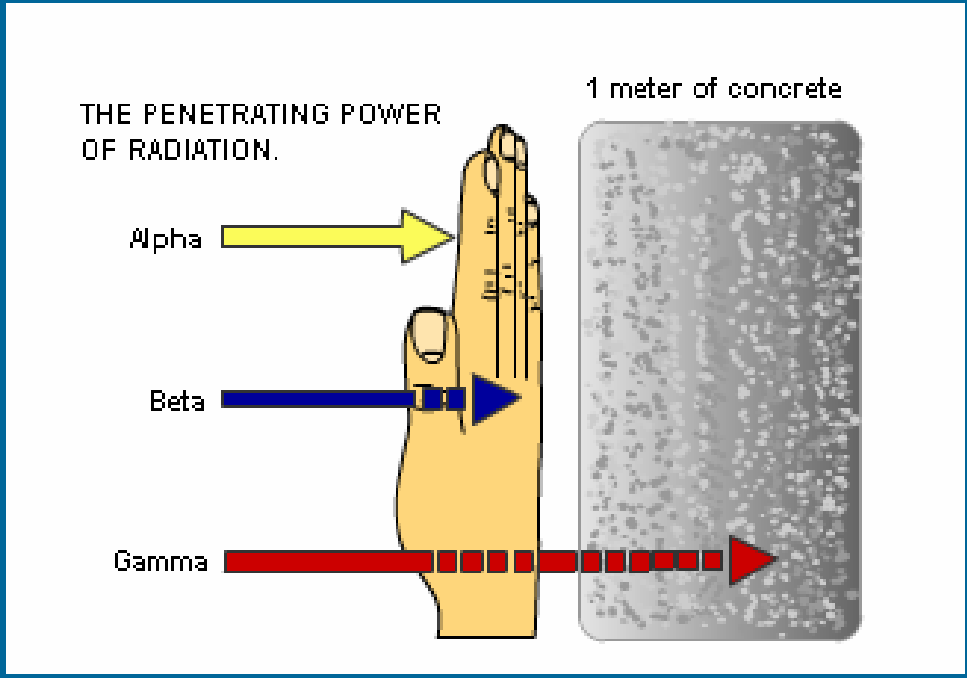
Radiografsko ispitivanje (RT)

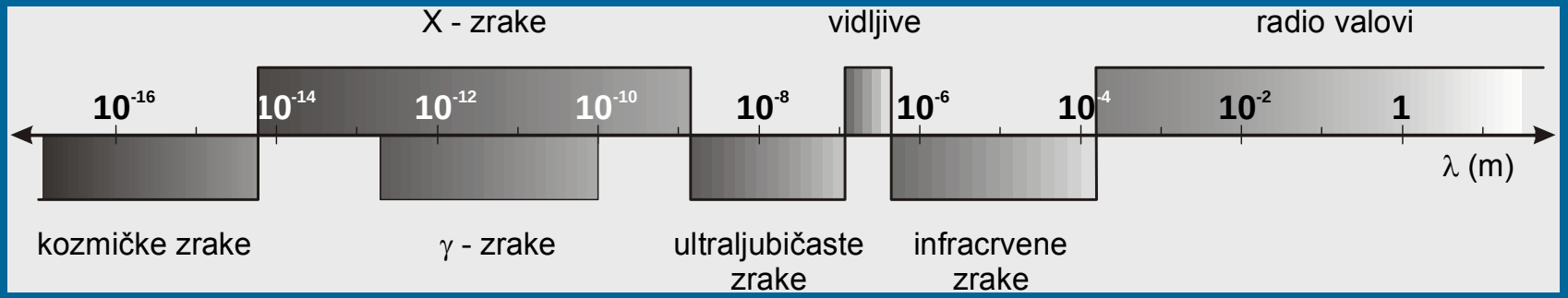
uvodno

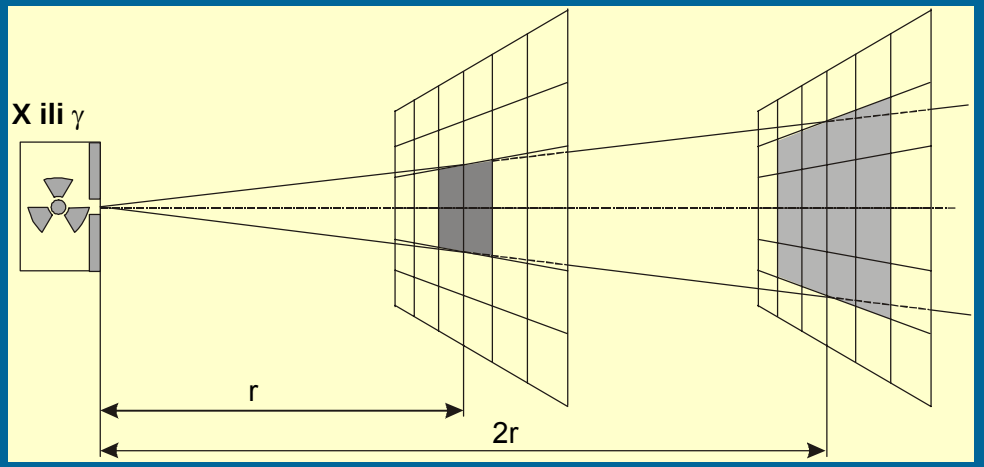
- metoda prolaskom zračenja (“prozračivanjem”),
- ionizirajuća zračenja ....
- čestična i elektromagnetski valovi ....
- X i γ zrake (zračenja) ....
- ... izvori zračenja
- film za industrijsku radiografiju



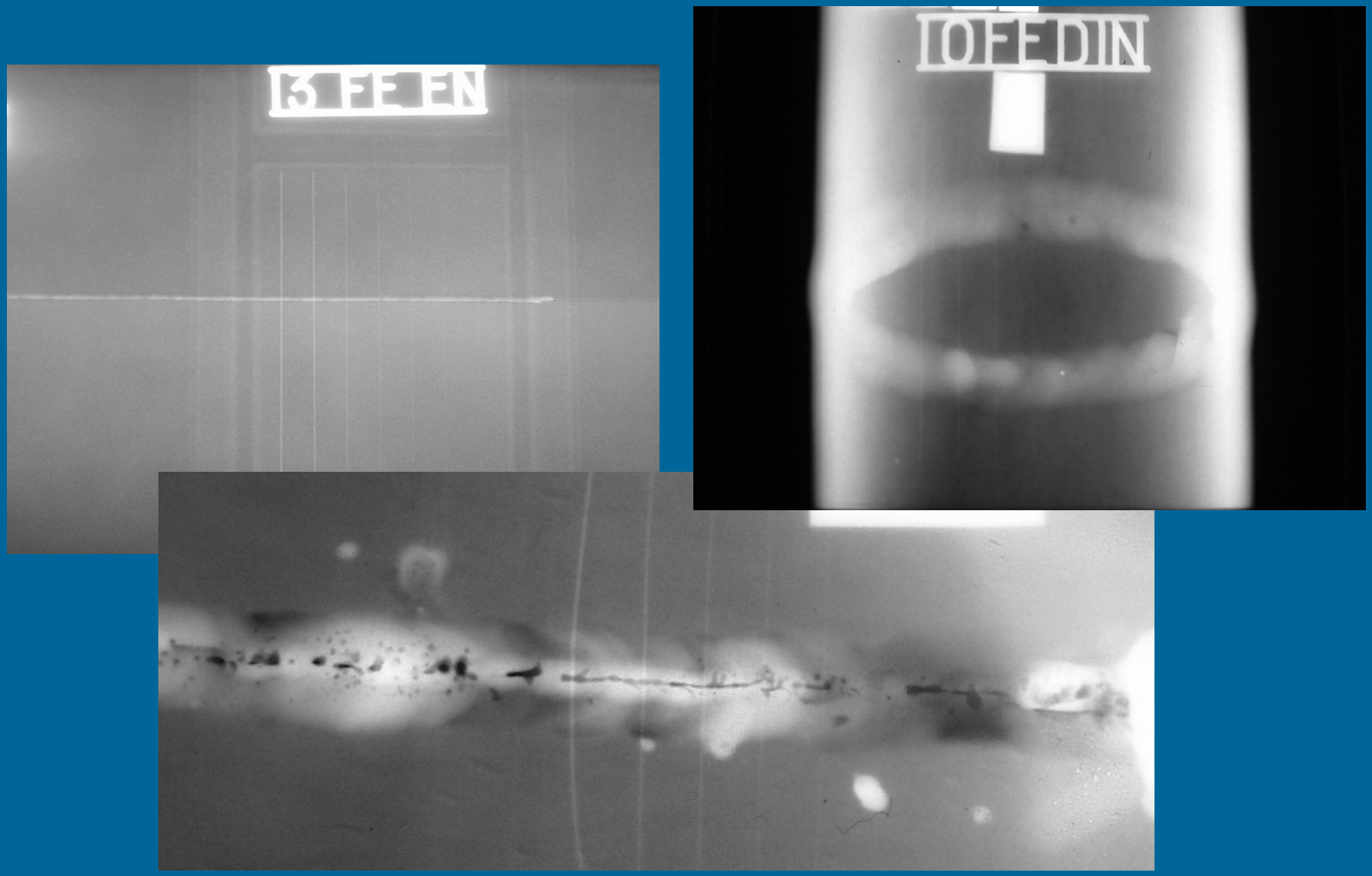
Radiografsko ispitivanje (RT)

X i γ zrake - elektromagnetski valovi, ionizirajuća zračenja....

