Innovative X-ray Solutions

Food inspection: Fish

FHF konference
Oslo 27 Nov. 2013

InnospeXion
the invisible made visible

InnospeXion ApS – Horseager 14 – DK 4330 Hvalsoe – DENMARK
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Innovative X-ray Solutions

INNOSPEXION

X-RAYS: Our business

InnospeXion uses the knowledge on X-ray interaction with matter to develop innovative techniques for inspection and characterisation, by imaging or by measurement of the spectrum of transmitted or scattered radiation. Since 2000, we have applied these principles for non-destructive testing services, prototype characterisation, manufacturing prototyping and for the continuous development of state-of-the-art industrial solutions. Since 2003, we have supplied intelligent and unique on-line, at-line or off-line x-ray based solutions to improve the productions cost-effectiveness. **The main success product is the low energy X-ray inspection systems that was awarded the Innovation Award 2007**

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Low energy X-ray inspection: 2007

The new MCIS from InnospeXion

MCIS is based on low energy X-rays:

- Improved contrast
- Less radiation
- Low weight
- Simple design

FOOD PHARMA TECH DK

Innovation Award

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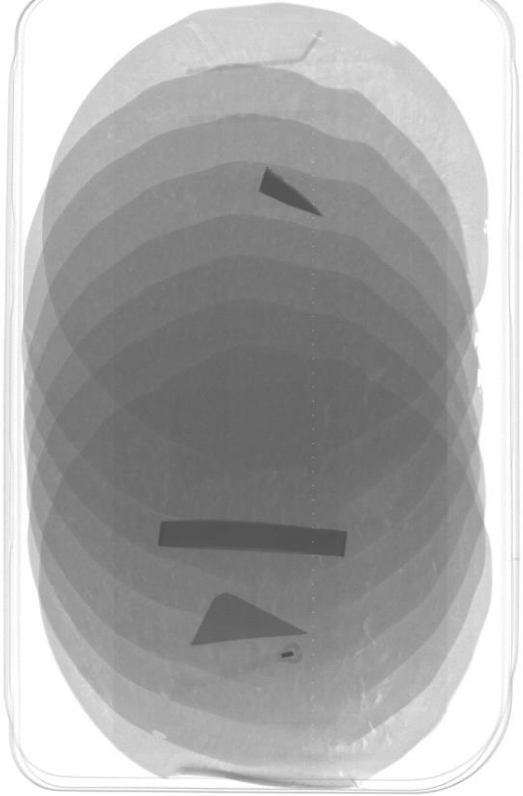

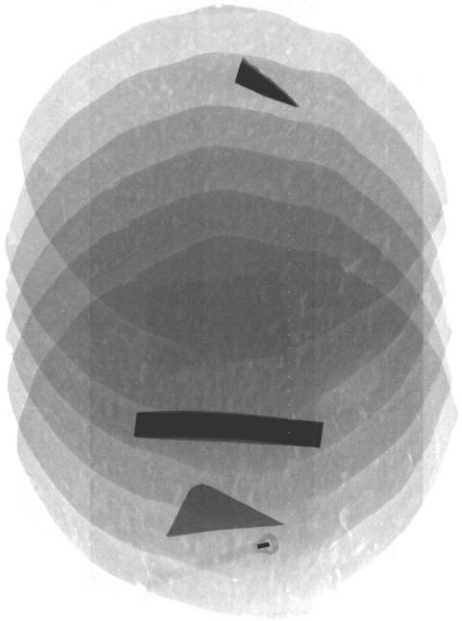

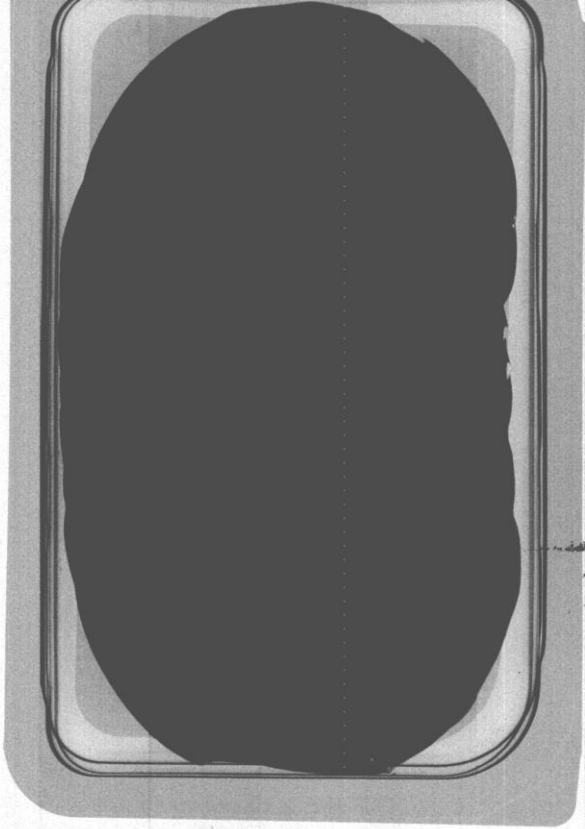

WORLD CLASS X-RAY IMAGE QUALITY

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Low energy X-ray inspection: 2009

The HYMCIS from InnospeXion

Second generation:

Hygienic design

Full PLC control

Innovation Award

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Low energy X-ray inspection: 2010-2011

The HYMCIS from InnospeXion

Available in tailored versions from 150 to 1600 mm conveyor width:

Hygienic design

Full PLC control

0.1 mm detection

Ultra high sensitivity

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Low energy X-ray inspection: 2011-2012

The HYMCIS from InnospeXion

Third generation:

PLC master - Versatile I/O design

Various Conveyor widths

Tailored design options

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Why is the technology interesting for fish bone detection?

