

DR & μ F *in* Aeronautics

N. POELST – September 2017





*The combination of
Digital Radiography flat panels (DR) with
micro-focus portable Xray generators (μF)
offer **oustanding solutions**
in **aircraft maintenance***



Fast review of the *state of the art*



RT

- (+) Easy interpretation (« objects become transparent »)**
- (+) Precision (« anomalies » can be seen located at < 100 mm)**
- (+) Wide area inspection (= film or detector size)**

- (-) Difficult settings (kV, mA, ...)**
- (-) Difficult positioning**
- (-) Ionizing radiations**

- (-) Chemicals**
- (-) Film development (→ delays)**



RT with DR flat panels

(+) Easy interpretation (« objects become transparent »)

(+) Precision (« anomalies » can be seen and located at 0.1 mm)

(+) Wide area inspection (= film or detector size)

(-) Difficult settings (kV, mA, ...)

(-) Difficult positioning

(-) Ionizing radiations

(-) Chemicals

→ no more chemicals

(-) Film development (→ delays)

→ CR → DR immediate result



RT with DR flat panels

(++) Digital : higher image quality and easier interpretation

(+) Precision (« anomalies » can be seen and located at 0.1 mm)

(+) Wide area inspection (= detector size)

(-) Difficult settings (kV, mA, ...)

(--) Not a flexible support

(-) Ionizing radiations

(-) Chemicals

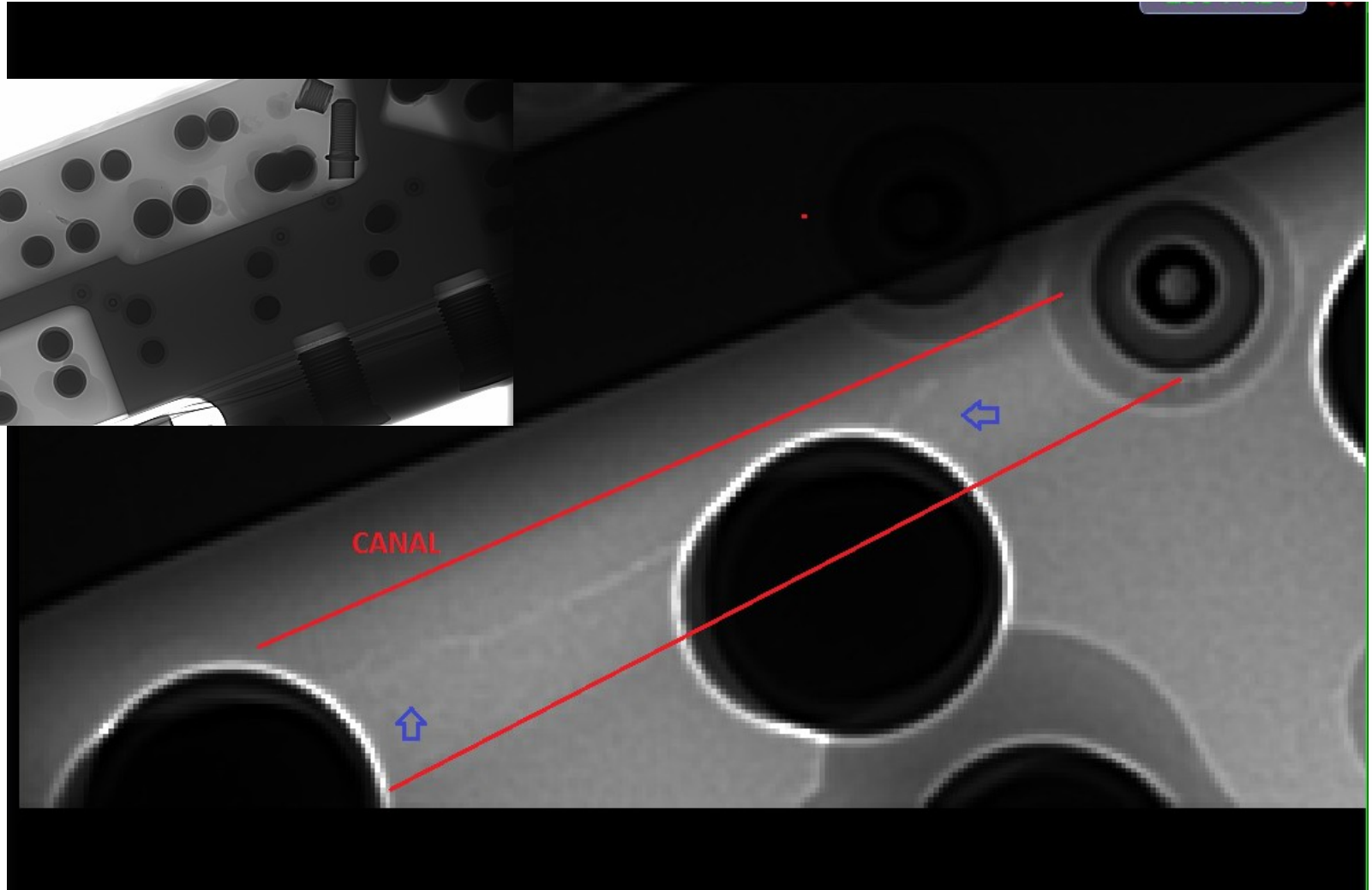
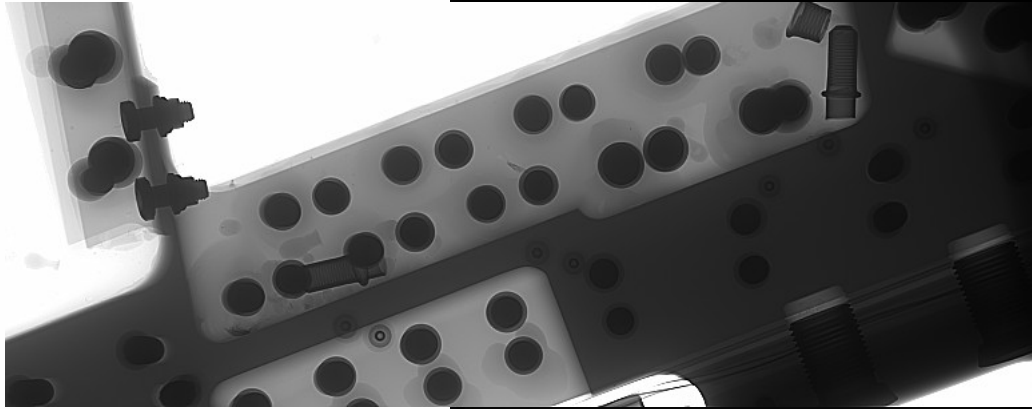
→ no more chemicals

