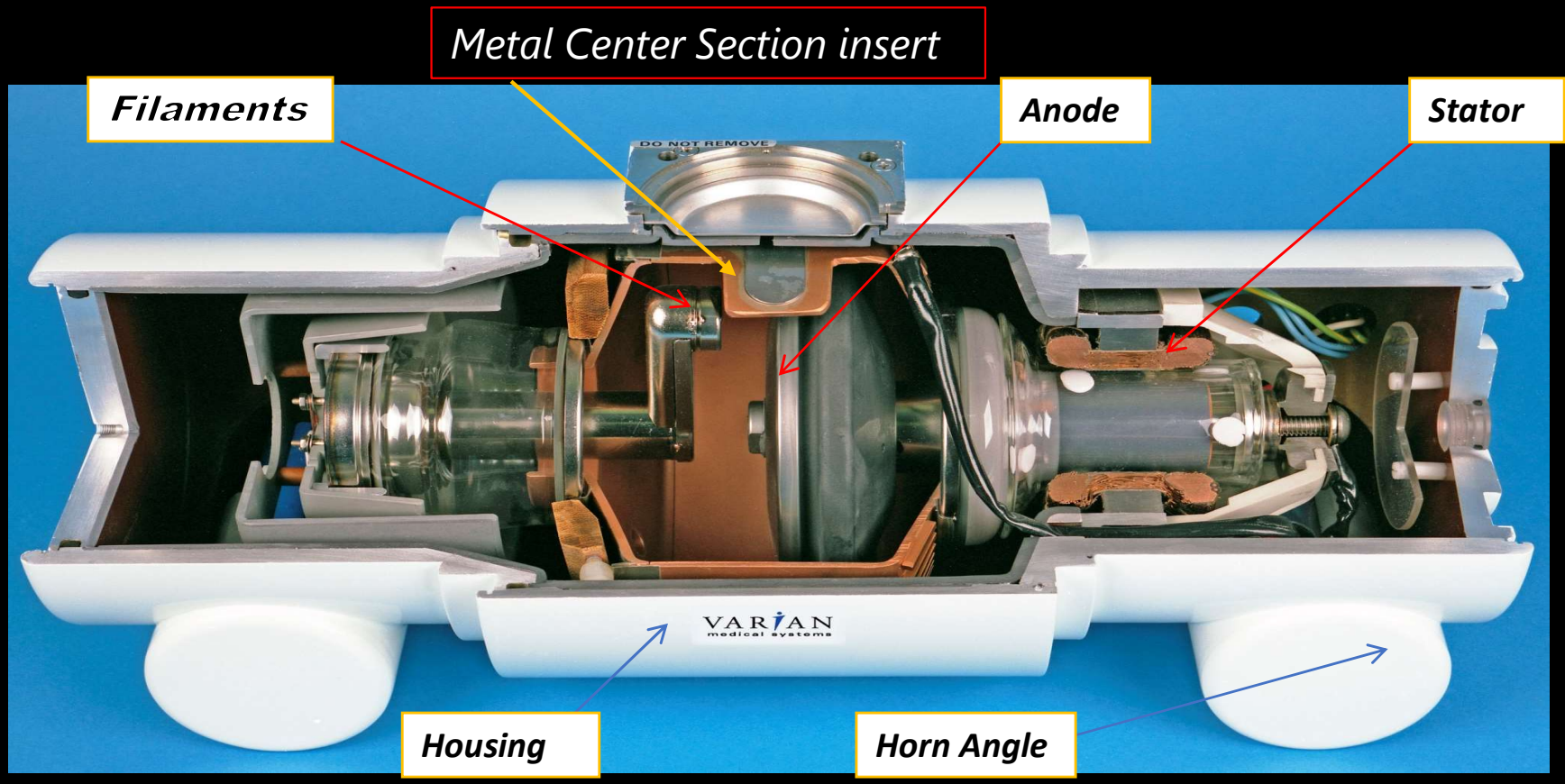
-75kV



+75kV

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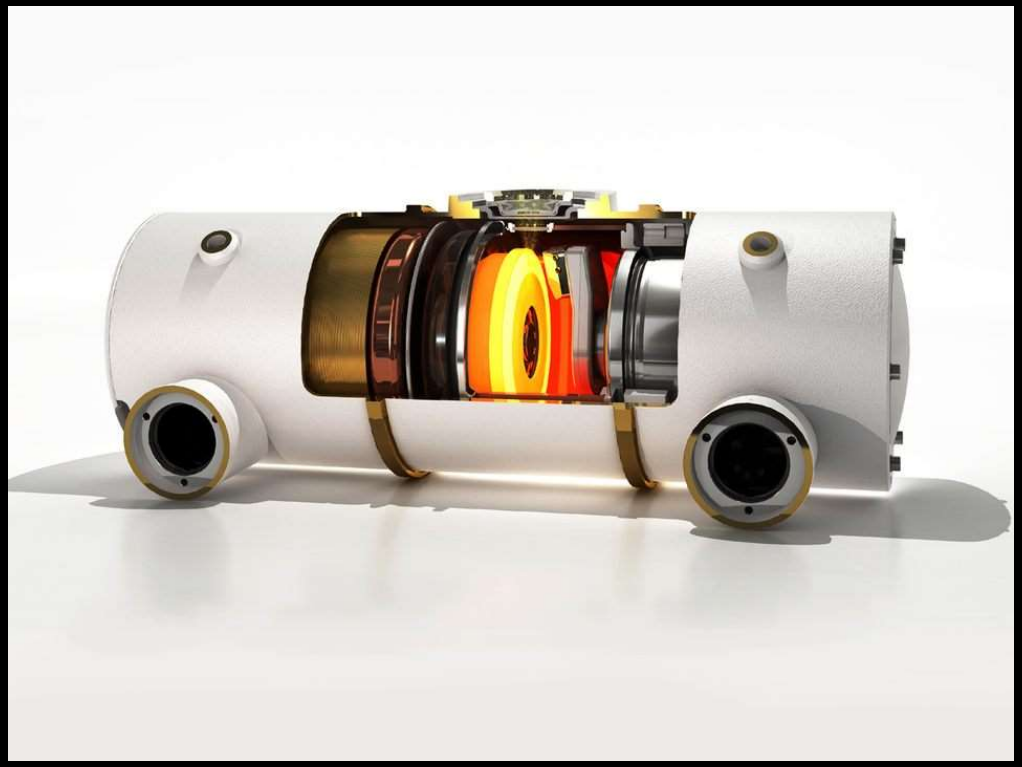
Filaments, Anode, Stator, Housing and Horn Angle



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Siemens X-Ray tube with a glowing target

Normal heat load



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Anode / Target

With normal wear



600 kHU

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Cathode Cup with Filaments

Large filament
Large focal spot