Small fish bones gives small contrast. At low energy, the contrast is much higher, and therefore detection is more reliable

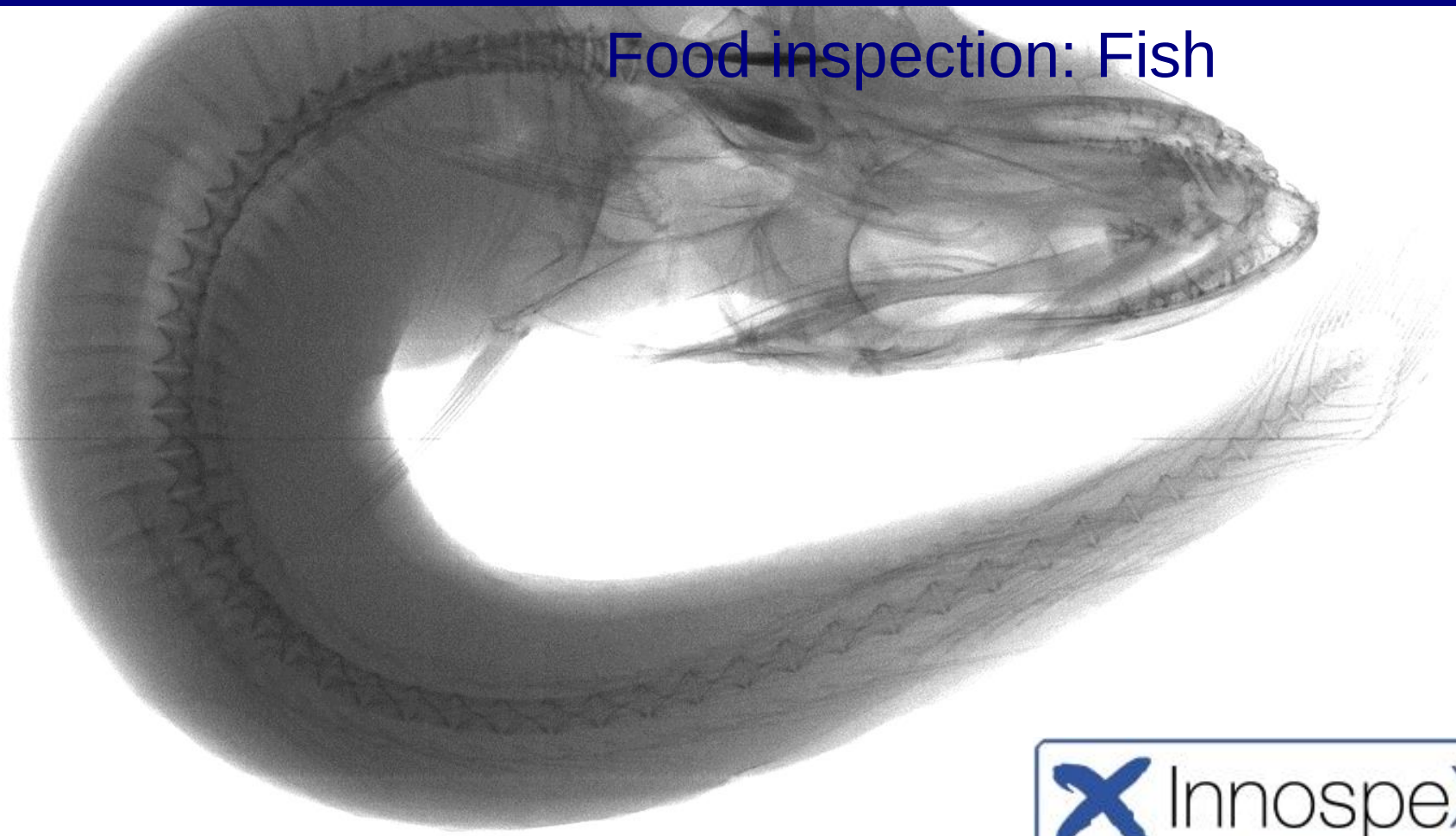
Small fish bones requires a high resolution for their detection. 0.1 mm resolution enables detection of bones down to 0.15 mm Ø.

Tailoring to meet the requirements in the fish industry is possible.

LOW-ENERGY X-RAYS

Application Examples

Food inspection: Fish



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Low energy X-ray inspection

The HYMCIS from InnospeXion

What’s that to do with fish?

The ordinary X-ray systems are not - in general - suitable for fish bone detection. There are two main reasons:

1. The systems operate with a pixel size of 0.4x0.4 or 0.8x0.8 mm. This resolution is too coarse for fish bones. We use a special technology involving 0.1 x 0.1 mm resolution.
2. The systems use a detector that converts the X-ray information "image" using a crystal called Gadox, Gadolinium Oxysulfide. This material is however only effective at X-ray energies above 25 kV. But the contrast between meat and bones in fish is unfortunately optimal at a LOWER energy. Therefore the traditional X-ray systems have difficulty in detecting fish bones, EXCEPT when these are very large, typically mm-sized in diameter.

Our technology is very different as we use a detector that is effective from about 5 kV, meaning that we actually gets a very clear image even of tiny bones.

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FACTS

→ The lower the X-ray energy (in KeV), the better the contrast;

→ The smaller the pixel dimension, the better the spatial resolution

→ Röntgen unveiled the potential for low E X-rays a century ago

CONTRAINTS

→ Low energy X-rays are easily absorbed – also by air!

→ When a pixel is small, it receives very little ”light”, or radiation. Hence, the SNR in a low E X-ray image may be very poor

→ For industrial automation, line speed may be high. Hence, even less radiation is received per pixel per time unit.