(-) Film development (→ delays)

→ CR → DR immediate result

Case study 1 : F-16 maintenance

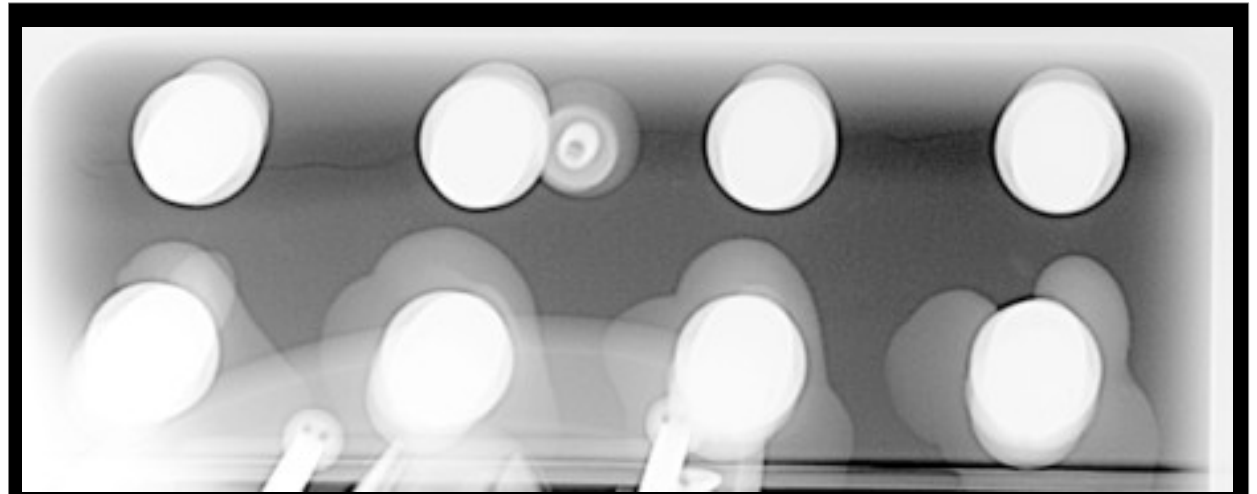




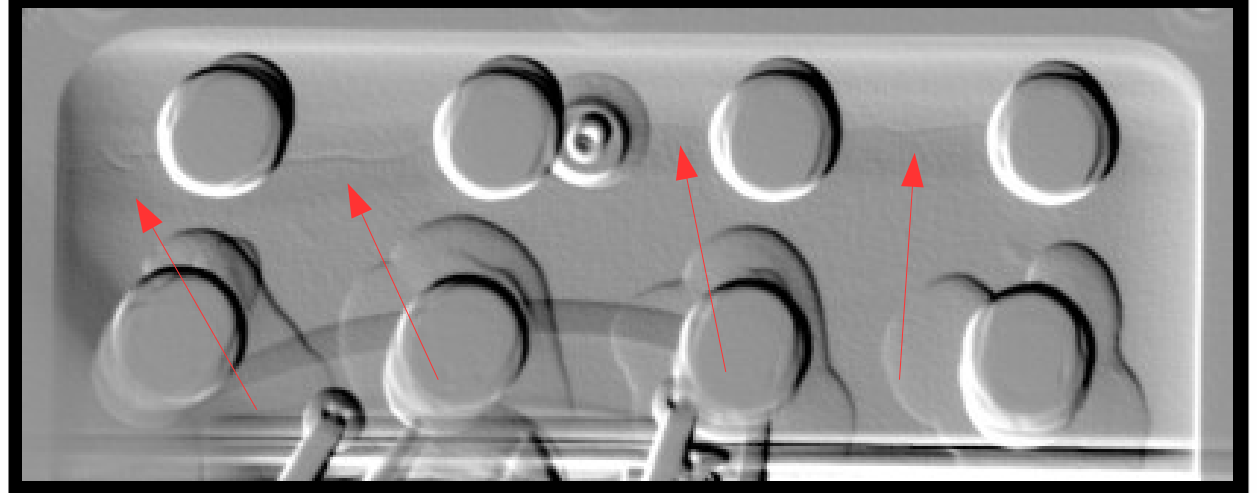
Cracks in the injection channel



**Crack in the injection channel
(2nd airplane)**

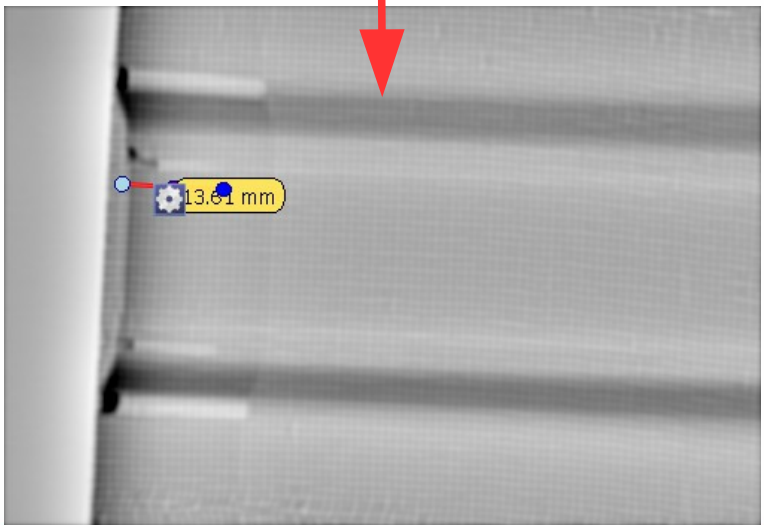
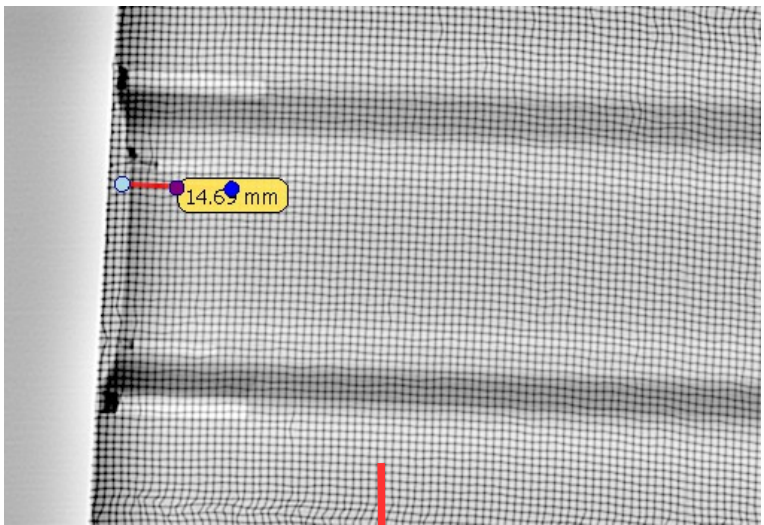