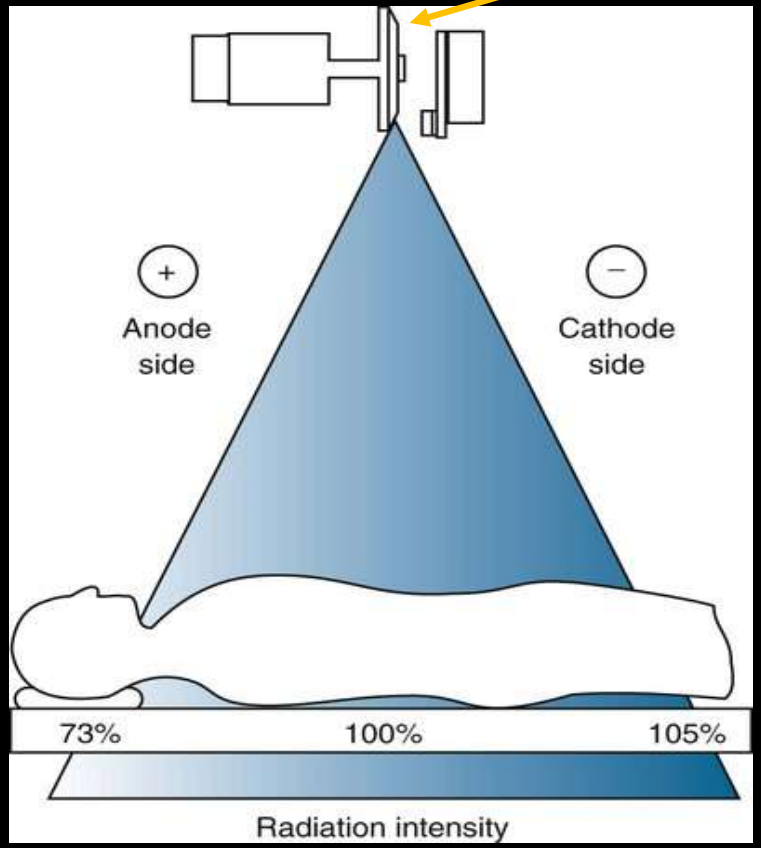


Small filament
Small focal spot

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Source to Image Distance

Target angle
Determines beam coverage



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IAE “Diagnostic” X-Ray Tube are:

- The industry **gold** standard
- 100% NEW X-Ray Tubes
- A “Reloaded Tube” is a “New Tube”
- The “Assembler” is the “manufacturer”
- Loading = Reloading = Assembling
- All manufacturers reuse housings*
  - *If they don’t they should!