THE SOLUTION

→ Very stable X-ray source

→ Very high quantum efficiency detection technology

→ Design that limits the physical constraints

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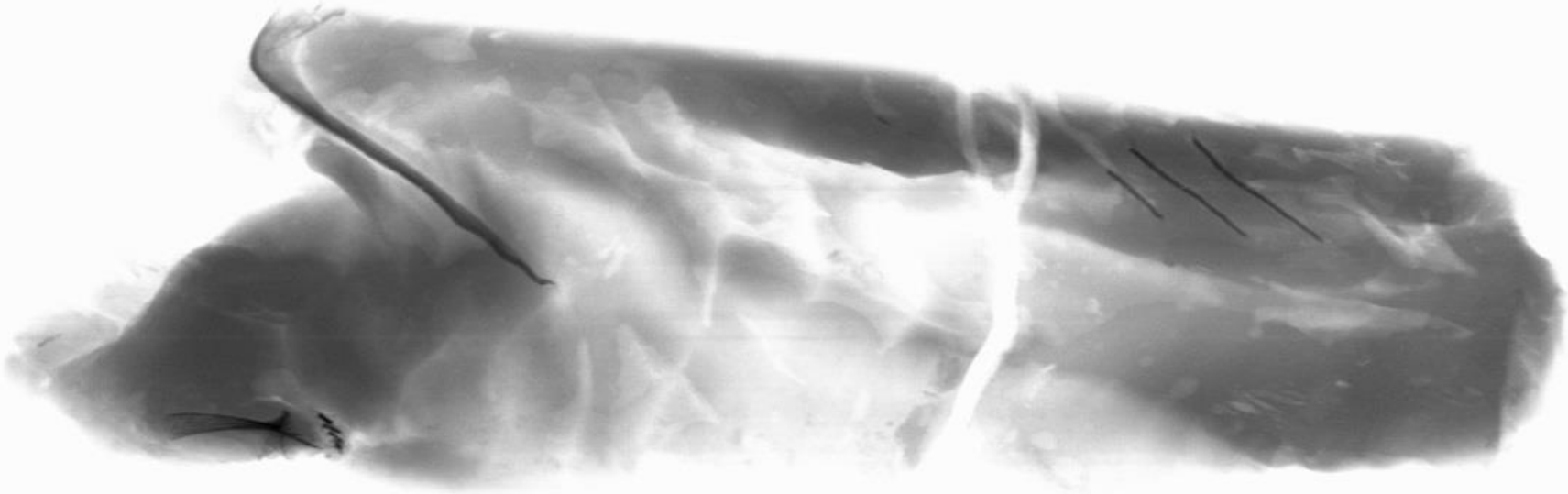
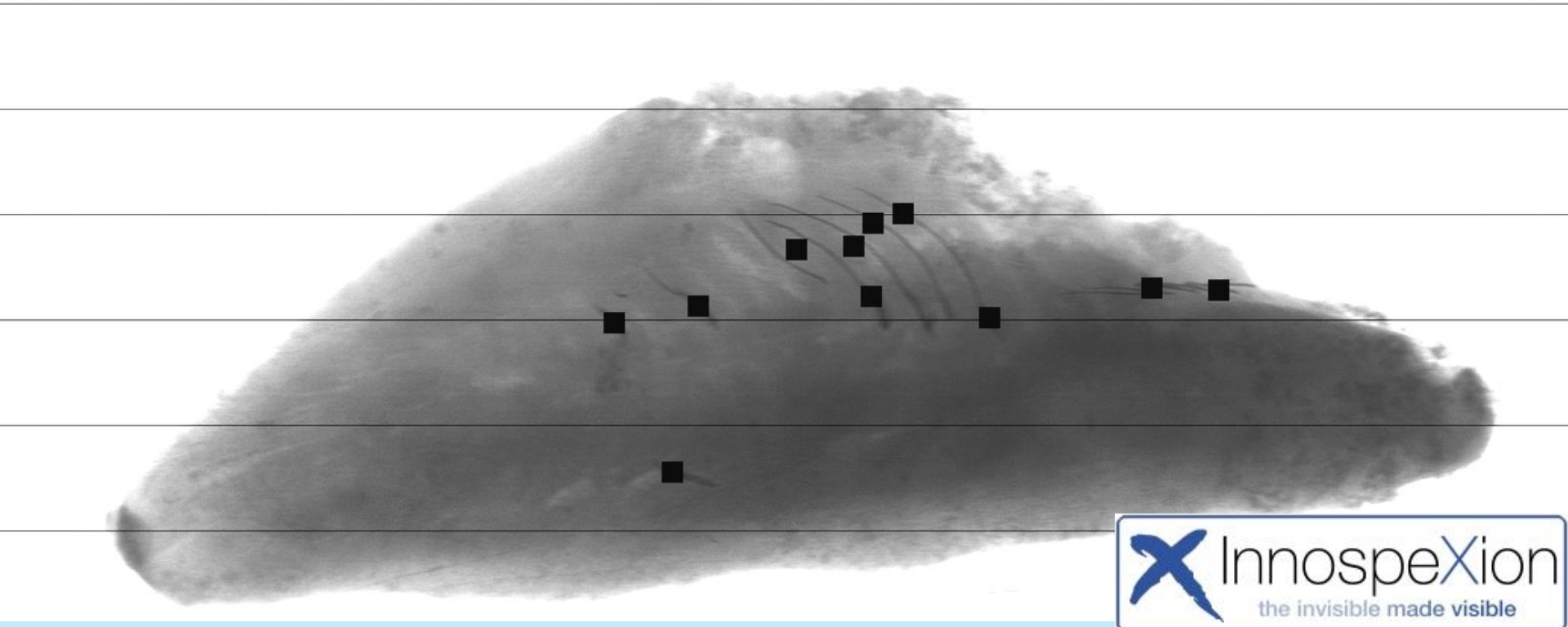