With embossing filter

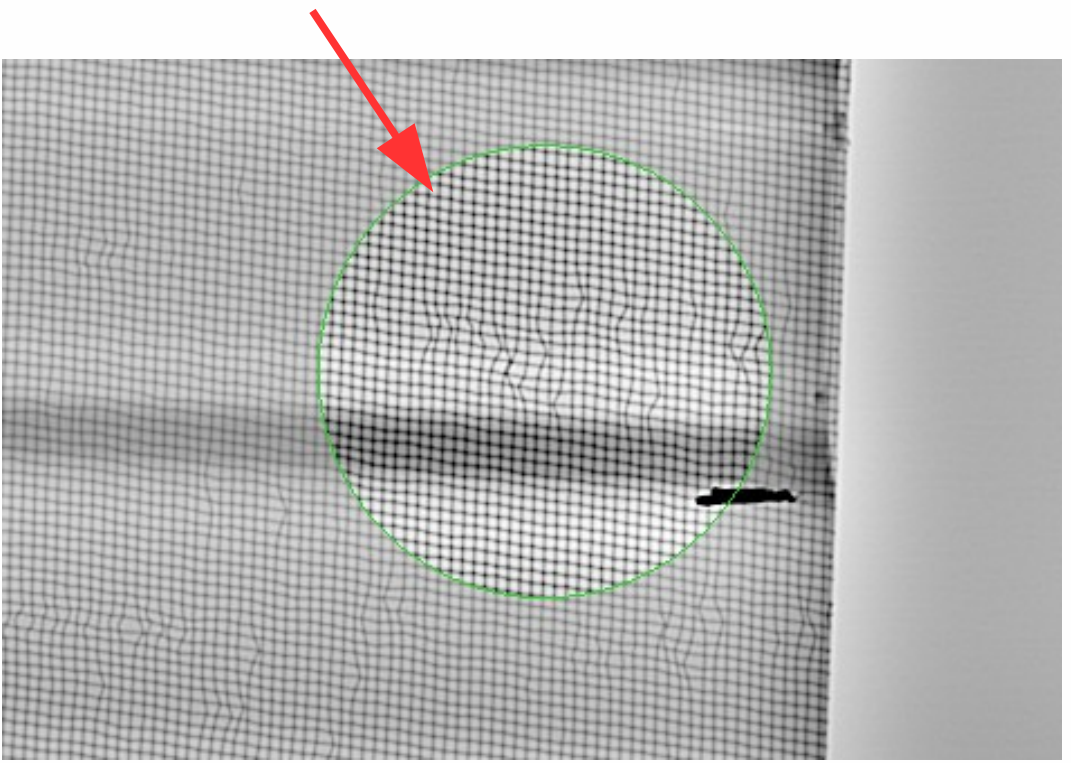




Case study 2 : Structure analysis



Filters - magnifier





Innovation : *Portable Real Time DR*



X·RiS

X-RAY IMAGING SOLUTIONS





RT with *real time* DR flat panels

- (++) Digital : higher image quality and easier interpretation
- (+) Precision (« anomalies » can be seen and located at 0.1 μm)
- (+) Wide area inspection (= detector size)
- (+) Immediate result

- (+) Easy radiological parameter settings (kV, mA, ...)

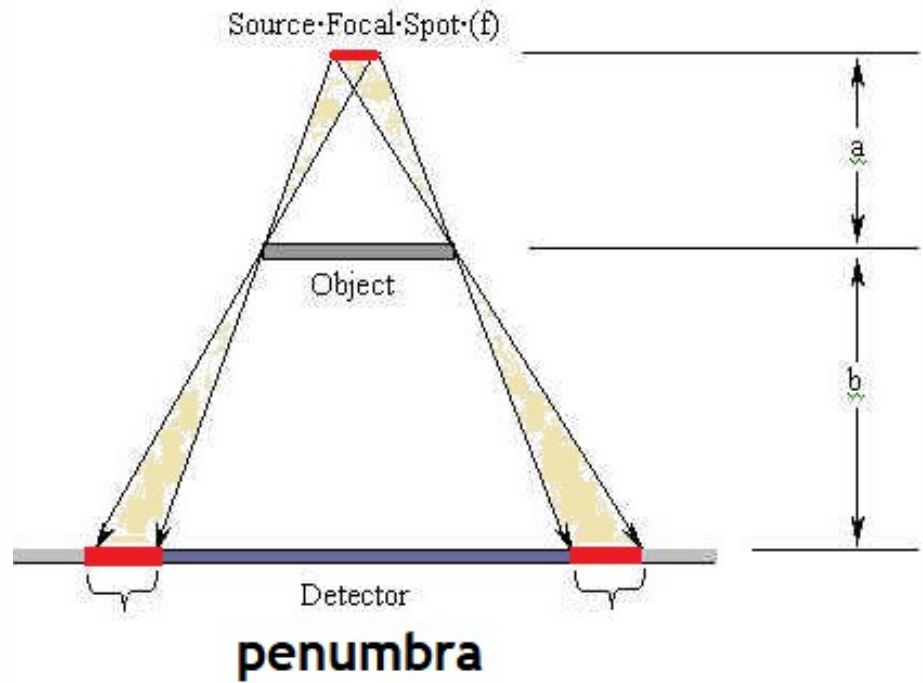
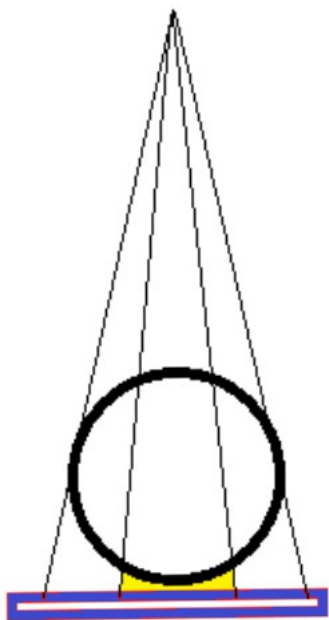
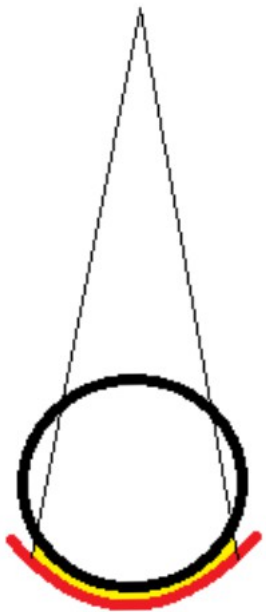
- (--) Not a flexible support
- (-) Ionizing radiations