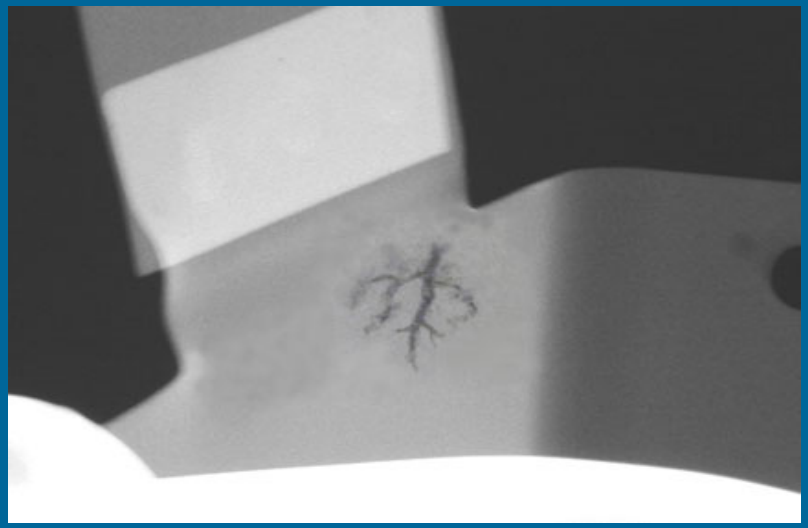


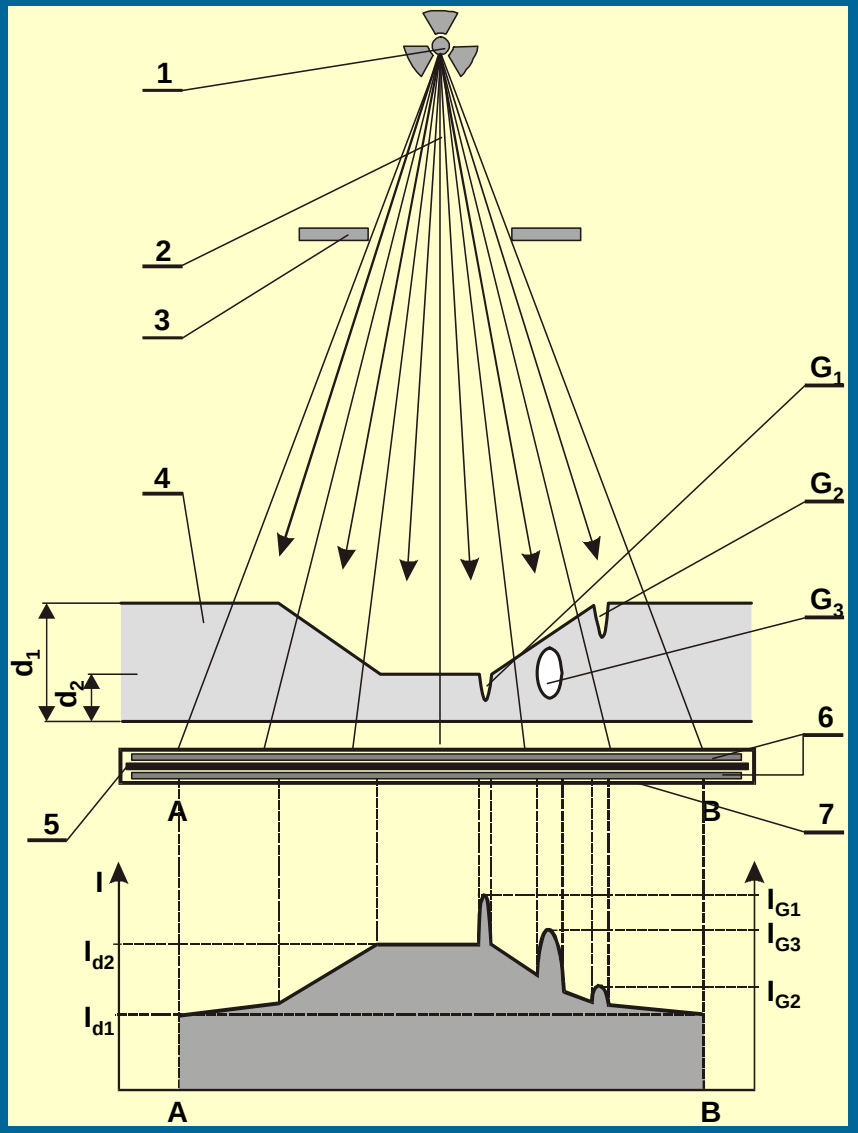


Radiografsko ispitivanje (RT) - primjena



Radiografsko ispitivanje (RT) - princip metode





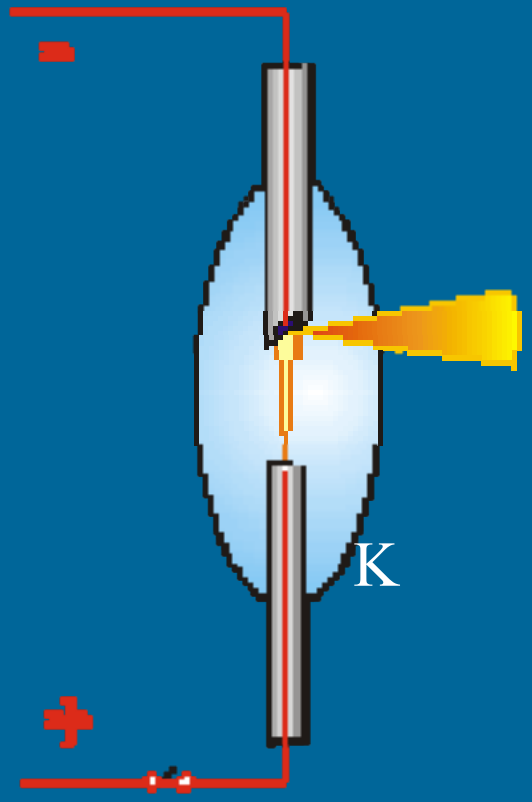
Radiografsko ispitivanje (RT)

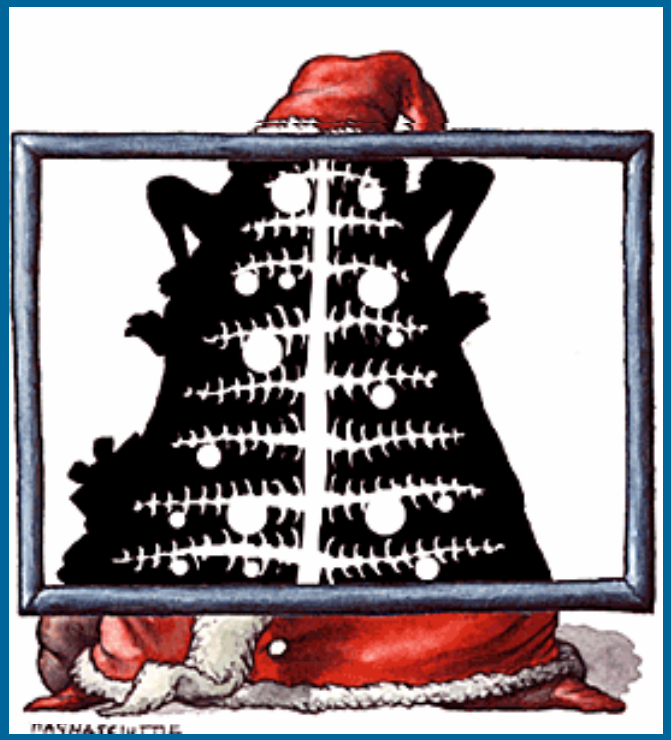
značajke

- izvori zračenja
  - potrebna je zaštita od ionizirajućih zračenja,
  - izotop - vrijeme poluraspada - nabava novog izvora
- uvjetno - vremenski odmak do rezultata ispitivanja,
- postoji (trajni) zapis kao rezultat ispitivanja (radiogram)
- topografska pripadnost – ***traceability*** – dodatne oznake na radiogramu