LOW-ENERGY X-RAYS

Application Examples

Food inspection: Fish bones
Automatic detection & identification in fillets



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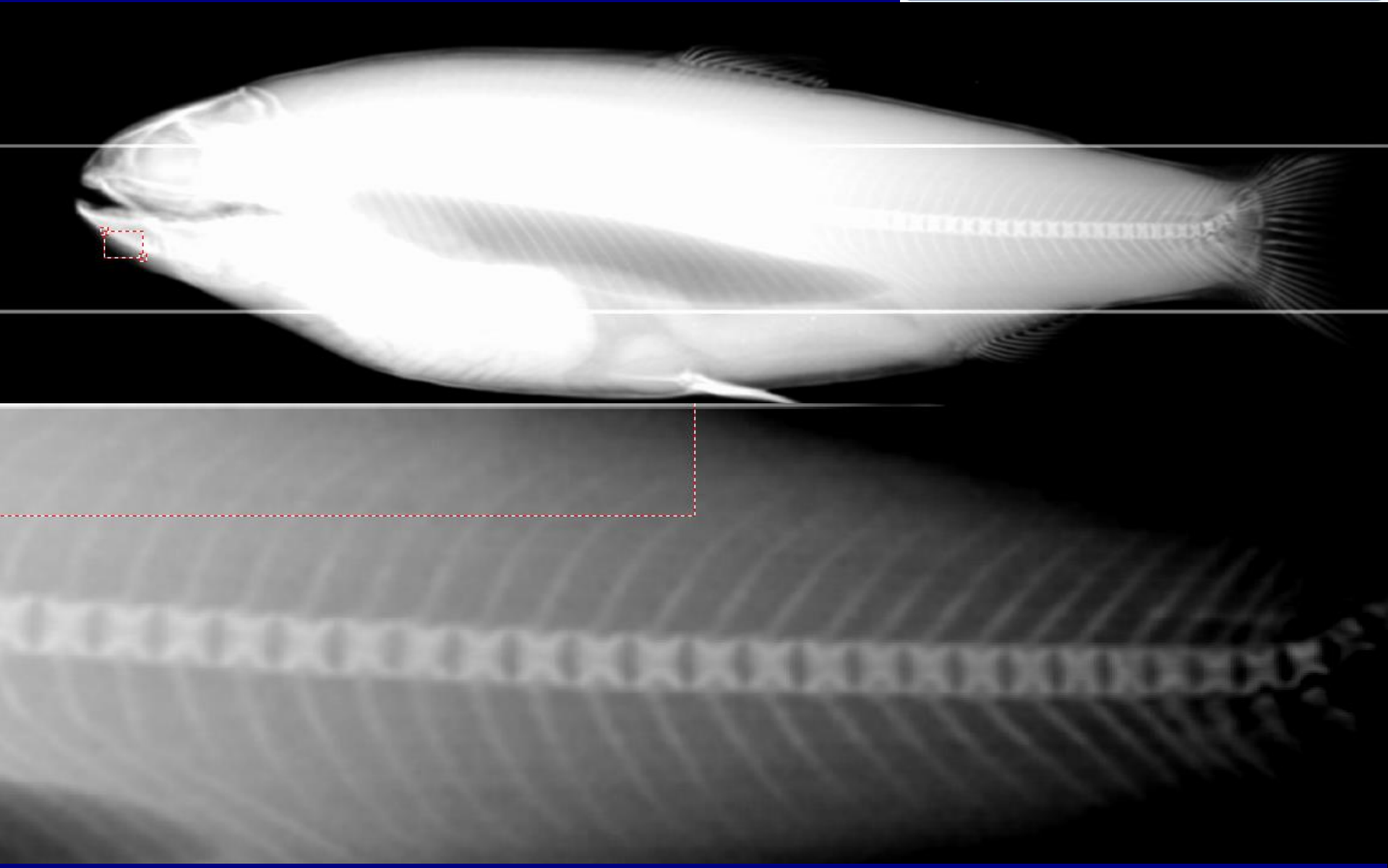
mm	mm	%	mm	mm	%	mm	mm	%	mm	mm	%	mm	mm	%
Bone diameter	Bone length	POD	Bone diameter	Bone length	POD	Bone diameter	Bone length	POD	Bone diameter	Bone length	POD	Bone diameter	Bone length	POD
0,25	5	60	0,35	5	75	0,45	5	81	0,55	5	90	0,65	5	92
0,25	7	61	0,35	7	77	0,45	7	83	0,55	7	92	0,65	7	94
0,25	9	62	0,35	9	78	0,45	9	84	0,55	9	93	0,65	9	95
0,25	11	63	0,35	11	80	0,45	11	86	0,55	11	95	0,65	11	97
0,25	13	64	0,35	13	81	0,45	13	87	0,55	13	96	0,65	13	98
0,25	15	65	0,35	15	83	0,45	15	89	0,55	15	98	0,65	15	98
0,25	17	66	0,35	17	84	0,45	17	90	0,55	17	98	0,65	17	98
0,25	19	67	0,35	19	86	0,45	19	92	0,55	19	98	0,65	19	98
0,25	21	68	0,35	21	87	0,45	21	93	0,55	21	98	0,65	21	98
0,25	23	69	0,35	23	89	0,45	23	95	0,55	23	98	0,65	23	98
0,25	25	70	0,35	25	90	0,45	25	96	0,55	25	98	0,65	25	98
0,25	27	71	0,35	27	92	0,45	27	98	0,55	27	98	0,65	27	98
0,25	29	72	0,35	29	93	0,45	29	98	0,55	29	98	0,65	29	98
0,25	31	73	0,35	31	95	0,45	31	98	0,55	31	98	0,65	31	98
0,25	33	74	0,35	33	96	0,45	33	98	0,55	33	98	0,65	33	98
0,25	35	75	0,35	35	98	0,45	35	98	0,55	35	98	0,65	35	98

Living fish X-ray image



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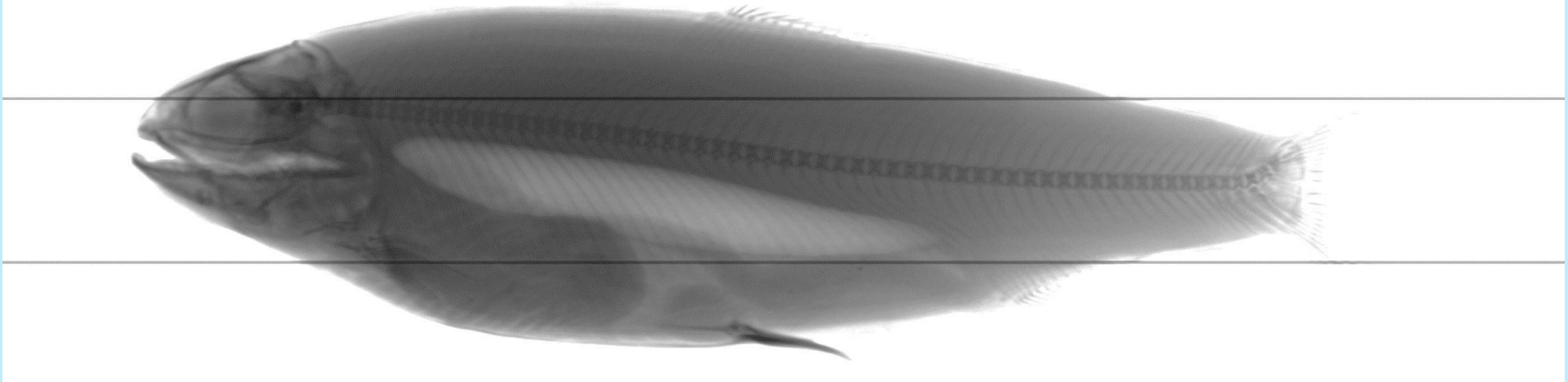