Issue of no-flexibility



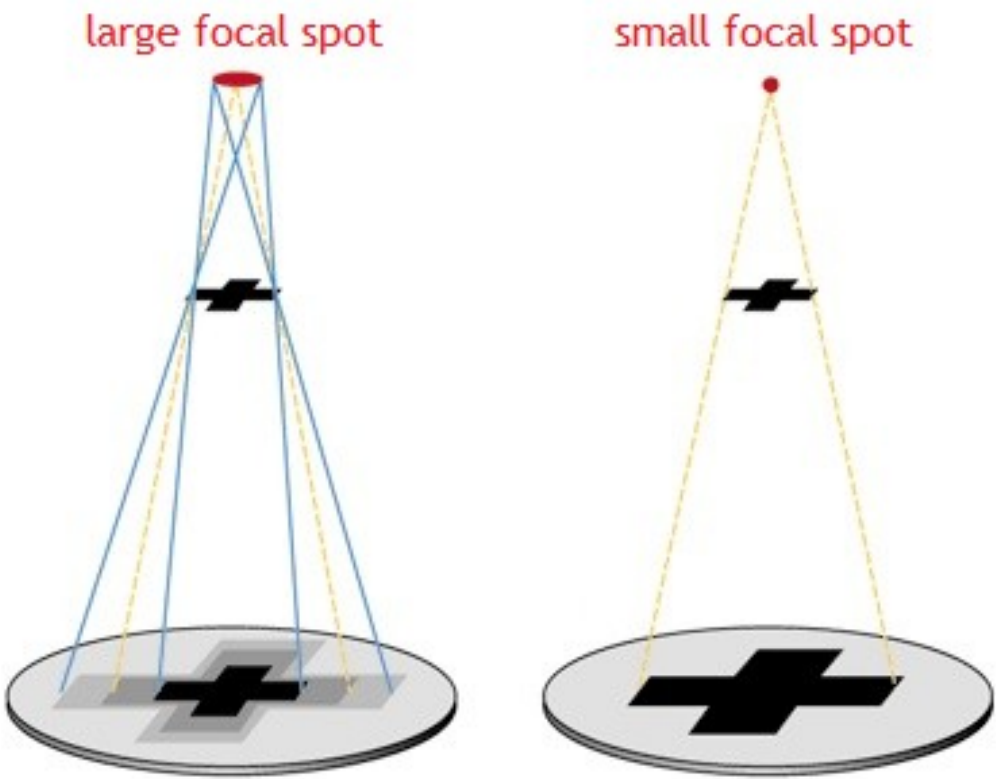
Why is the lack of *flexibility an issue* ?



→ Film/detector has to stick to the part to avoid penumbra / blurring



Why is the lack of *flexibility an issue* ?

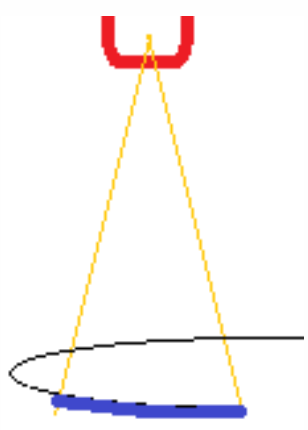




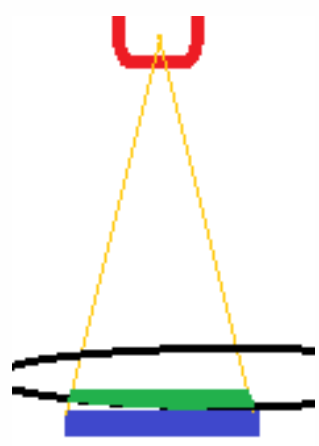
RT restriction due to focal spot size

With a FOD of 30 inches and a target resolution of 100 μm
The distance between the area to inspect and the detector has to be :

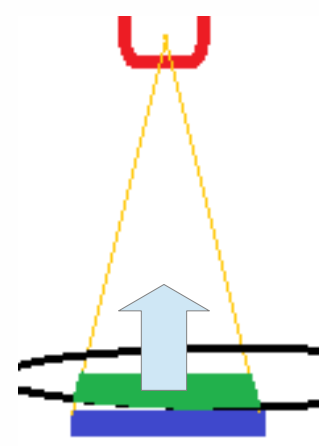
Focal spot :	3 mm	1 mm	0.5 mm
Max dist. :	1 inch	< 3 inch	< 6 inches



Only film !



DR is ok



analysis in
depth

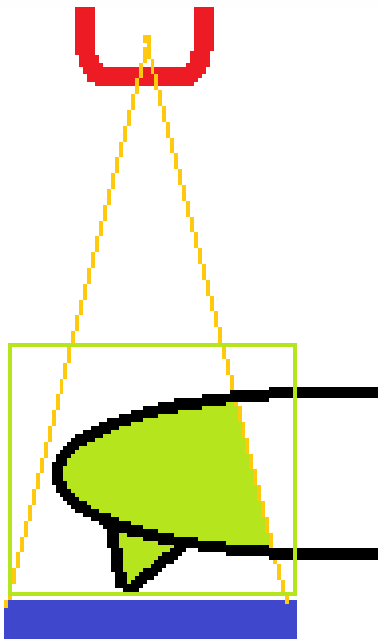


And if focal spot is even smaller ?



Focal spot size of 200 μm

Analysis is **not** restricted to surface
Analysis can be done on a ***whole volume*** !



With a focal spot of 200 μm and a DR of 200 μm
The ***whole area between $D/2$ and D can be checked*** !
! That is impossible with current portable generators !