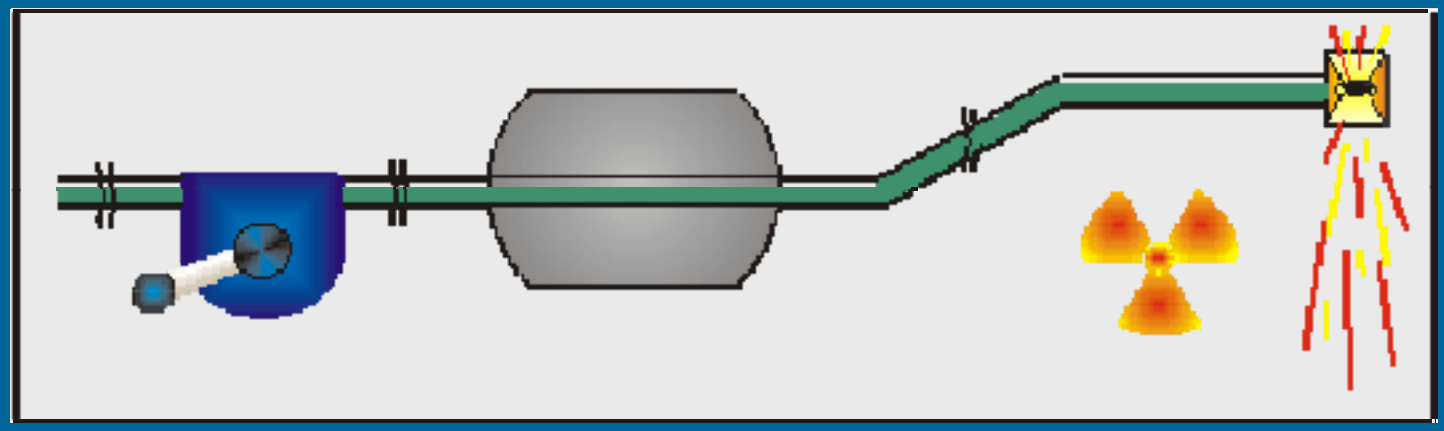
Radiografsko ispitivanje (RT)

Pomoću rendgen uređaja (X-zrake)
- rendgenografija i radioskopija (*real-time radiography*)





Radiografsko ispitivanje (RT) - gamagrafija



Radioaktivni izotopi koji se koriste kao izvori ionizirajućeg zračenja: kobalt (Co 60), iridij (Ir 192), u zadnje vrijeme i selen (Se 75).

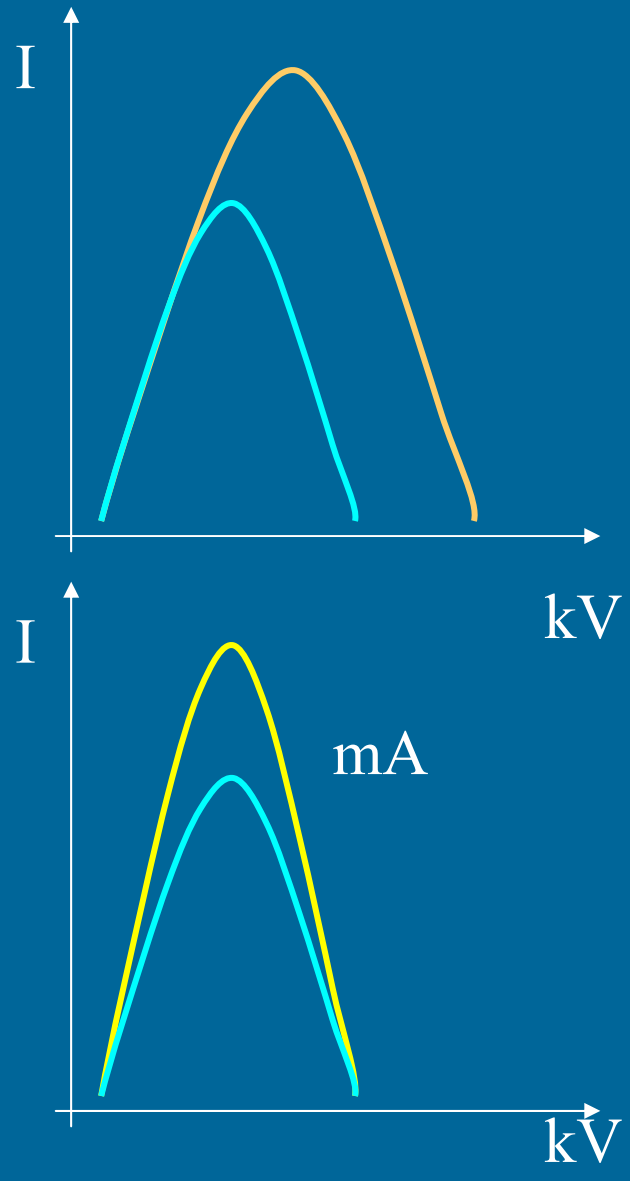
γ-zrake imaju veću prodornost od X-zraka te se u pravilu primjenjuju za prozračivanje većih debljina objekata (prema EN normama npr. za čelike preko 20 mm).

Radiografsko ispitivanje (RT) - radioizotopi

ISOTOPE DATA

Characteristic	Cobalt	Caesium	Iridium	Thulium
		** ELEMENT **		
Symbol	Co	Cs	Ir	Tm
Isotope	60	137	192	170
Chemical form	Co	CsCl	Ir	Tm2 O3
Half life	5.27 yrs	30.1 yrs	74.3 days	129 days
Density (g/cm^3)	8.9	3.5	22.4	4
Number of gamma quanta spectra lines	2	1	16	2
Gamma quanta energies of spectra lines (MeV)	1.33 1.17	0.661	0.885 0.785 0.613 0.604*	0.084 0.052
Half Value Layer (mm)				
Lead	12.5	6.4	6.3	--
Concrete	68.6	53.4	48.3	--
Equivalent kV in X-ray tubes (effective voltage)	1250	670	590	84

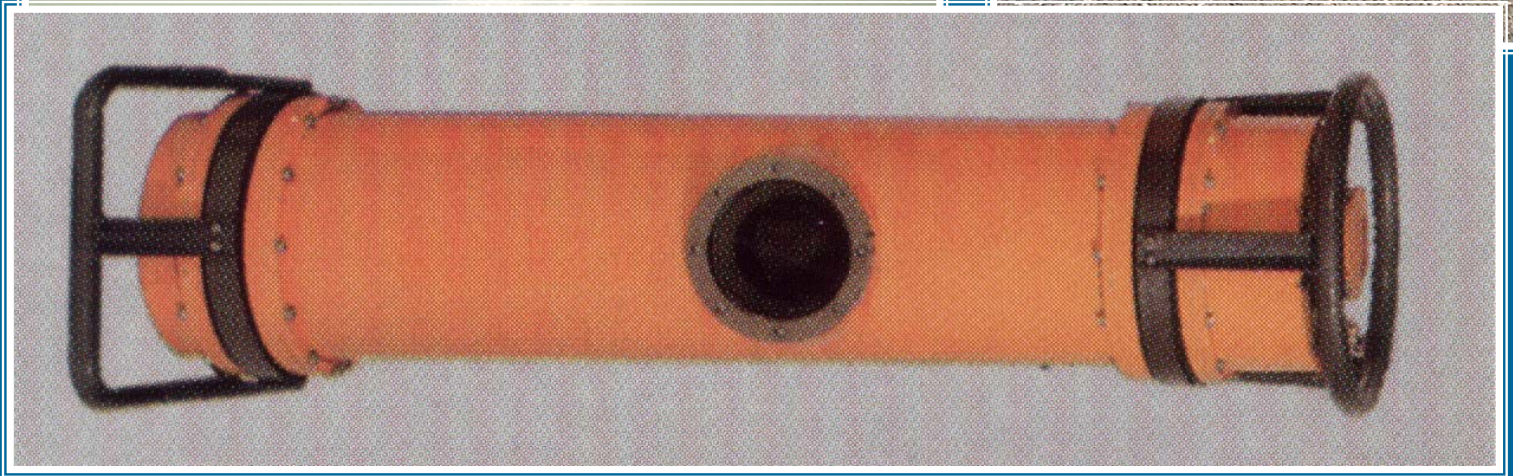
(RT) – Rendgen uređaji – energije zračenja