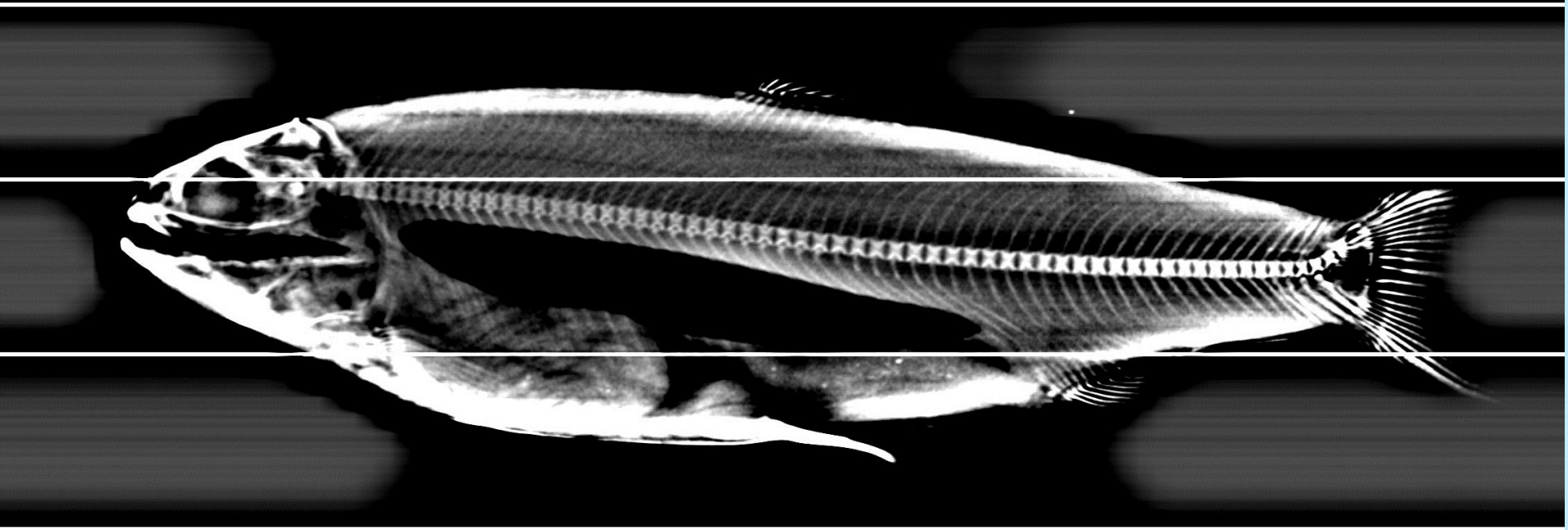

X-ray imaging at high speed: Solutions offered by Low-Energy X-rays

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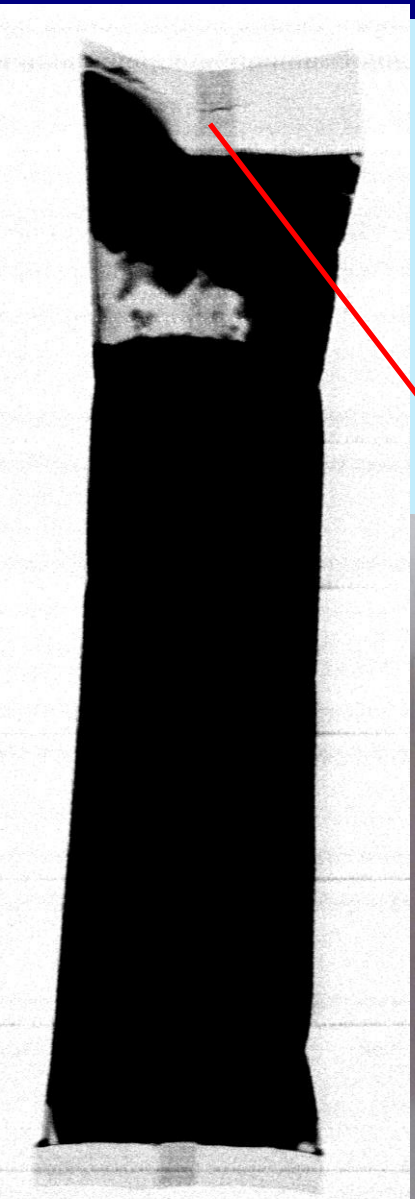
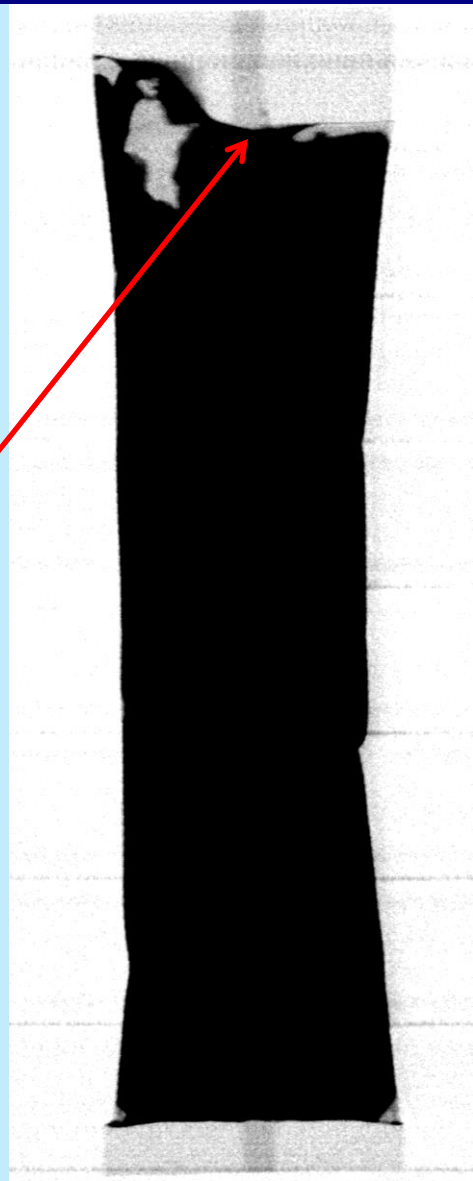
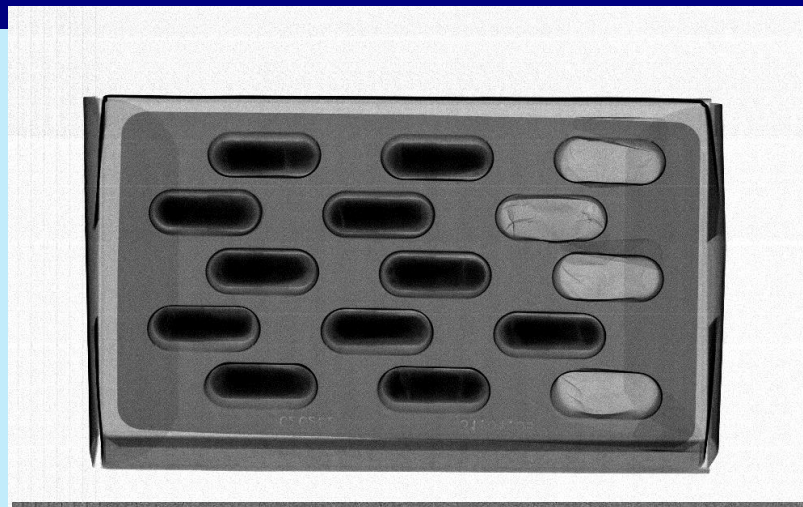
Low-Energy X-ray discloses packaging imperfections