Spatial resolution is increased (see below)

- ***small focal spot is helpful to avoid blurring***
- ***μ focus opens the gate to RT inspect in volume***

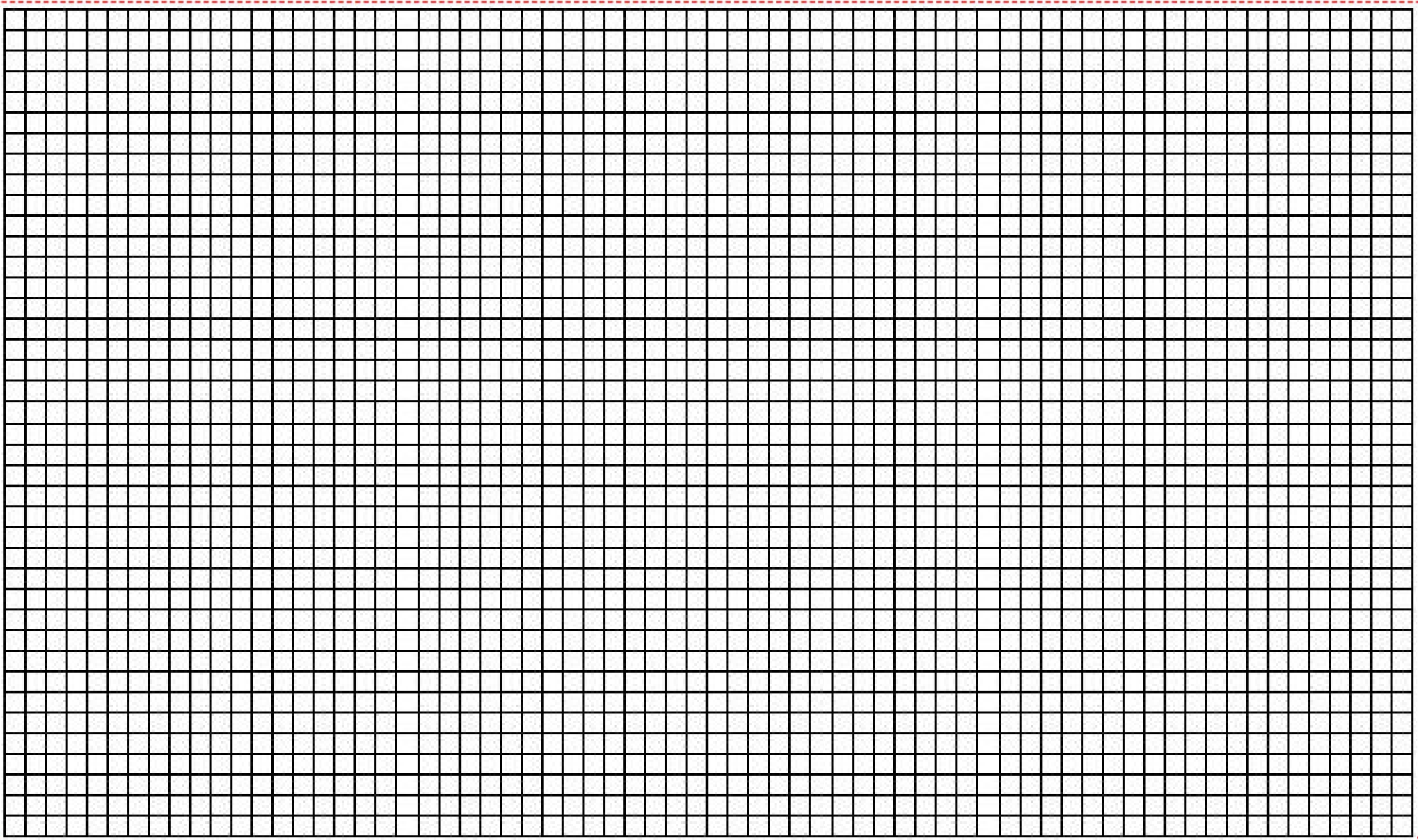


*Innovation : magnification
with a μ -focus*



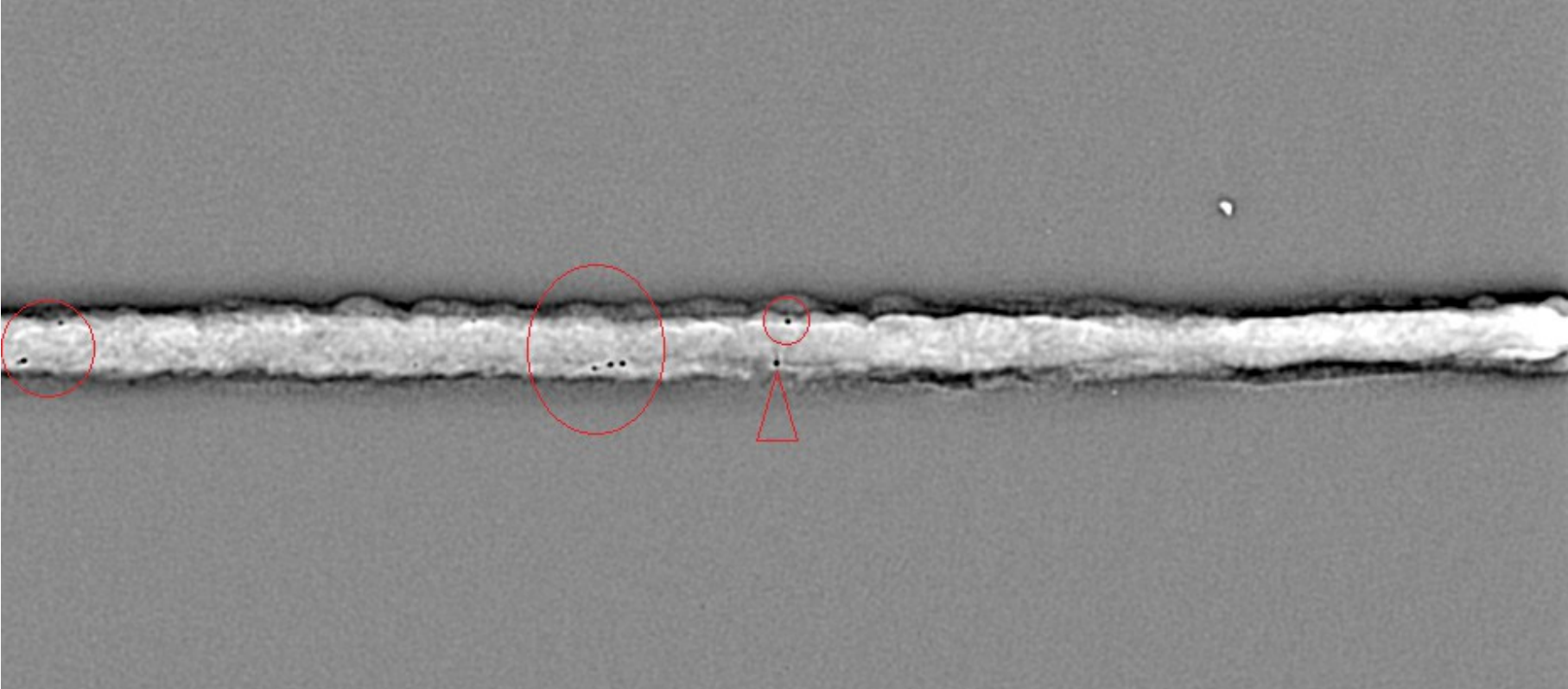
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X-RAY IMAGING SOLUTIONS