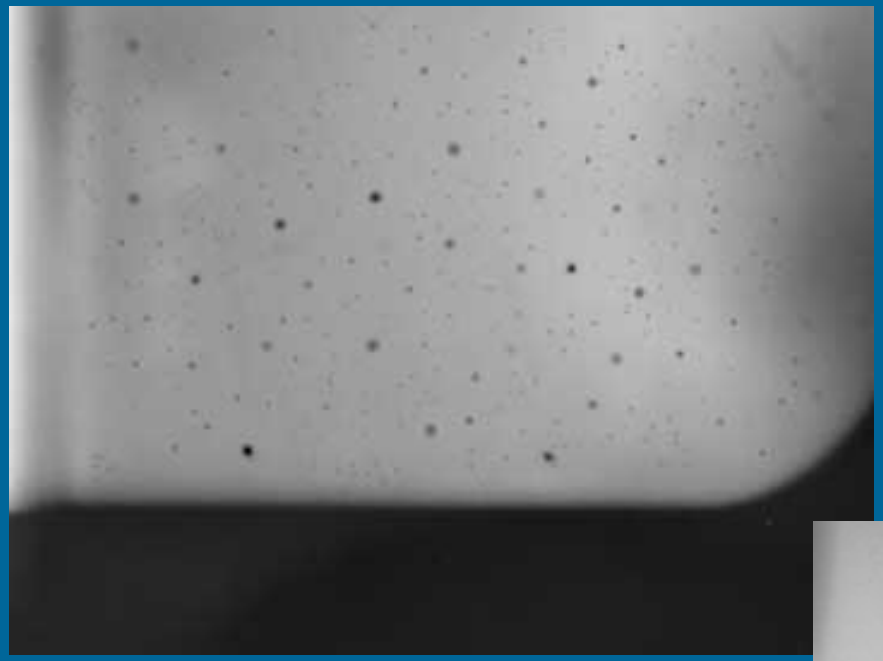
⇨ povećanje napona cijevi

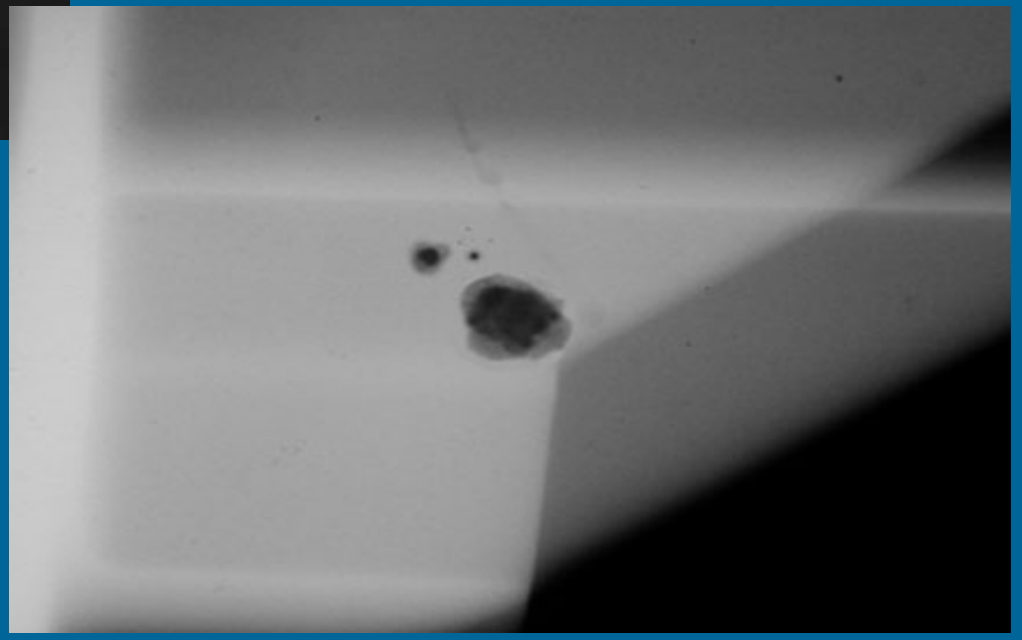
⇨ povećanje struje cijevi (žarne niti)

Radiografsko ispitivanje (RT) - oprema

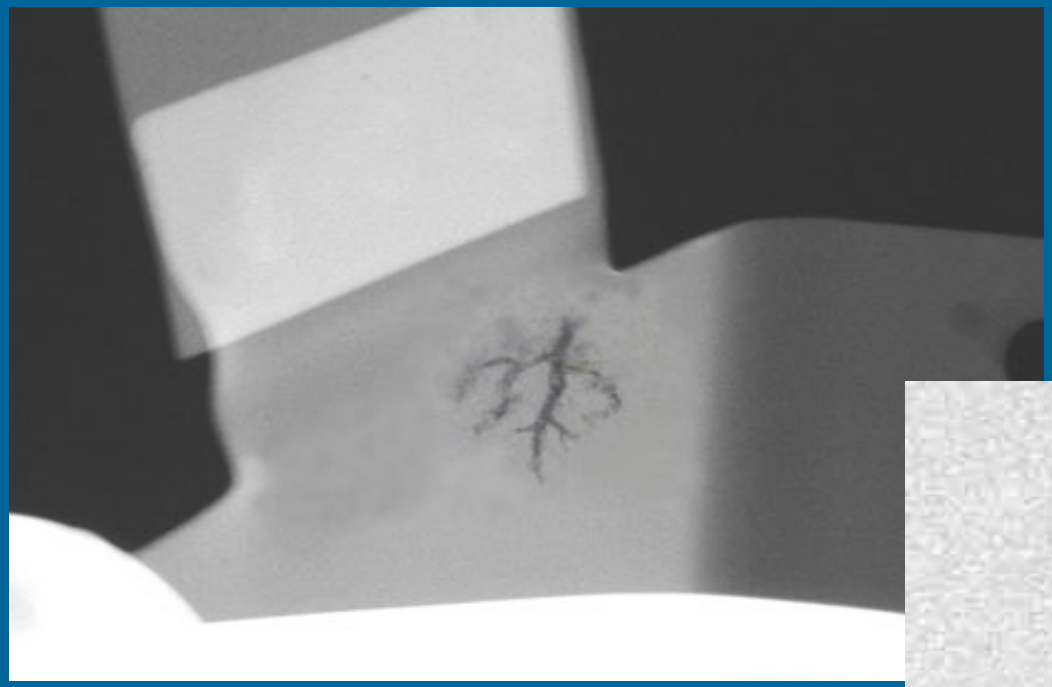


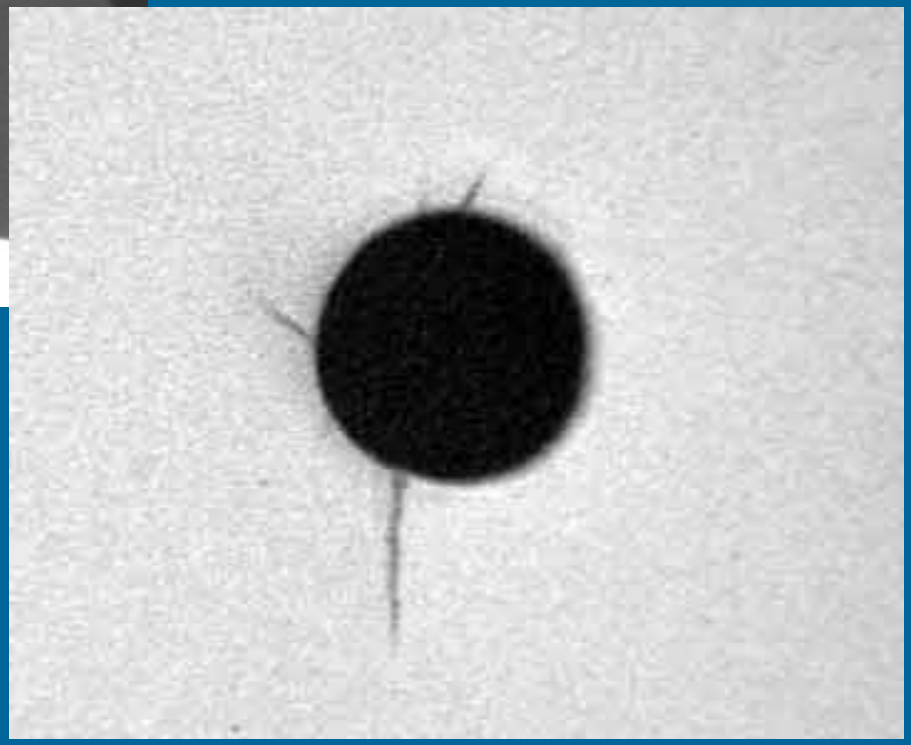
Radiografsko ispitivanje (RT) - radiogrami





Radiografsko ispitivanje (RT) - radiogrami



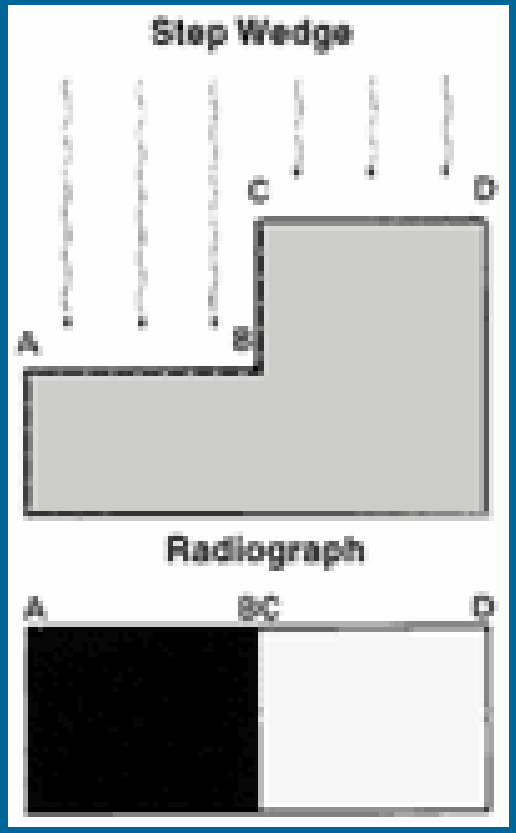


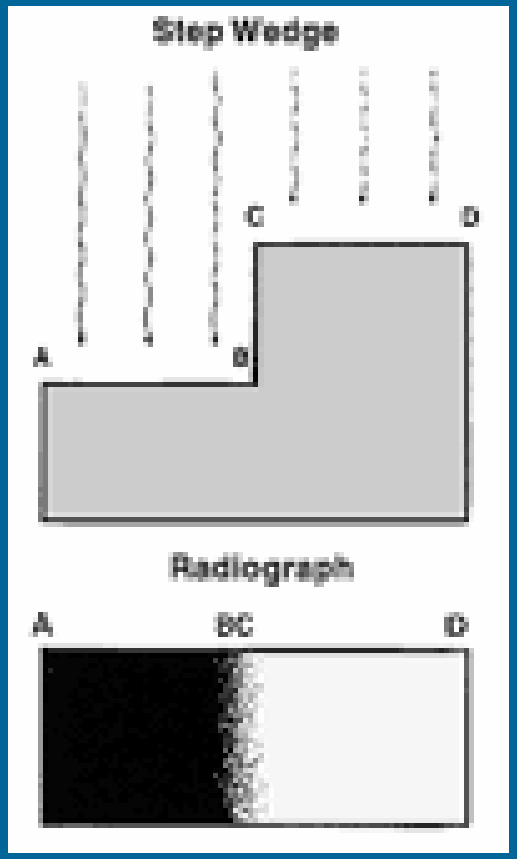
Radiografsko ispitivanje (RT) - parametri

