

X InnospeXion

the invisible made visible



Working HYMCIS System

Automatic detection and rejection of bones in chicken fillets, pieces and nuggets.

Did you know that?

The InnospeXion chicken bone detection system is based on the newest and most effective X-ray technology, providing high contrast and high resolution X-ray images.

The high quality X-ray images is a necessity for the automatic identification and detection of bones and soft bones in Chicken products.

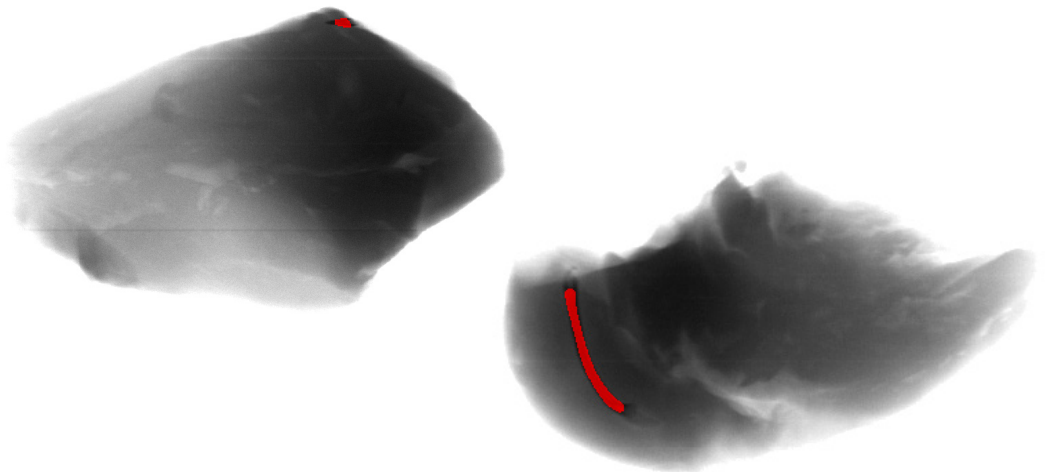
The unique technology has been proven in numerous applications during many years, e.g. for fish bone detection in the fish processing industry.

Hence, the technology satisfies the requirements of the chicken industry, e.g. concerning hygiene, robustness, cleaning, detection performance, and false reject rate.

Integrated technology, including tailoring towards individual sorting, reject, and other automation requirements.



The system automatically detects and rejects bones down to less than 2 x 2 x 2 mm, including softbone (defined as having a Hounsfield unit absorption in the range 300 – 550 (according to test samples from the Danish Meat Research Institute, DMRI, www.dmri.dk)).