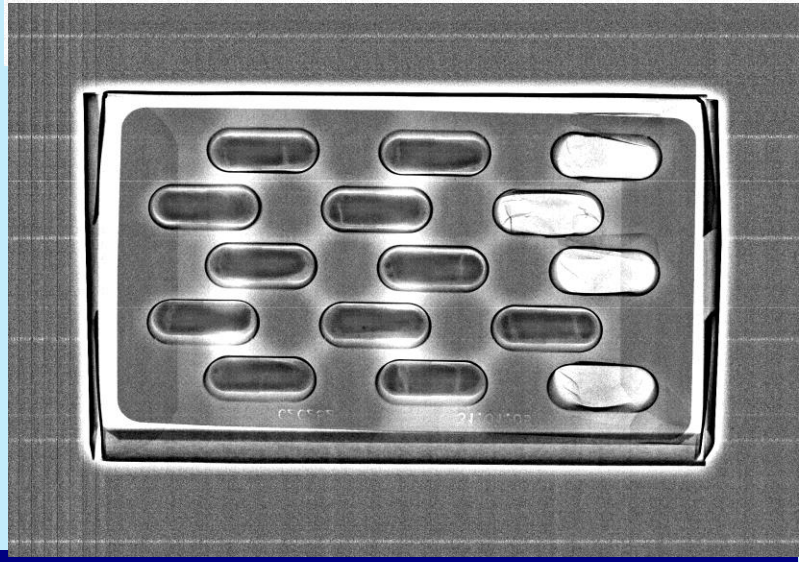




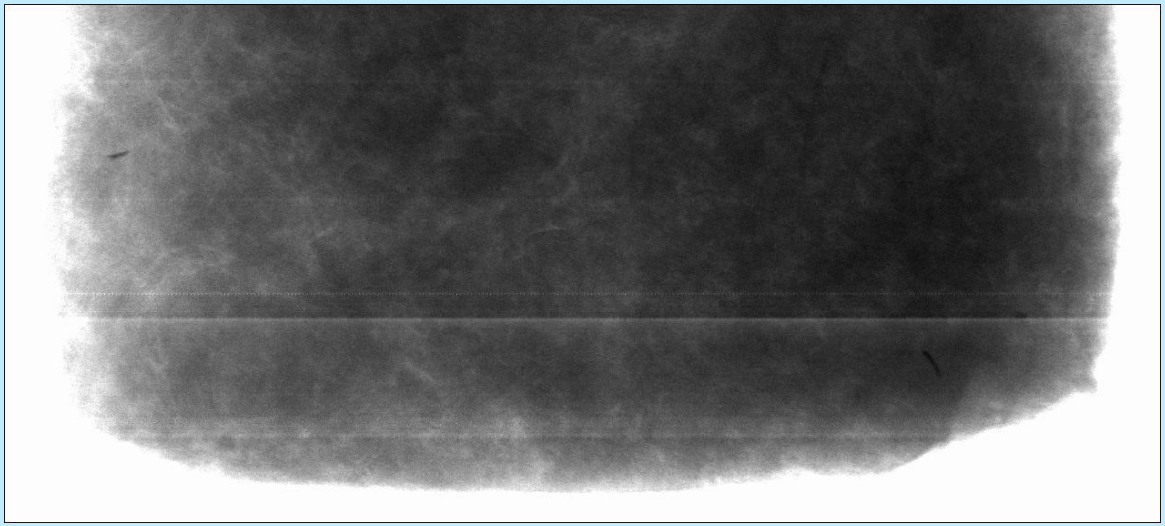
LOW-ENERGY X-RAYS

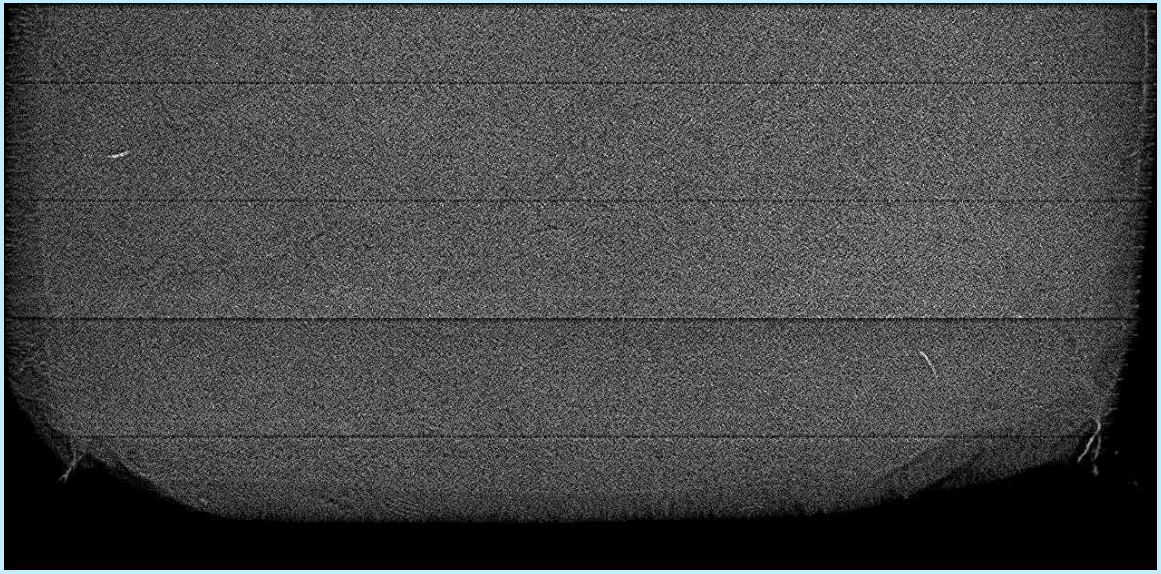
APPLICATION EXAMPLES – Blister packaging