X-Ray Tube Quality

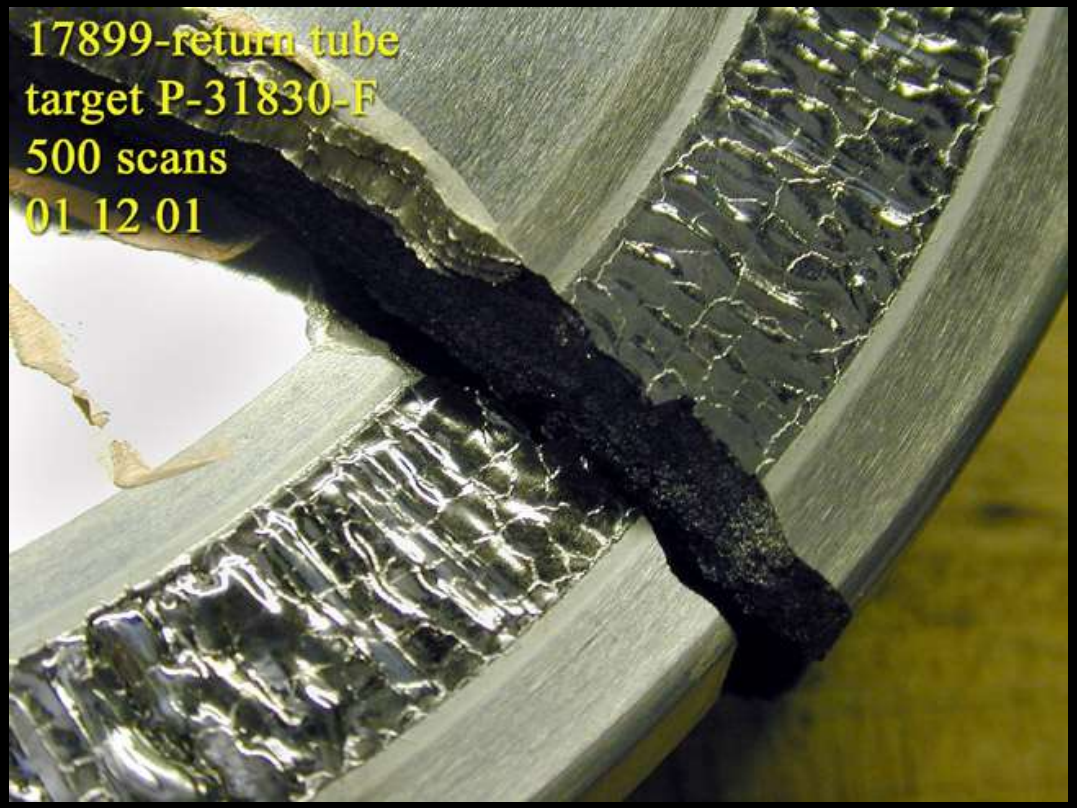
Causes of failures

- Insert:
  - Bearings – Noise, Early failure
  - Lack of Vacuum inside the envelope – Arcing
  - Tungsten deposits on envelope
  - Broken filament: granularization in filament material

- Assembly or Load:
  - Dielectric quality of the oil - Arcing
  - Quality of the seals - Oil leak, Air intrusion
  - Mechanical failure of sensors, switches

- Installation
  - Arcing in receptacles: - air space in grease
  - Melted filament – improper filament voltage calibration