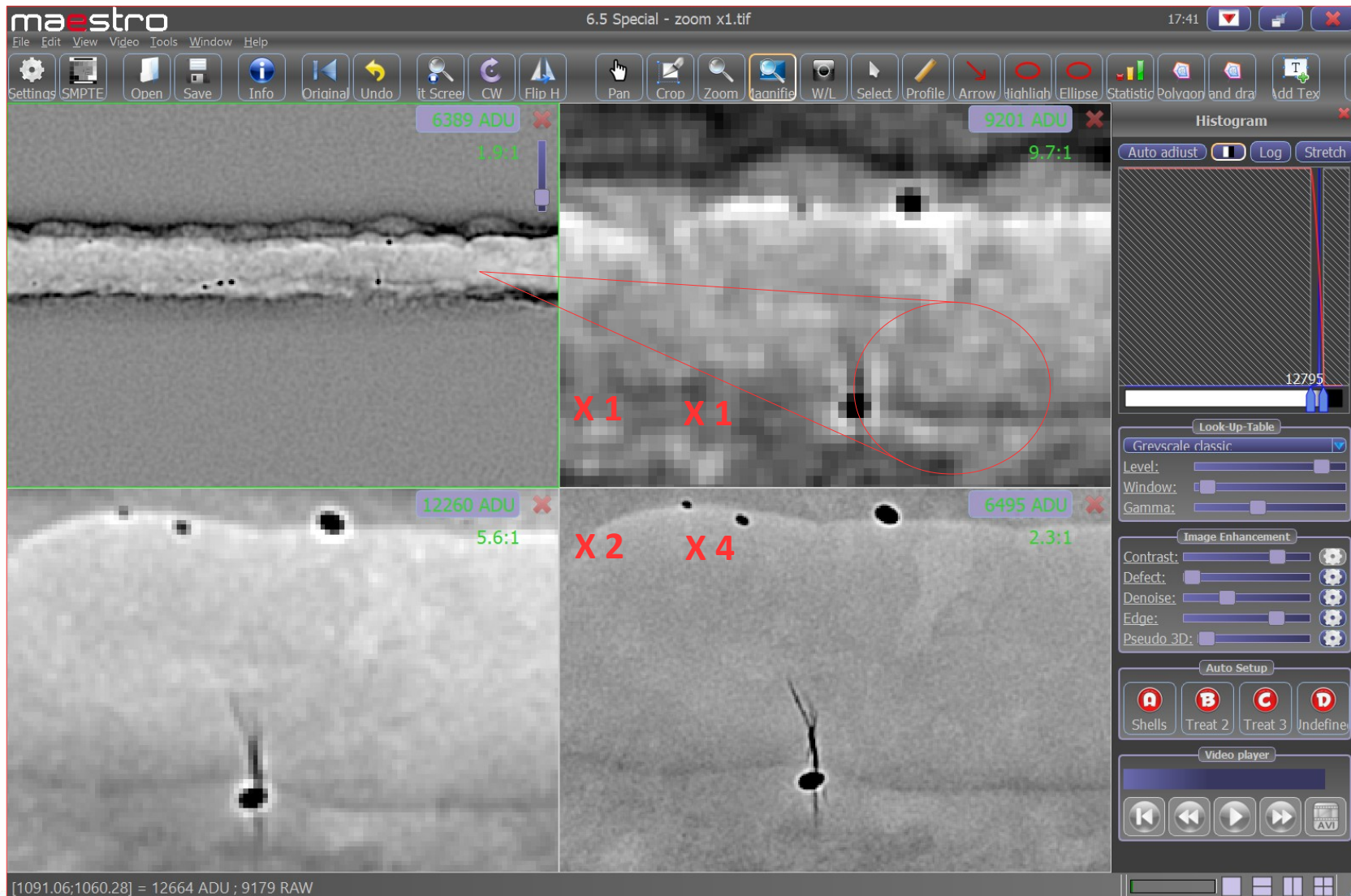


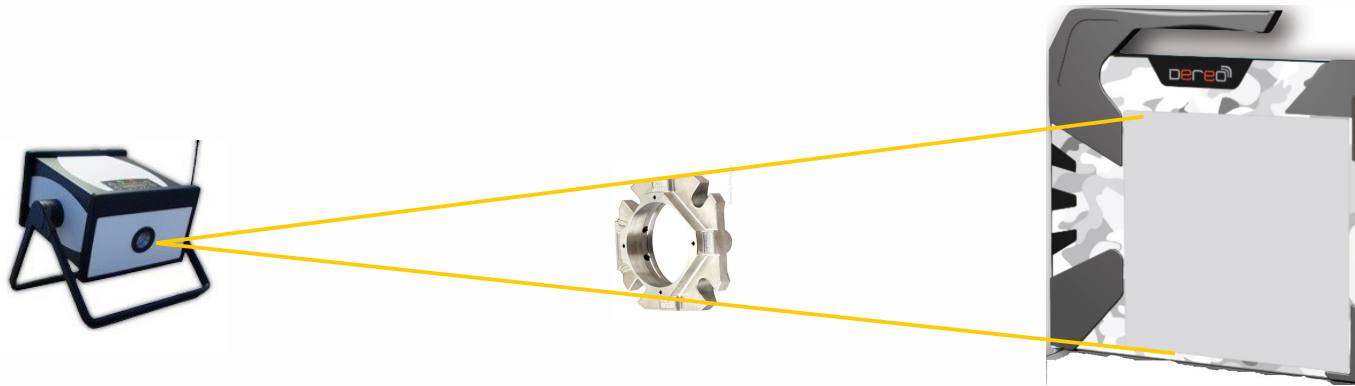


Case study 3 : **Ti welding – 6 mm thick**



Case study 3 : Ti welding – 6 mm thick





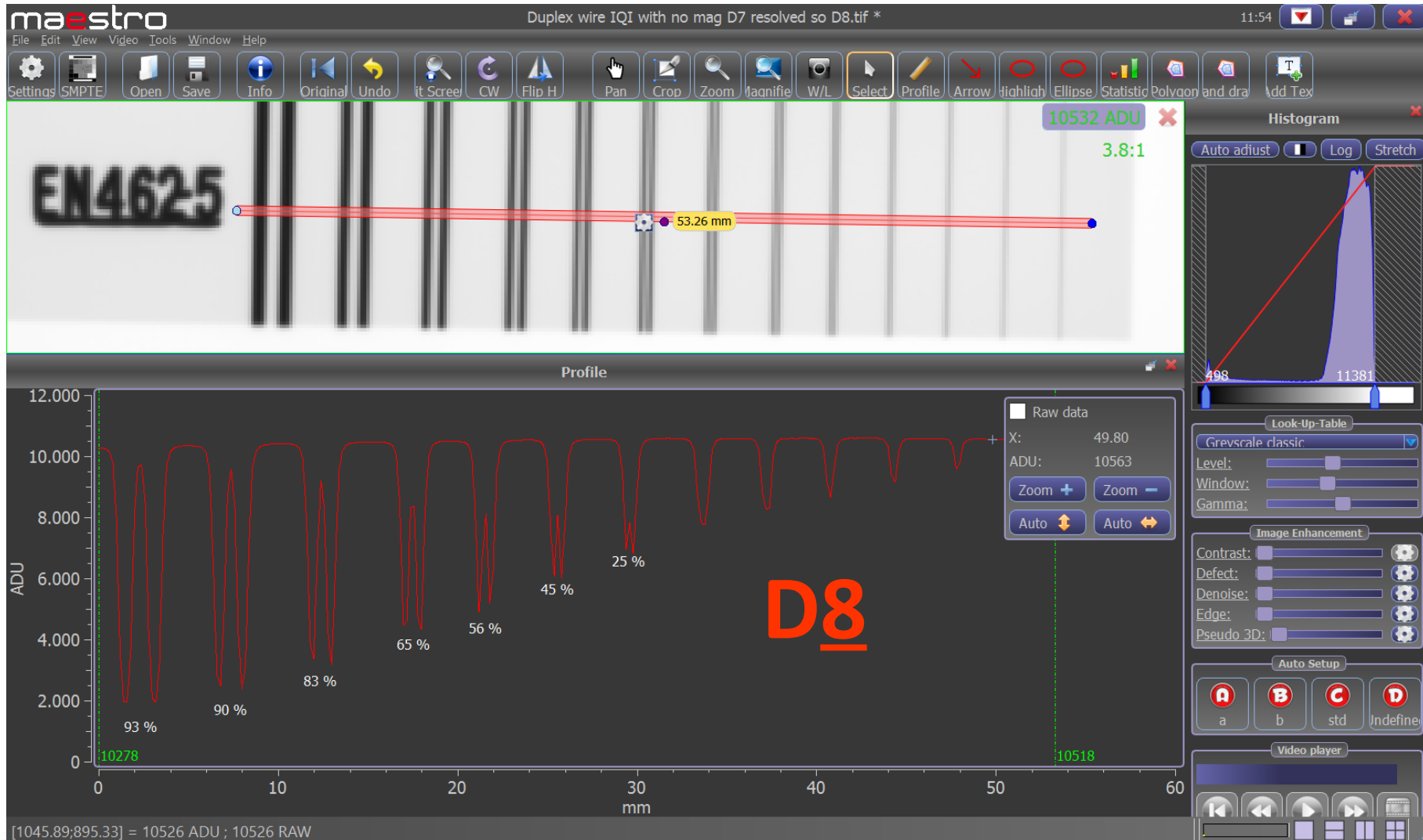
