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Portable X-ray & X-Ray Production

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Who We Are

- COMET, AG is a 65 year-old Swiss company and a leading supplier of advanced system and component solutions based on x-ray, electron beam and RF technologies.

- COMET provides X-ray/ EB source technology supporting customer screening, inspection & material processing requirements.

- We are represented worldwide, with global operations supporting OEMs on a global basis: United States, Europe and China.

- COMET’s strategy is underpinned by product innovation, staff expertise and building A+ customer experiences!
X-ray sources are used in many different applications

Non Destructive Testing
- Wheel inspection
- Pipeline inspection
- Engine block inspection

Security
- Luggage inspection
- Truck inspection
- Inspection of parked Cars

Food Inspection
- Jelly inspection
- Fish bones inspection

Thickness Gauging
- Hot steel plate
- Cold steel plate

e-beam
- Sterilization of Food Packaging
- Sterilization of Pharma Packaging
- Curing of Inks

new
X-Ray basics

How are x-rays produced
1. Start with a tube made of glass or metal containing a very good vacuum (\(<10^{-6}\) mbar – typically \(10^{-8}\) mbar).
2. Have on opposite sides inside the tube a cathode (\(-\)) and an anode (\(+\)).
3. The cathode contains a filament exactly like a light bulb.
4. Apply high-voltage between cathode and anode – don't overdue it unless you want to hear some nasty sparks and want to buy a new X-Ray tube.
Technical generation of X-Rays

1. Shape the electrical field by tuning the geometry of tube, cathode and anode in such a way that electrons are focused onto one spot on the anode.
2. This is the tubes focal spot!
Technical generation of X-Rays

1. Heat up the filament (it's made of Tungsten) to above 2000° C.
2. This will lead to thermionic emission of electrons.
3. The electrical field will accelerate the electrons to the anode.
4. The impacting electron will create Brems- and/or Characteristic radiation.
Technical generation of X-Rays

1. The more electrons hitting the anode / the focal spot, the more X-Ray radiation is created! Dose and Intensity increases.
2. The Anode (made of Tungsten / Tungsten alloy) gets hot → Energy conversion favors the thermal side....
Technical generation of X-Rays

1. If you don't want to destroy the anode/tube apply cooling (water, oil, air)!
Technical generation of X-Rays – a bit more realistic
Technical generation of X-Rays – a bit more realistic

Small Filament for small Focal Spot

Big Filament for big Focal Spot
The modern portable X-ray system

- The tube head

Tube head electronic, Gas insulated tube tank with power transformer high voltage multiplier column and filament supply, metal ceramic X-ray insert, anode cooler with integrated lead protection, fan for air cooling of anode cooler.
Generic Tube Designs – Exit Windows

- Side window tube
- Transmission target tube
- End window tube
2. Focal Spot Specifics

→ The bigger the spot the bigger the possible thermal load.
→ The smaller the spot the higher the image sharpness.
→ Small, Round & Uniform → Good Image Quality

Requirements on the target / focal spot...
Requirements on the target / focal spot...

Example: Enhanced resolution due to smaller focal spots:

MXR-451
Spot = 2.5
(900W)

MXR-451HP/11
Spot = 0.4
(700W)
Portable X-ray Systems

History

Trends

Difference between Metal Ceramic and Glass tubes
Portable X-ray – The evolution

Timeline

- First portable X-ray unit
- Change from oil to gas insulation
- Change from Glass tubes to Metal Ceramic Inserts
- Change from Half-wave to Constant Potential Energy
Major steps in the evolution

- From half wave to Constant Potential High Voltage technology
  - Significant shorter exposure time

- X-Ray Spectrum

![Dose Rate vs. High Voltage graph for Constant Potential Energy](image1)

![Dose Rate vs. High Voltage graph for Non Constant Potential Energy](image2)
Key trends in Portable X-ray systems

- Lower weight
- Higher X-ray power
- Reduced down time
- Longer exposures at full power
- Less leakage radiation and improved safety features
- Higher image quality
- Better System integration
PXS Family

Low weight and compact sized portable X-ray system for in-field X-ray inspection at 160 kV to 300 kV
X-Ray vs Gamma

- Same power on the first to last day on the job
- Plays well with Digital Imaging, better focal spots, better images
- Less paper work
- Many times has faster exposure times (time is money)
- Less roped off area, smaller footprint
- Works with Inverters, Generators, 110 or 220 volts
- Easy to transport across boarders
Thank you for your attention.
X-Ray vs. Gamma

• An Iridium 192, 100 curie source, is the industry standard in the field, according to the Rad Pro Calculator this produces 50 Rem/hour at 1 meter distance, a COMET PXS 300Kv 900 Watt portable x-ray tube at 200Kv has 5,000 Rem/hour, almost 100 times more output than the gamma source. This means shorter exposure times.

• X-ray has a more defined focal spot which results in better images.