Cold Anode hits



Crazing - Tungsten deposits promote arcing

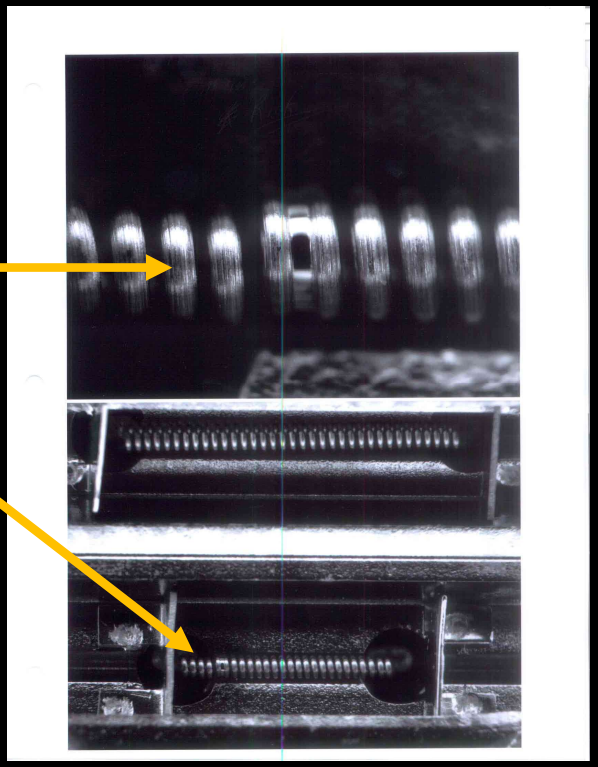
Filament buildup on the glass envelope



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Blown filament

Melted filament



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Arcing inside the insert

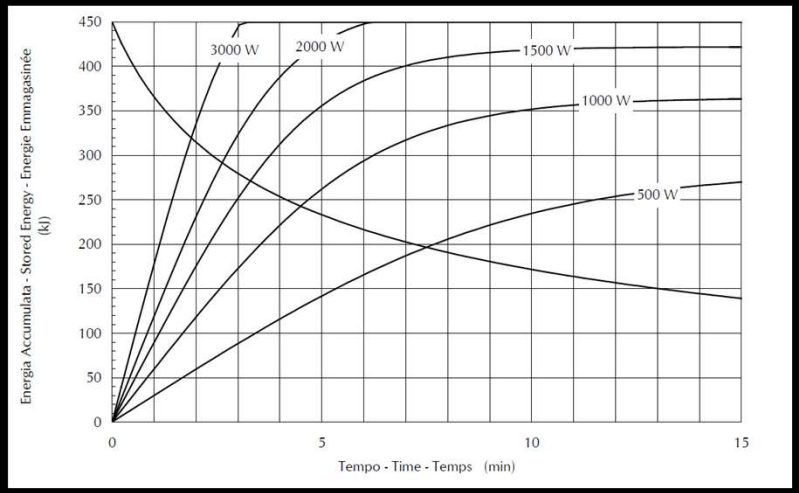
Instability – Loss of Vacuum



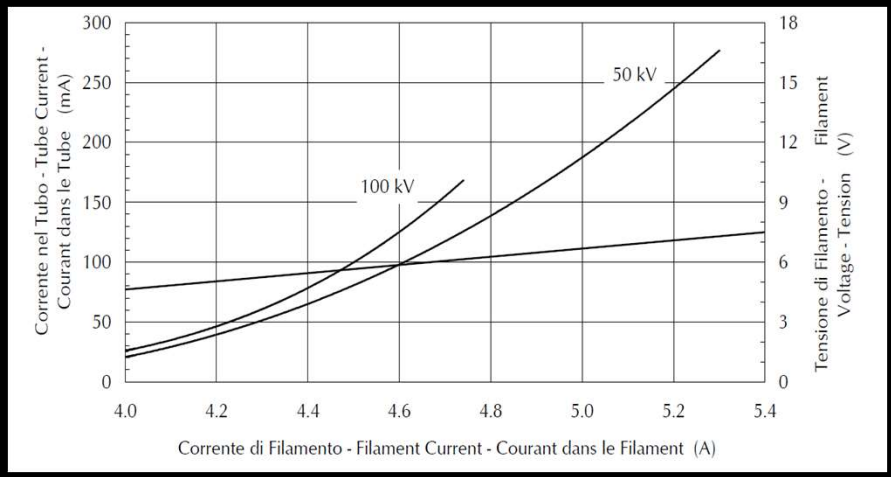
Calibration

Tube library in the generator

- Stator type
- Anode Heating and Cooling Curves



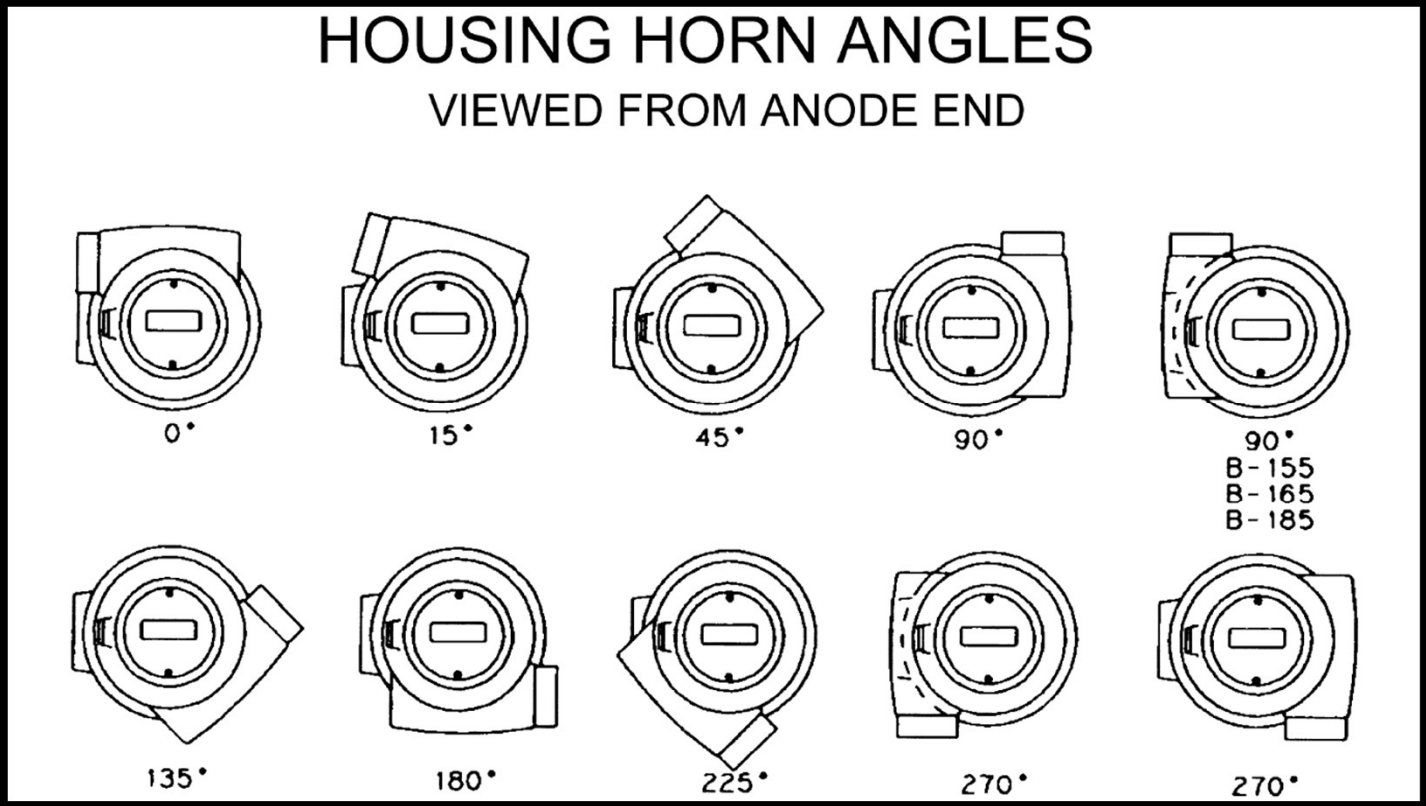
Filament curves



Characteristics for Tube compatibility

Characteristic	Example
• Housing:	
• OEM Original or Compatible – Physical mounting	MX100
• Horn Angle: for cables / port orientation	90°
• Stator type: Ohm range	"R"
• Insert:	
• Target:	
• Size: Insert target size translates to housing size	3"
• Angle: Determines beam coverage	12°
• Heat storage: 150 kHU – 810 kHU	300 kHU
• Focal spot size: contributes to resolution	0.6mm / 1.2mm
• kW small focal track / Large focal track	40/100

Horn Angle


HOUSING HORN ANGLES