- X-zrake daju kvalitetnije radiograme od γ-zraka "prodornost"
- prema zahtjevima EN normi RT se primjenjuje za debljine čelika do ≈ 40mm.
- energija zračenja keV – kV
  (napon na cijevi rendgen uređaja 100 – 400 kV)
- kod rendgen uređaja - struja 3 – 5 mA ....
- udaljenost
- veličina izvora – veličina fokusa

Radiografsko ispitivanje (RT)

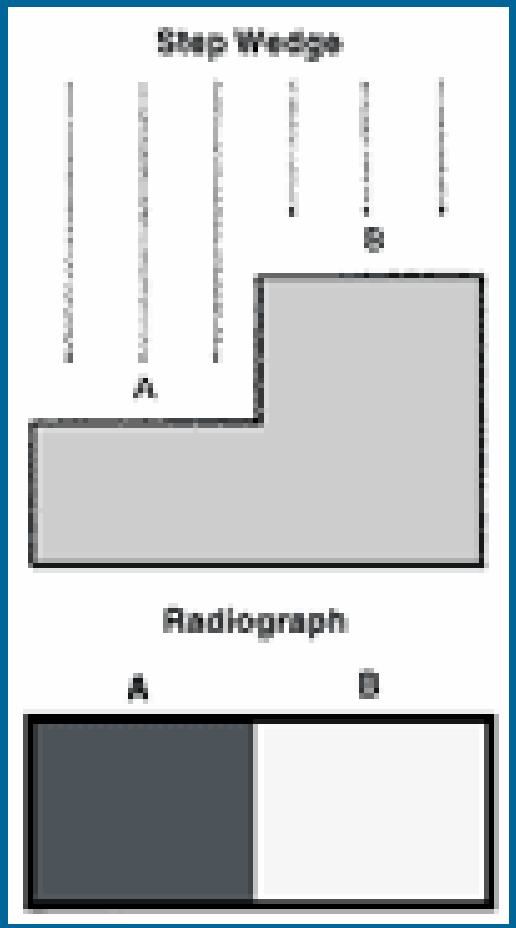
oštrina - *definition*

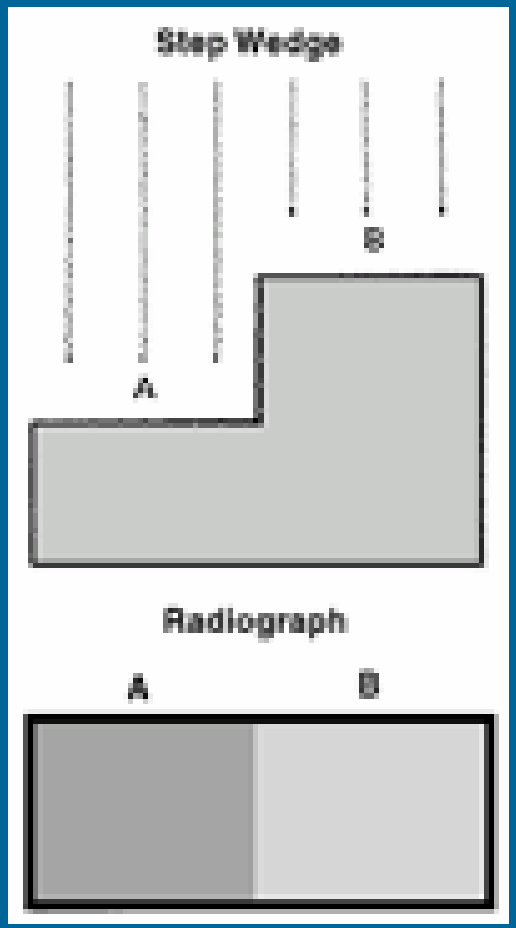




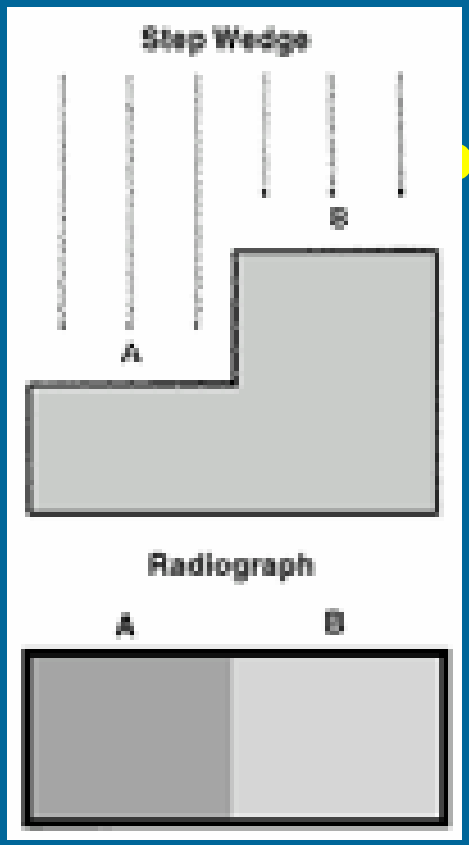
Radiografsko ispitivanje (RT)