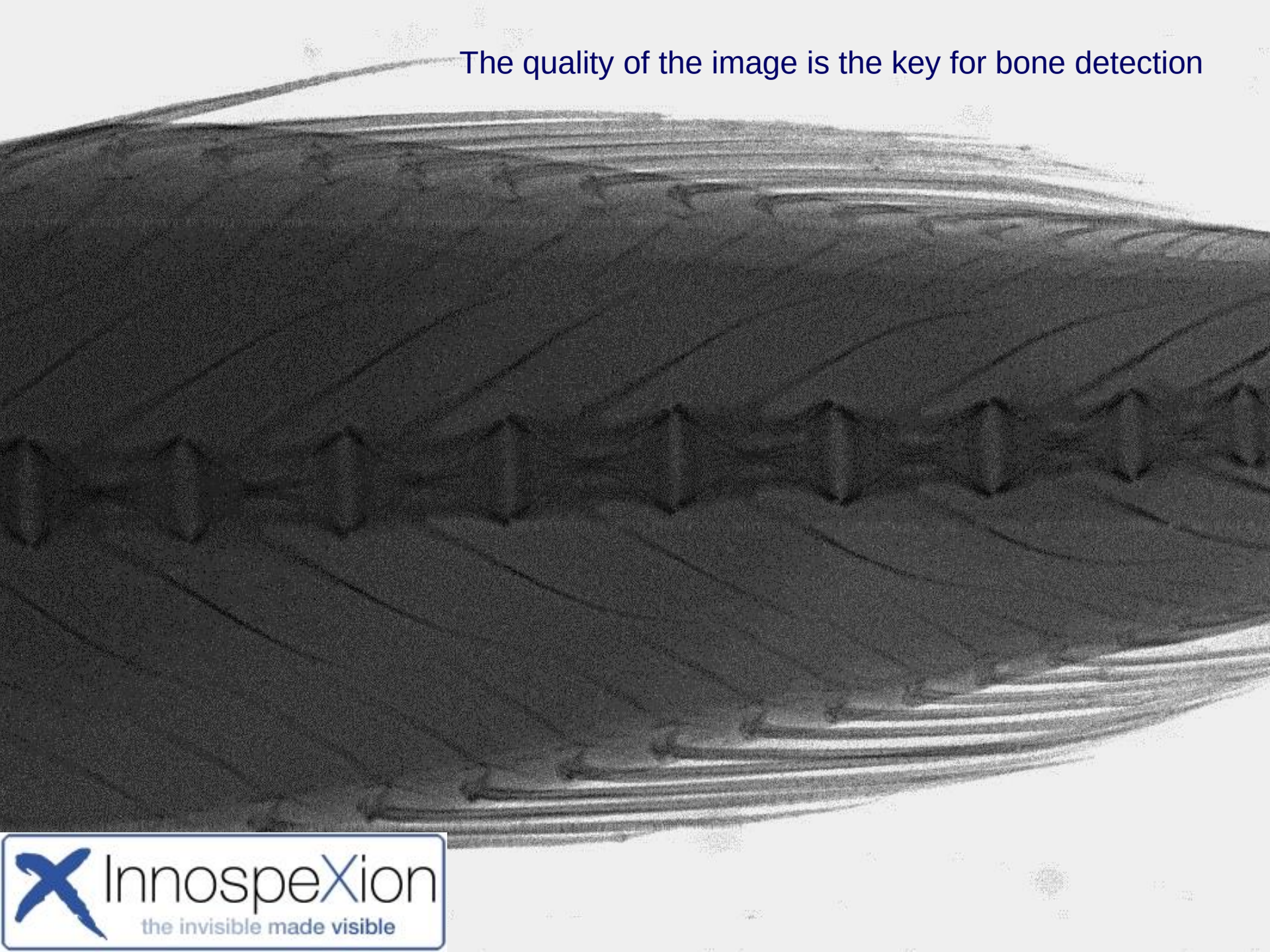
Blister packaged products with defects: missing objects and damaged objects (cracks).
Note the huge dynamic range showing packaging, sample (product) integrity as well as defects.
Imaged at production speed = 22 m/min





FISH BLOCKS – 4-5 CM THICK TUNA

The quality of the image is the key for bone detection



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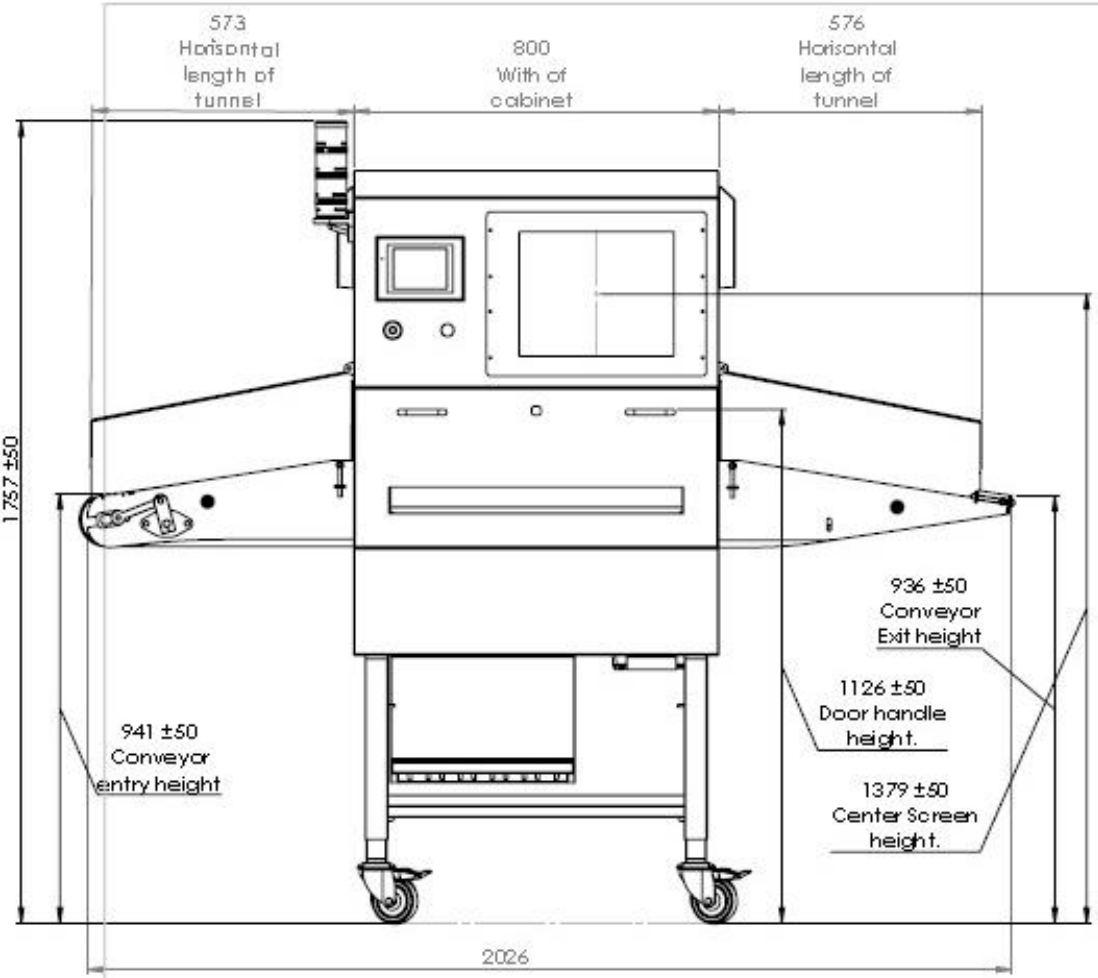