VIEWED FROM ANODE END
0°
15°
45°
90°
90°
B-155
B-165
B-185
135°
180°
225°
270°
270°

Common Models

GE, Siemens, Philips, Shimadzu

OEM original tubes manufactured by the OEM or supplied to the OEM.

- IAE insert in IAE housing
- Choose the tube in the software

IAE inserts loaded into original OEM Housing or Compatible Housing

- Fit is identical
- Function is equivalent, some additional calibration may be required.

GE

Rad / RF / Portable / C-Arm

- MX100 housing –
  - MX100-09 90° horn angle
  - MX100-18 180 ° horn angle

		System
• MX-100	R/F Over Table RAD	Precision / Optima Proteus
• MX100	Under table	Precision / Optima
• MX100	R/F Undertable	Advantx
• MX75 / RAD-11	Portable	AMX 4+
• MX75/ RAD-10	Portable	AMX 4
• ORIII	C-Arm	OEC 9800 / 9900
• ORIIIB	C-Arm w vascular (cooling)	OEC 9800 / 9900

MX100



OR-III



Philips Medical Systems

Rad / RF

Philips Tube Model

- SRO 33/100 (350 kHU) ROT350 ROT360

p/n: 9874 005 16122*

- SRO 25/50 (350 kHU) ROT350 ROT360

p/n: 9874 004 23122*

RO 17/50 ROT350 ROT360

- *Sample p/ns only. The OEMs sell under various part numbers.