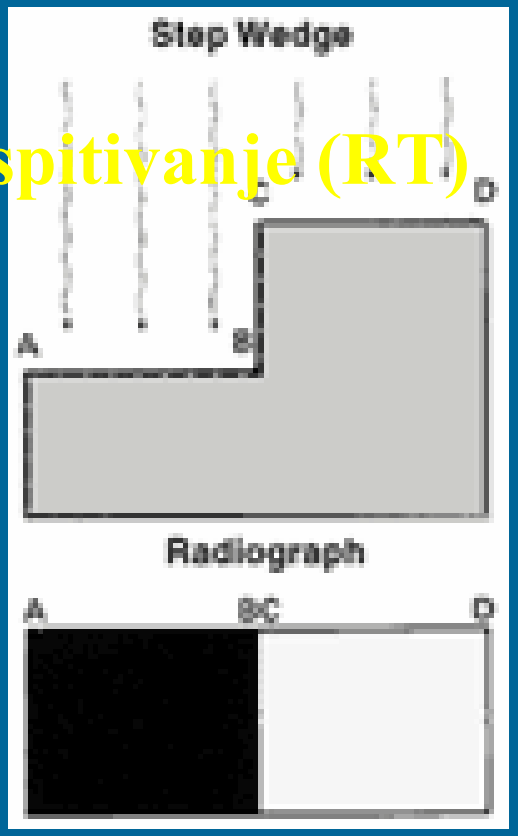
kontrast - *contrast*

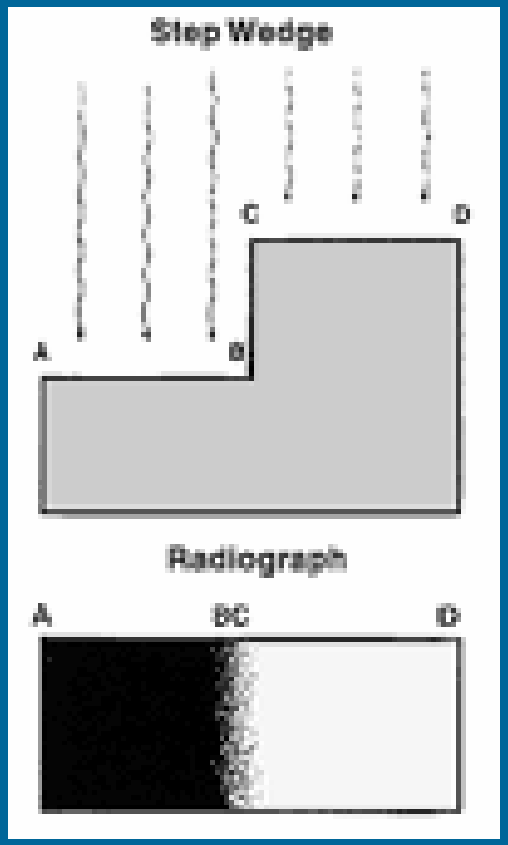


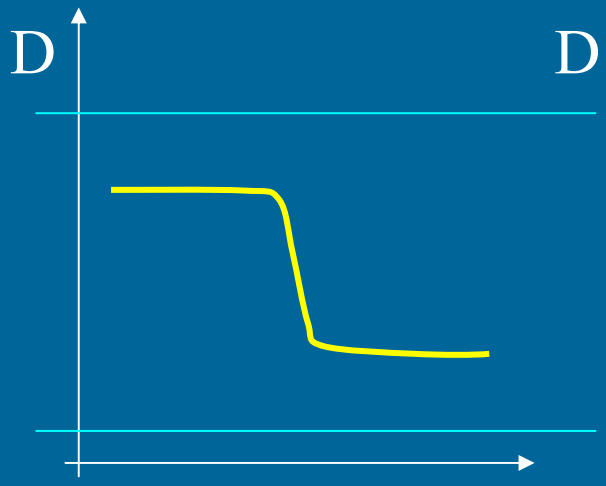


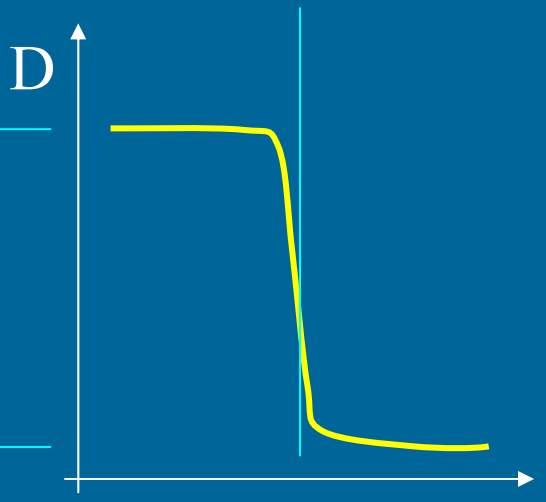
o ispitivanje (RT)

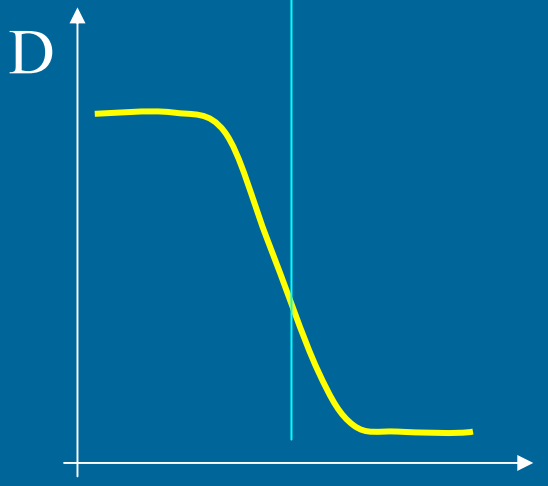








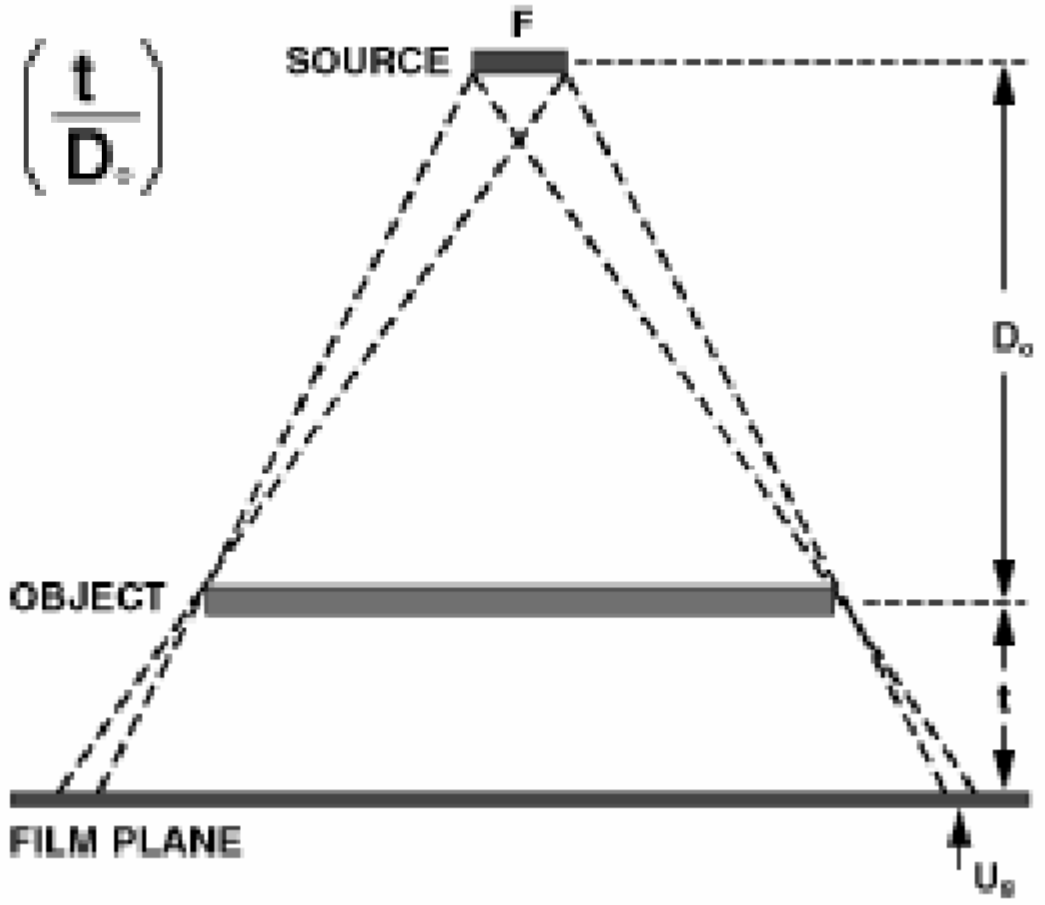




Radiografsko ispitivanje (RT) – (ne)oštrina

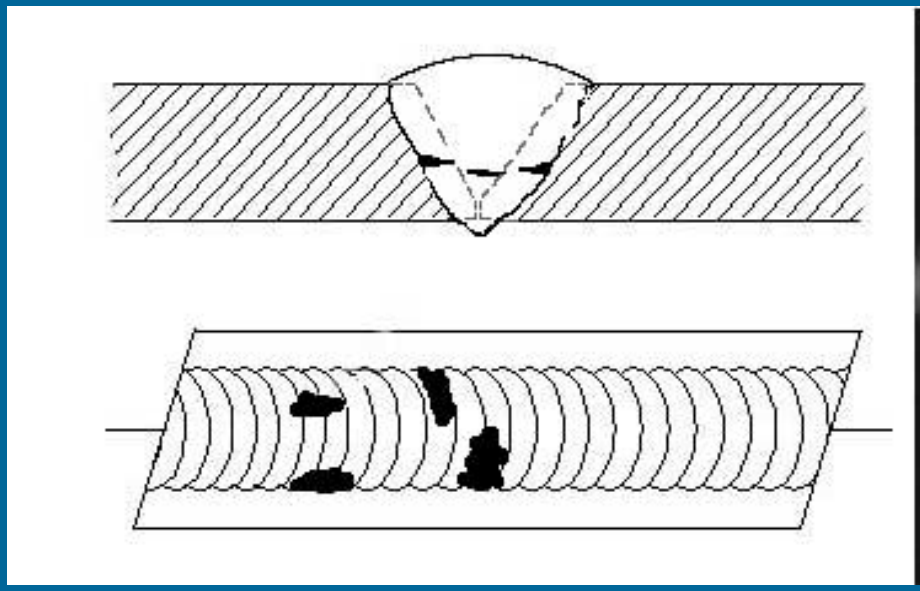
$$\frac{U_g}{F} = \frac{t}{D_o} \quad \text{or} \quad U_g = F\left(\frac{t}{D_o}\right)$$