200 μm
focal spot

magnification x 2

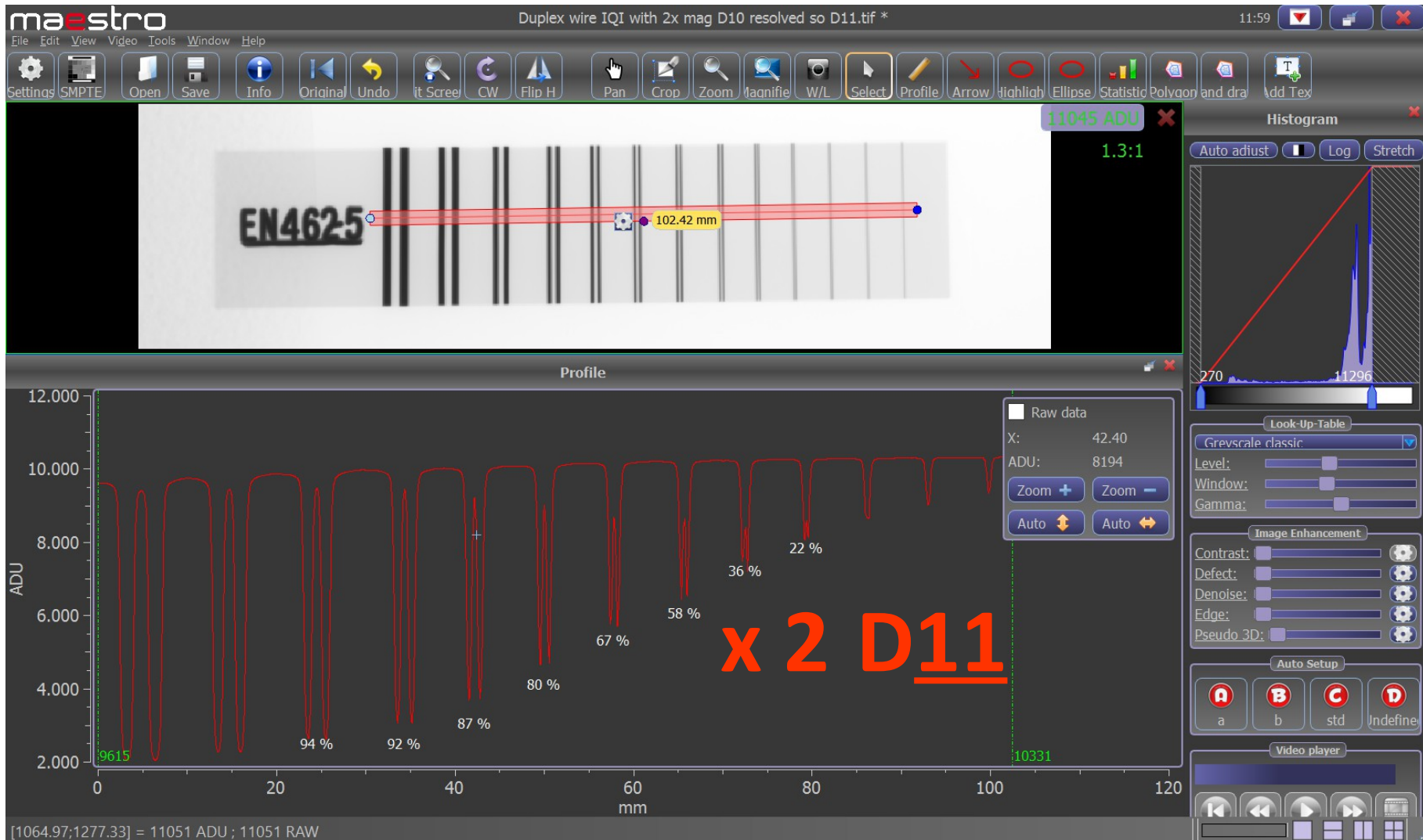
200 μm
SRb : D8

Effective pixel size at D/2 : **100 μm**
Measured SRb : **D11**

Case study 4 : Duplex IQI [DeReO WA 4040]