Varian Medical Systems / Varex Imaging Components

Rad / RF

RAD-14	Diamond	300 kHU 3”
RAD-68	Diamond	300 kHU 3”
RAD-60	Sapphire	400 kHU 4”
RAD-92	Sapphire or B-130H	600 kHU 4”



Diamond



Sapphire

Shimadzu Medical

Rad / RF

Housing:

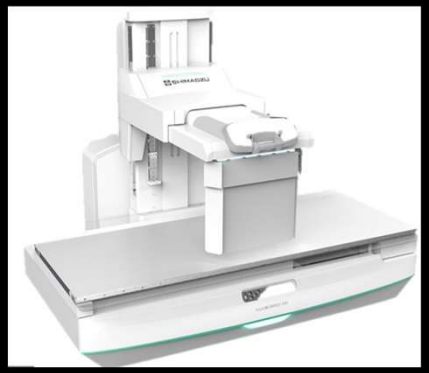
- RX80 / RX85 / RX100

SHIMADZU Model	Housing
• 0.6/1.2P18C- *85*	RX85
• 0.6/1.2P38C - 80	RX80
• 0.6/1.2P38DE - 85	RX85
• 0.6/P324DK - 80	RX80
• 0.7/1.3U163C-36	RX36

  - Mobile aRT / dARt Portable x-ray system tube



RX85





RX80



Siemens Healthineers

Rad / RF

Siemens Model

- Opti 150/30/50C
- Opti 150/30/50HC
- Opti 150/40/82C
- Opti 150/40/73C
- Opti 150/4080C
- Opti 150/40/80HC



Opti 150



Luminos R/F

Carestream

Rad / RF / Portable

System	Carestream P/N
	5H9191
	AA3344
	9G8064
	S9G9064 (service)
	AA4055
	R10-T920
	SPAD3533
• Revolution (Portable)	9G6044



Evolution



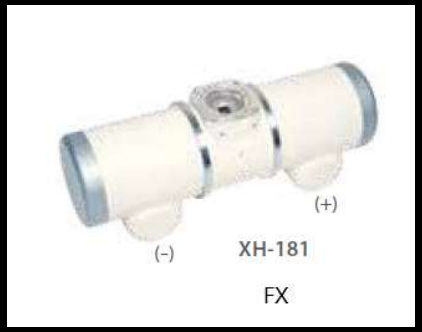
Revolution

Toshiba / Canon Electron Products

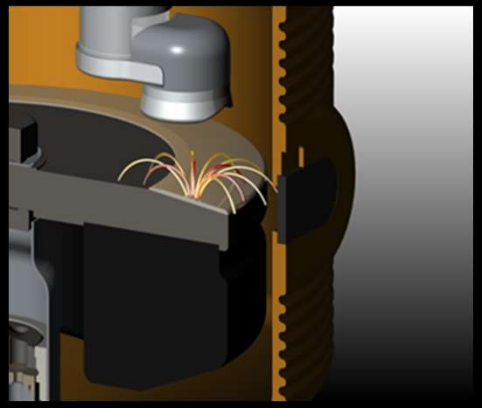
- Systems: Many RAD Systems and Portables use Canon / Toshiba X-ray tubes



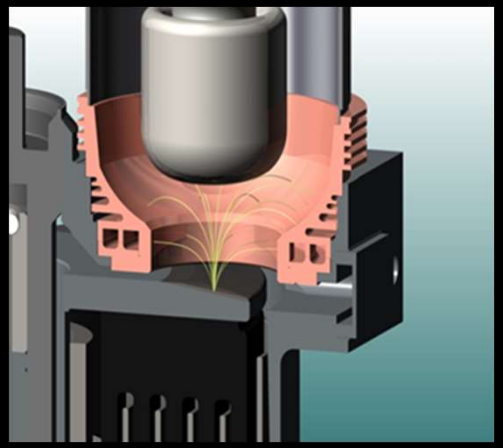
- Housings: Suffix X / FX / GX – designates Horn angle
- Common Models:
  - E7239 X — Small Rad systems
  - E7242 FX — Small Rad systems
  - E7252 FX — Medium Rad systems
  - E7886 X — Mobiles
  - E7884X — Mobiles
  - E7255 X — High Throughput RAD systems / R/F systems
  - E7254 X — High Throughput RAD systems



X-ray Technology - Anode End Grounded Tubes



- No Aperture
- Electrons scatter after creating useful x-ray beam
- Rebound and heat the anode unnecessarily
- Create waste radiation which fogs the image
- No Fins
- Hot Anode radiates heat to vacuum can