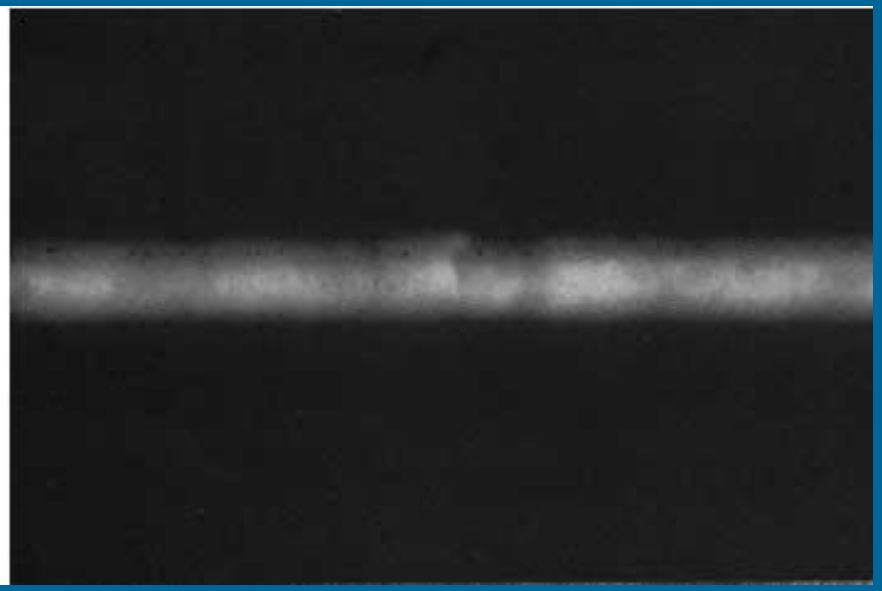
geometrijska neoštrina



Radiografsko ispitivanje (RT) - radiogrami

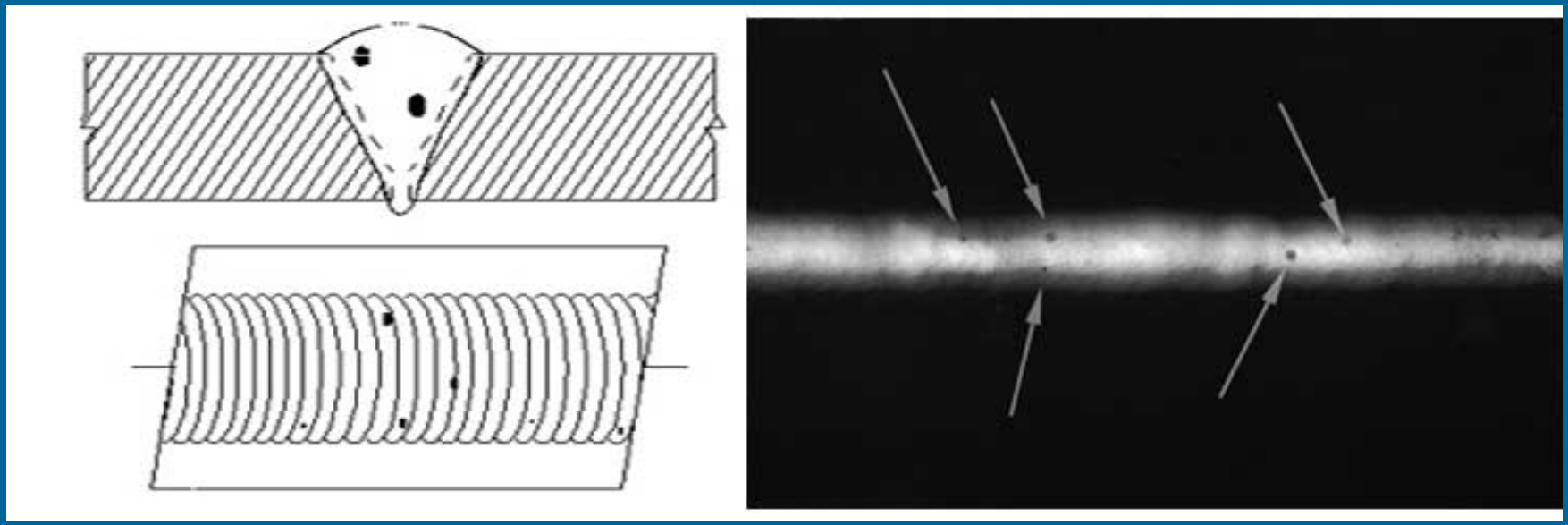
Naljepljivanje – *cold lap*





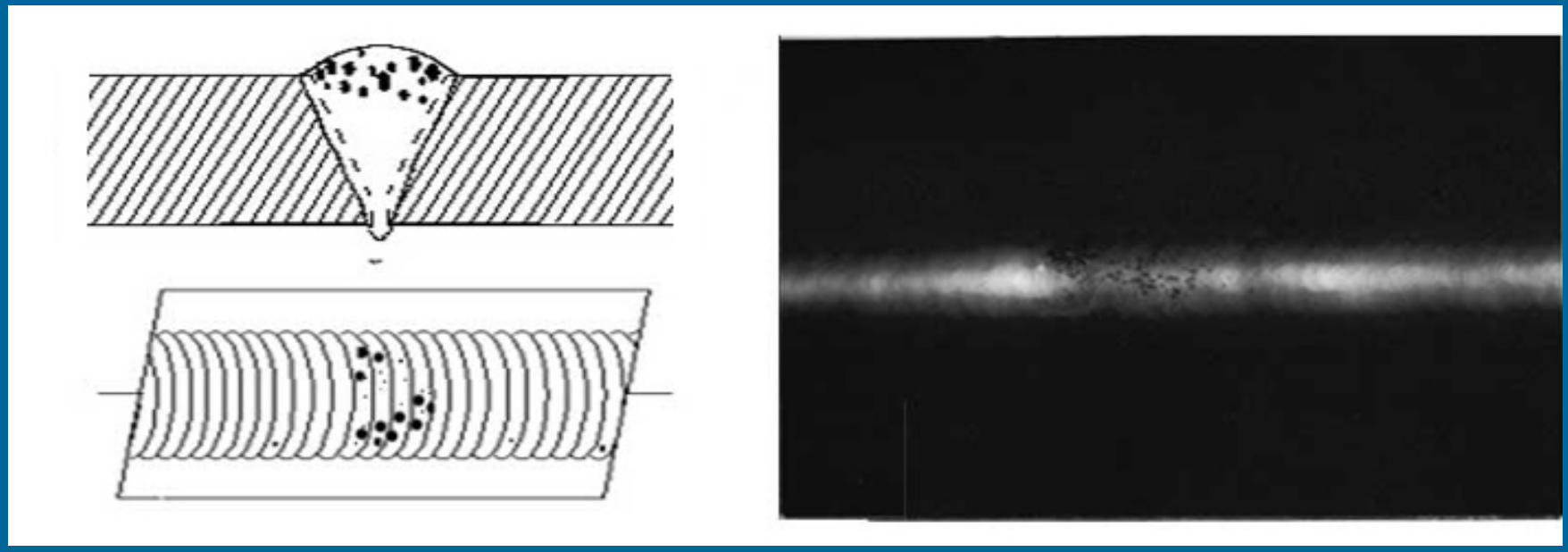
Radiografsko ispitivanje (RT) - radiogrami

Poroznosti - *porosity*



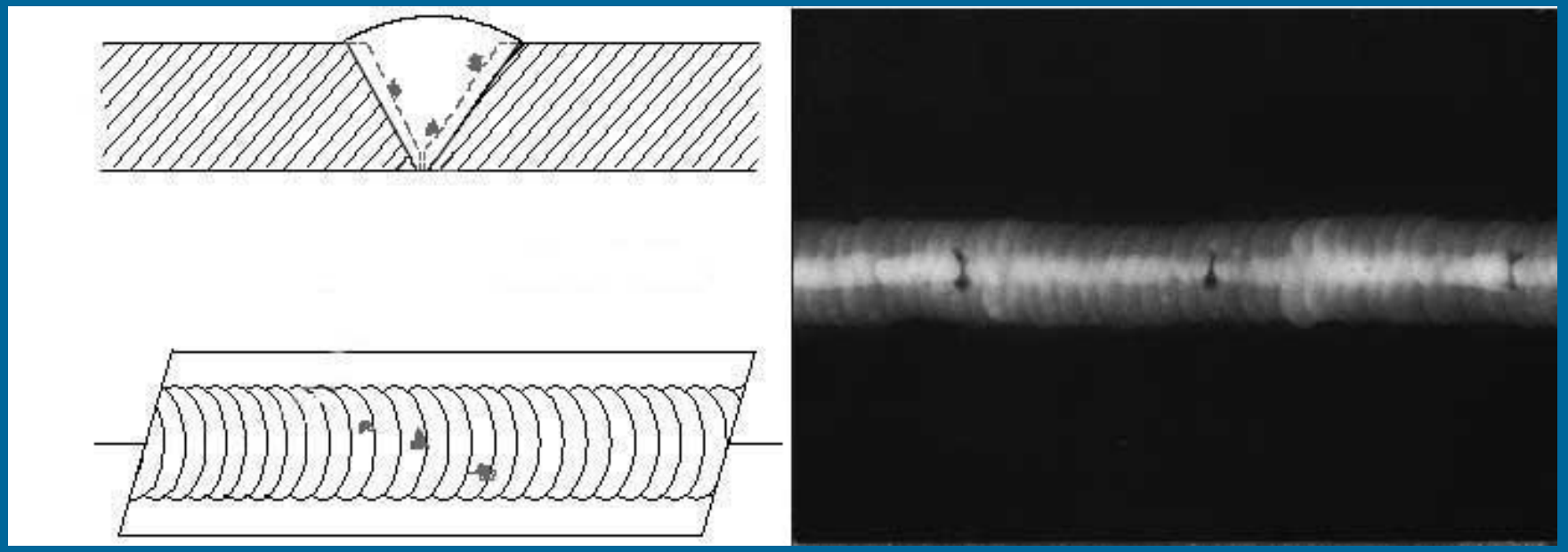
Radiografsko ispitivanje (RT) - radiogrami