Case study 4 : Duplex IQI [DeReO WA 4040 with μ GemX]





Conclusions



RT with *portable real time DR flat panels and μ focus*

- (++) Digital : higher image quality and easier interpretation**
- (+) Precision (« anomalies » can be seen and located at 0.1 μ m)**
- (+) Wide area inspection (= detector size)**
- (+) Immediate result**

- (+) Easy xray parameter settings with real time (kV, mA, ...)**
- (++) Complete volume inspection**
- (++) increased spatial resolution with magnification**

- (-) Ionizing radiations → DR are 10 x more sensitive than film**



X·RiS
X-RAY IMAGING SOLUTIONS

X-RIS offer of solutions

X-RIS (X-Ray Imaging Solutions) Digital Radiography in NDT and Security

4 segments :

- **Portable** security
- **Portable** NDT
- **Stationary systems** (upgrade → complete solutions)
- **Special** development



NDT



SECURITY

Differentiation :

user-friendly and pragmatic solutions ; very close to the **application**



μ GemX-150

- μ focus portable battery-powered Xray generator
- monobloc - 30 x 30 x 20 cm - 14 kg (all included)
- dedicated to **Digital Radiography**
- 150 kV – 1 mA – 150 W
 - enough for 15 mm Fe after 60 s
 - class B from 1.5 to 15 mm of Fe
- wireless control
- micro focal spot
 - < 0.2 x 0.2 mm (ASTM E 1165-12)
 - 0.15 mm (IEC 60336)
- constant potential (100 kHz) → averaging



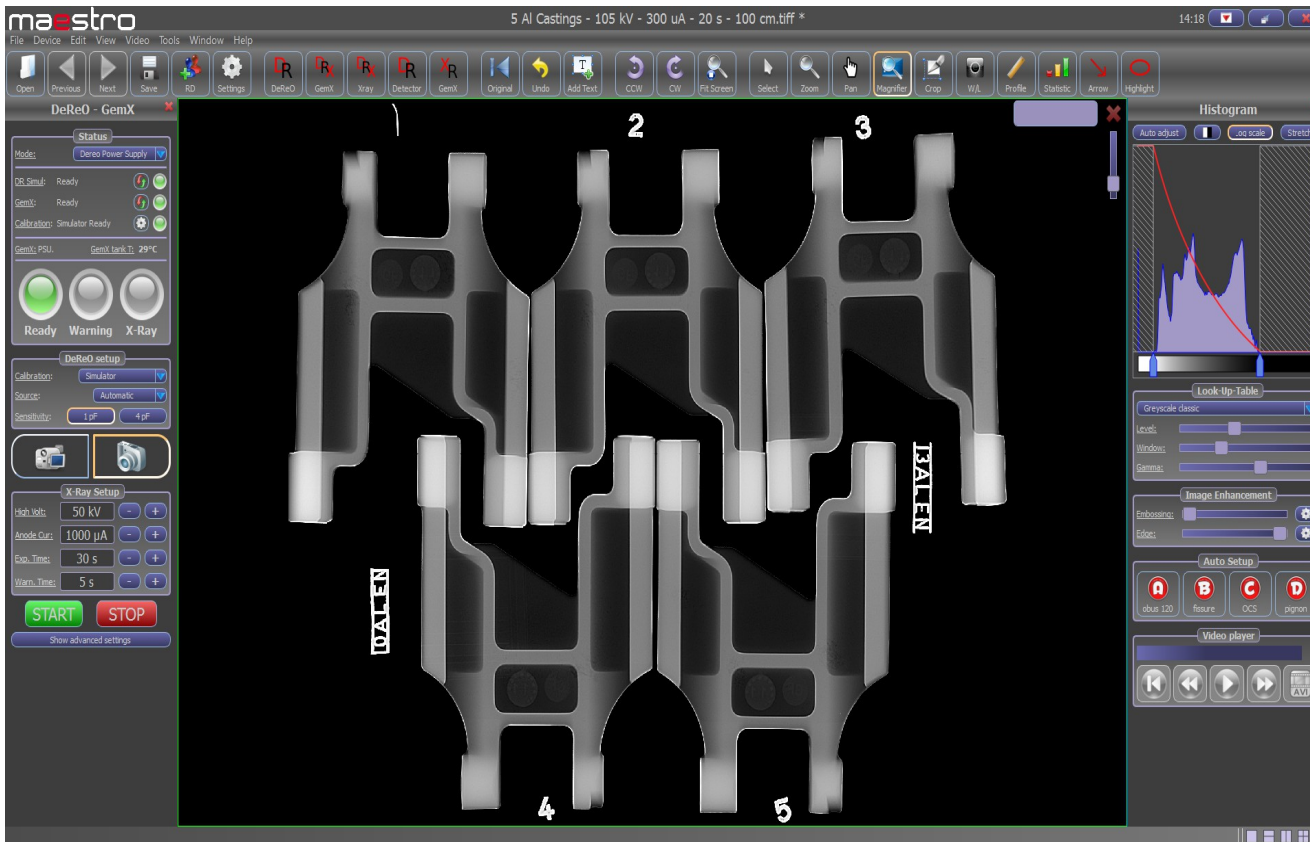
DeReO range

- Portable and Rugged DR Panels
- Active area : from 4" x 2" to 17" x 14"
- Pixel size : from 48 μm to 200 μm
- CMOS – GadOx (selection of scintillators)
- Wide range : WA – HE – HR – UP

- Self detection of Xrays
- Adjustable sensitivity
- Adjustable capture time per frame
- Real time + averaging
- Battery powered
- Wifi



Maestro



user-friendly
real time filters
magnifier
gen. control
modularity
customisable
IEC compliant