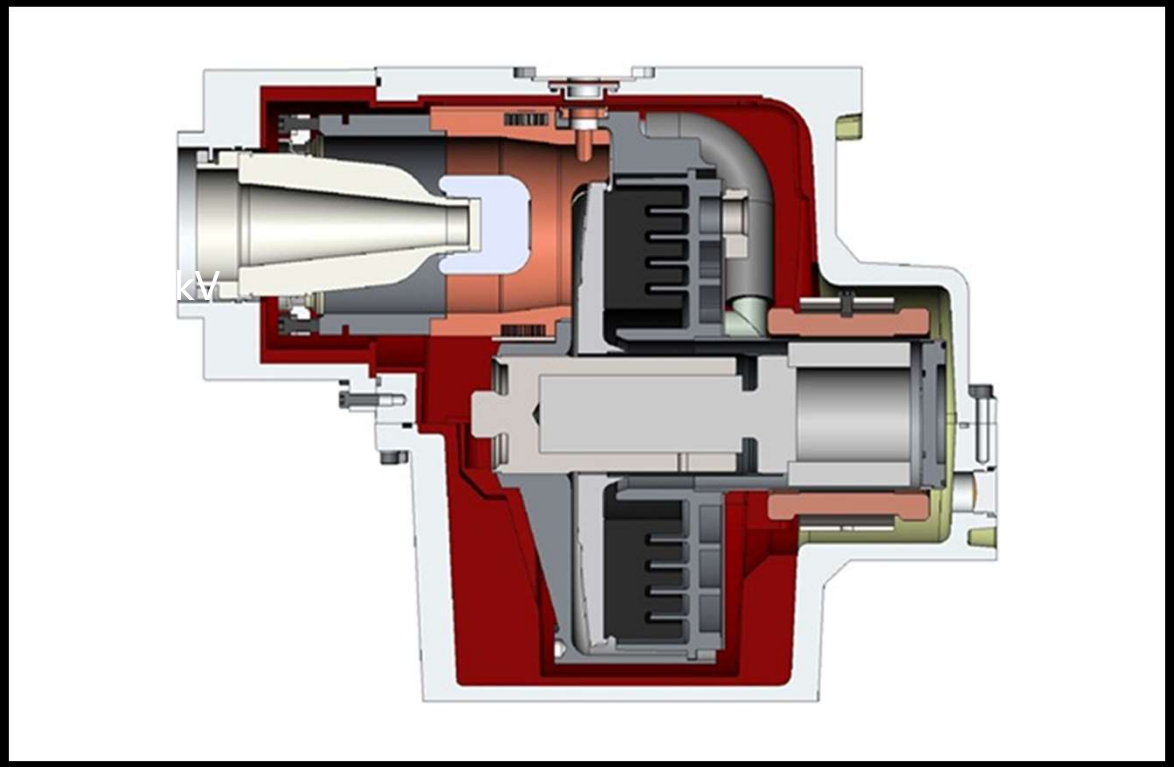


- Aperture
- Electrons collected after creating useful x-ray beam
- Patented aperture
- Anode runs cooler
- Virtually no waste radiation to fog the image
- Fins
- Fins radiate 30% more heat to the vacuum can

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Anode End Grounded – AEG Technology
GE Hercules / Canon CXB-750D