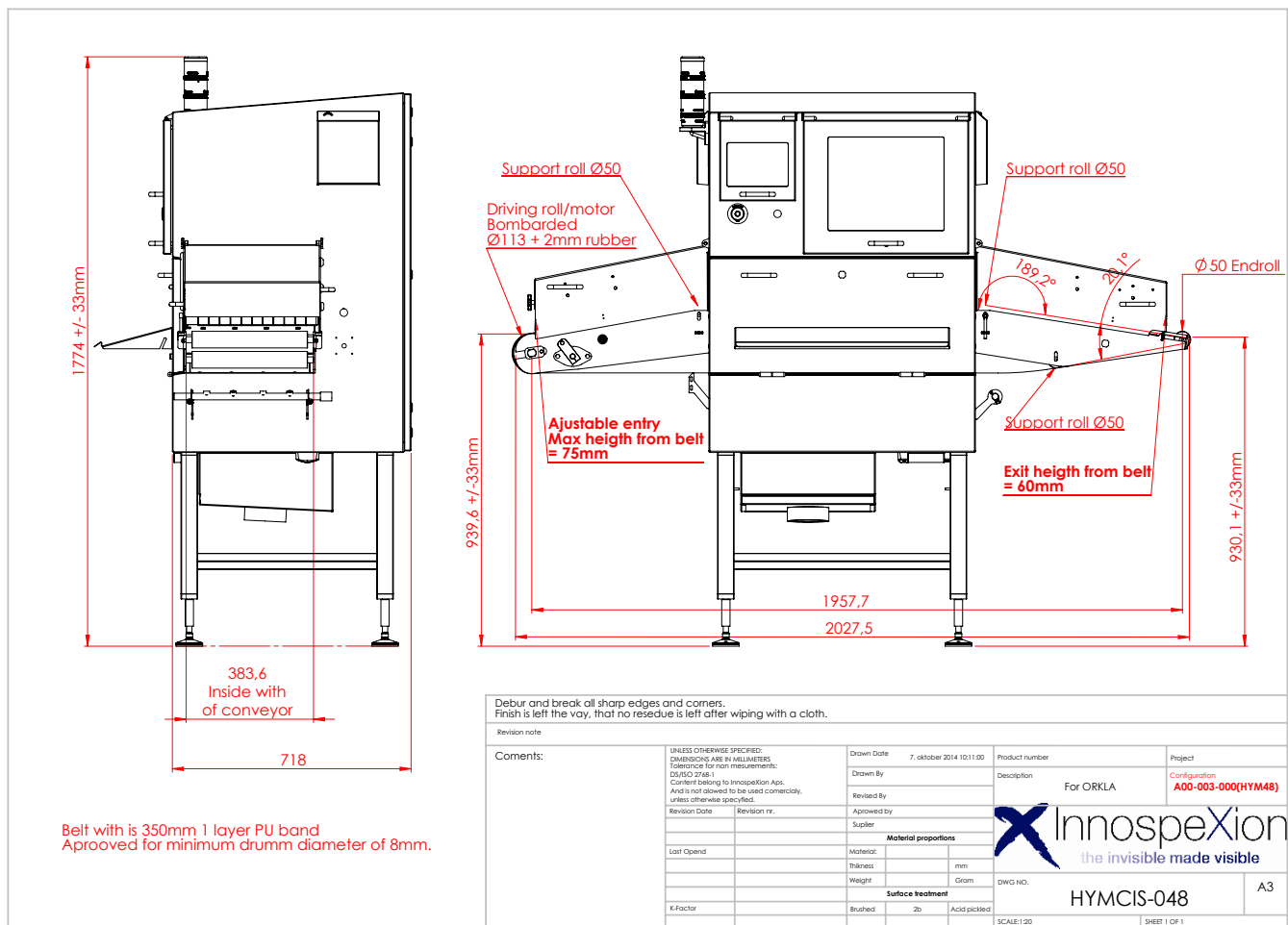
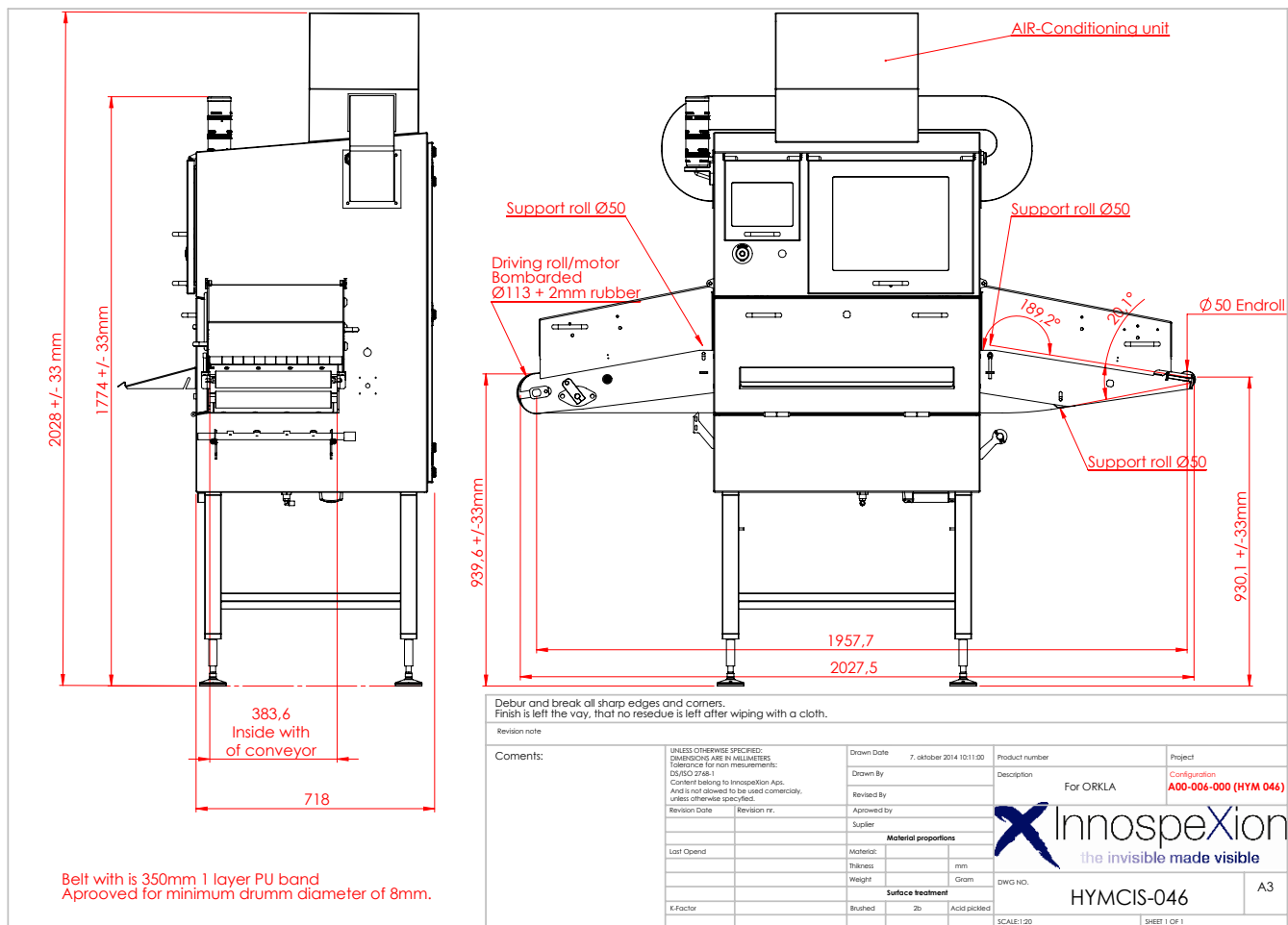
The chicken bone detection system is a variety of the "HYMCIS" products, which have been on the market since 2006.