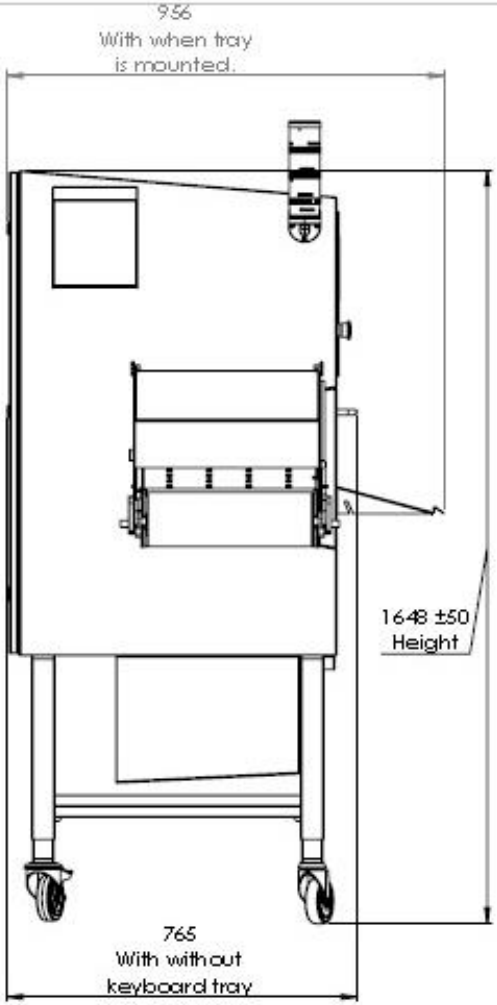

The machine have the posibility
to be ajusted +/- 50 mm in height.
For easy adaptation to the process
line.

Comments:

DRAWN By

Client

Project

Supplier

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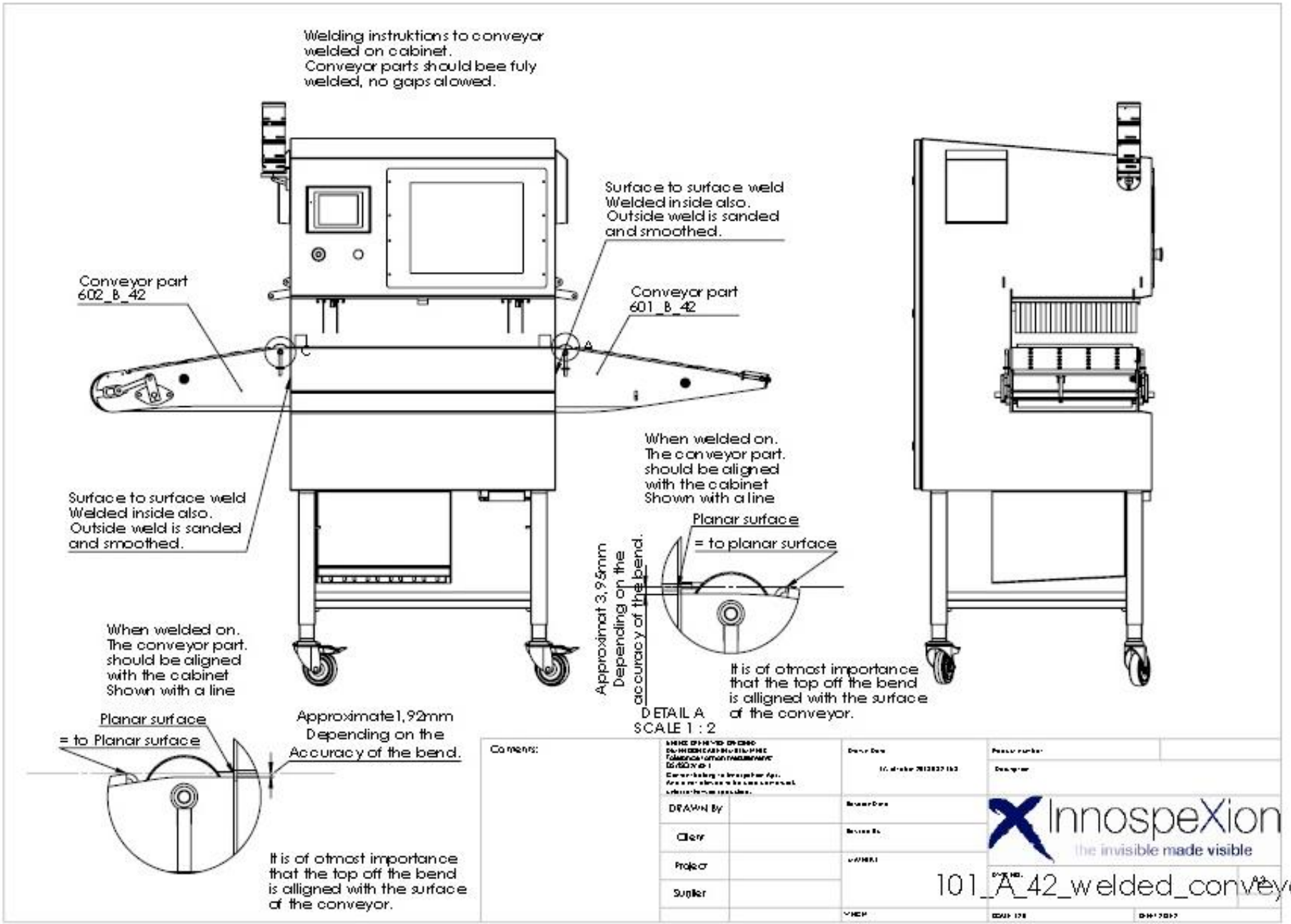
101_A_42_welded_conveyor


Welding instruktions to conveyor
welded on cabinet.
Conveyor parts should bee fuly
welded, no gaps alowed.
Surface to surface weld
Welded inside also.
Outside weld is sanded
and smoothed.
Conveyor part
602_B_42
Conveyor part
601_B_42
C
A
Surface to surface weld
Welded inside also.
Outside weld is sanded
and smoothed.
When welded on.
The conveyor part.
should be aligned
with the cabinet
Shown with a line
Planar surface
= to planar surface
Approximat 3,95mm
Depending on the
accuracy of the bend.
It is of otmost importance
that the top off the bend
is alligned with the surface
of the conveyor.
DETAIL A
SCALE 1 : 2
When welded on.
The conveyor part.
should be aligned
with the cabinet
Shown with a line
Planar surface
= to Planar surface
Approximate 1,92mm
Depending on the
Accuracy of the bend.
It is of otmost importance
that the top off the bend
is alligned with the surface
of the conveyor.
Comments:
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101_A_42_welded_conveyo

Low energy X-ray inspection

The HYMCIS from InnospeXion

(probably) **The worlds most sensitive, and highest resolution, X-ray systems for on-line control at manufacturing speeds up to 120 m/min**

Danish engineering – Made in Denmark

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