-150 kV

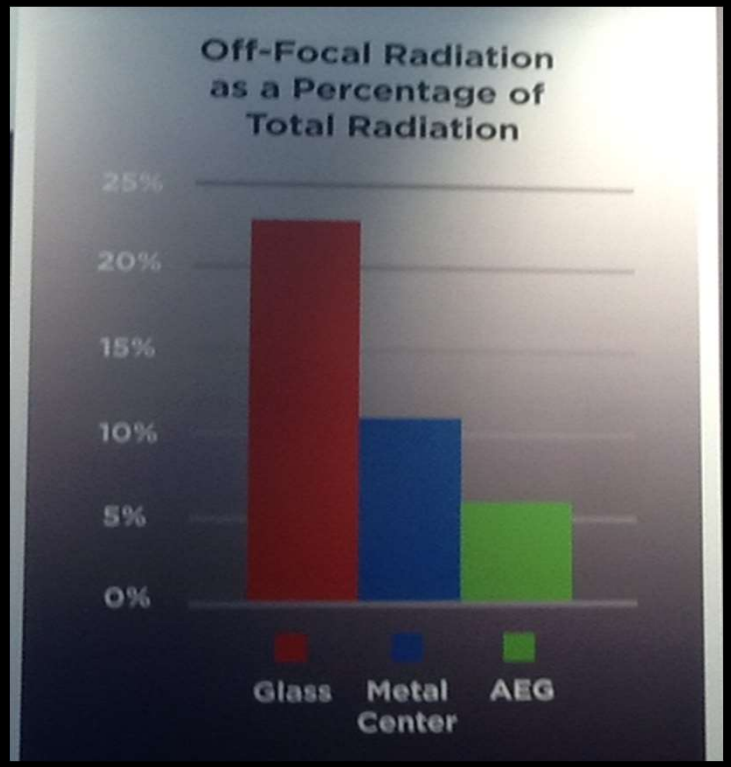




Ground

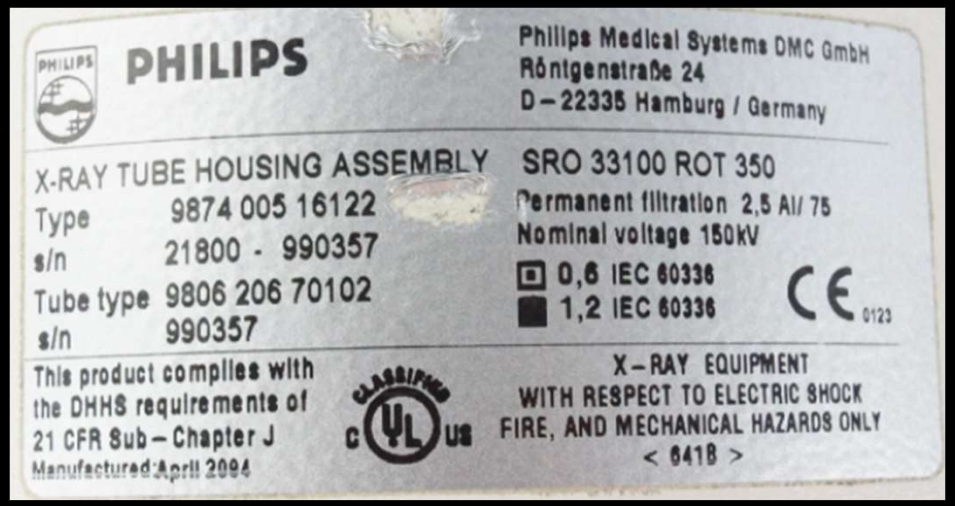
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Off focal Radiation – Soft beam

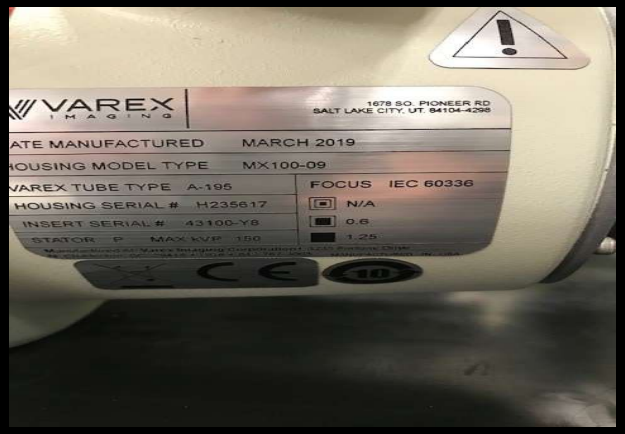


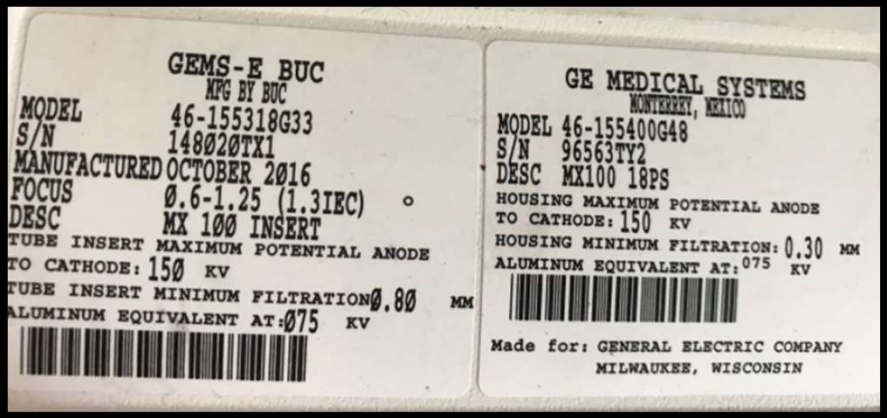
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Tube ID label on the housing









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Thank you for attending!

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