Gnijezda pora – *cluster porosity*



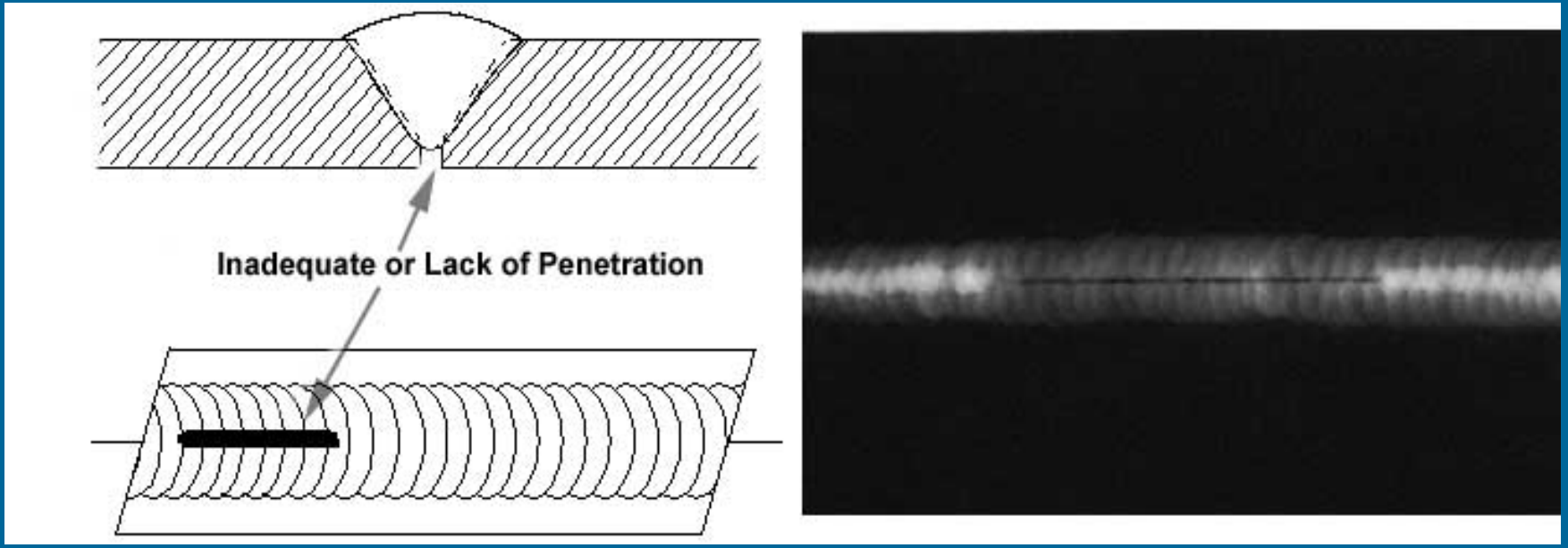
Radiografsko ispitivanje (RT) - radiogrami

Uključci troske - *slag inclusions*



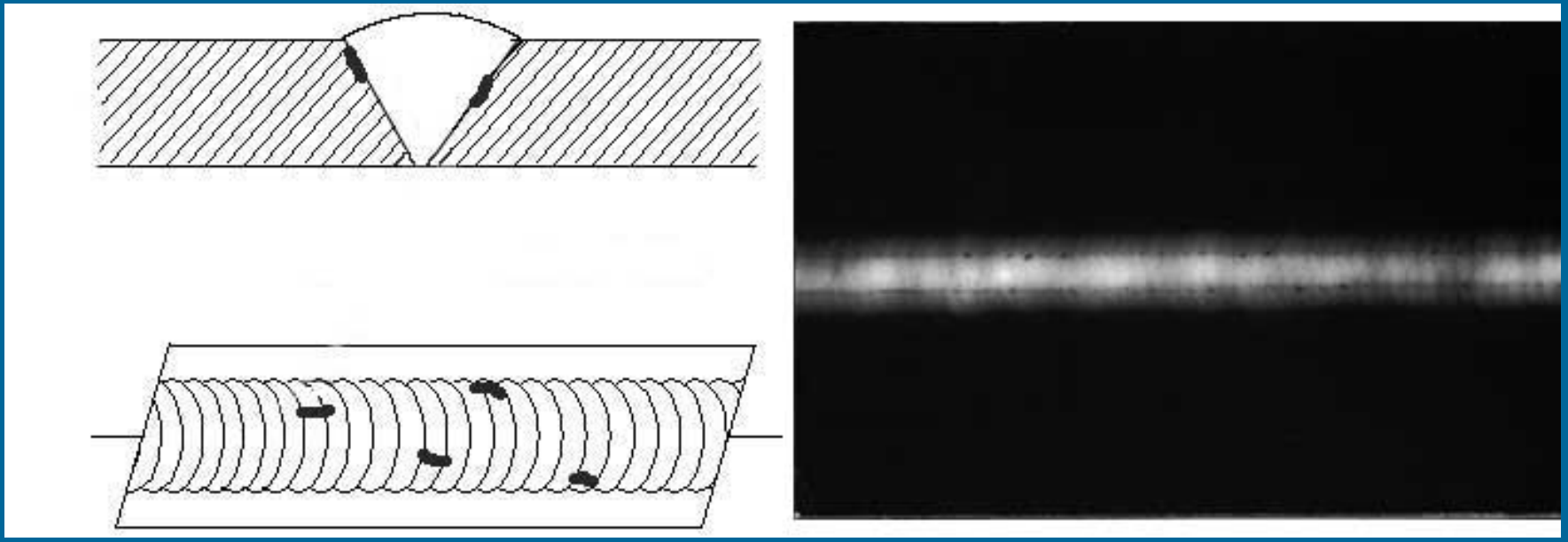
Radiografsko ispitivanje (RT) - radiogrami

Nedovoljna penetracija meterijala
incomplete penetration, IP; *lack of penetration*, LOP



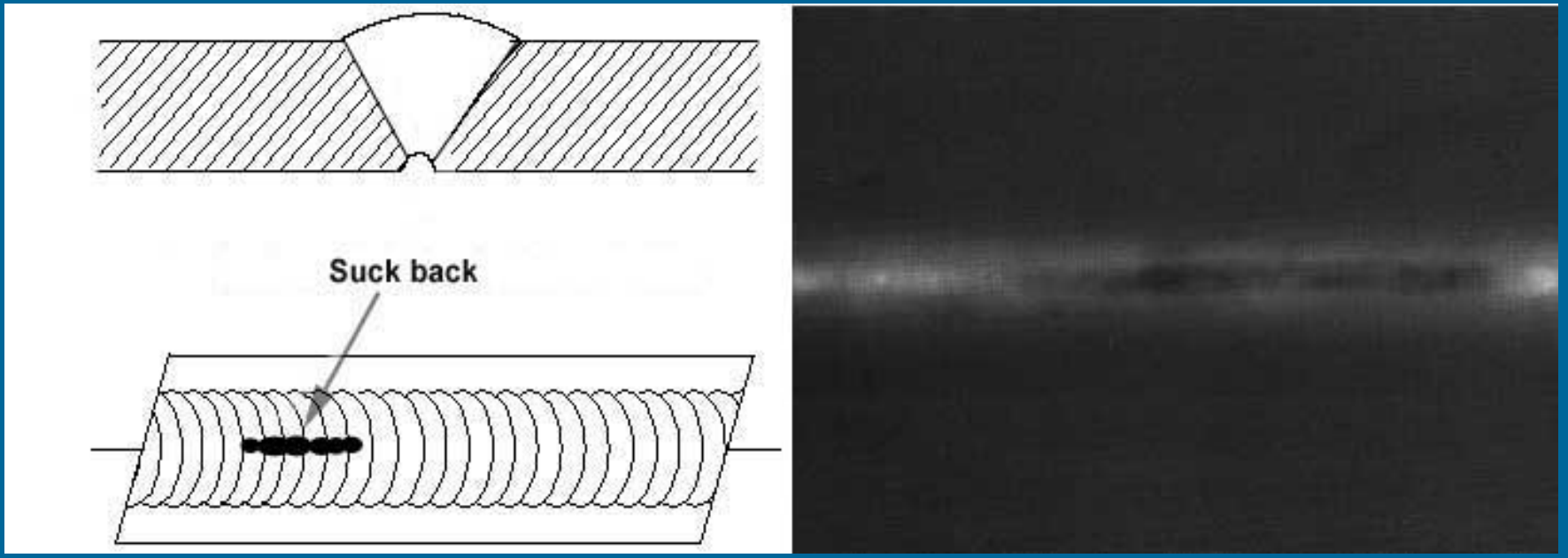
Radiografsko ispitivanje (RT) - radiogrami

Nepotpuno protaljivanje - *incomplete fusion*



Radiografsko ispitivanje (RT) - radiogrami

Uvlačenje - *internal concavity, suck back*



Radiografsko ispitivanje (RT) - radiogrami

Uključine volframa - *tungsten inclusions*