The technology has received innovation awards due to the high quality X-ray images acquired and analyzed in real time.

The technology is robust, reliable, and very well proven for demanding 24/7 applications worldwide. Developed, Engineered, and Made in Denmark.

General specifications

Detection capability	< 2 x 2 x 2 mm bone of > 450 H.U. (please refer to POD table, below)
False reject rate	Typically < 1 to 2%
Typical "hit" rate (typical detected bone content percentage)	From 5 to 15 % of production
Validated detection performance	98 to 99 out of 100
Inspection capability	120 – 150 fillets per minute
Fillet ("Product") height ("thickness")	45 mm maximum
Product minimum height	10 mm (typical)
Distance between fillets	25 mm minimum
Fillet presentation	Flat lying, non-folded, with or without inner fillet
Active detection width	200 mm
Conveyor width	350 mm
Conveyor belt	FDA approved fiber reinforced rubber belt
Belt cleaning	Continuous water spray on outlet side with scraper on inlet side, underneath the belt
Conveyor elevation	950 +/- 50 mm
Tunnel entrance/exit opening	400 x 50 mm (wxh)
Maximum conveyor speed	450 mm/s (27 m/min)
System dimensions	2026 (W) x 765 (D) x 1900 (H) (mm)
System weight	300 - 350 kg
Reject distance	Between 0 and 1000 mm from X-ray conveyor outlet
Reject sorting	Up to 16 outputs (3 bone classes defined as standard)
Cooling system	Top mounted air condition system, closed circuit
X-ray source cooling	Closed water circuit
Radiation emission limit	< 5 uSv/hr
Radiation compliance:	Acc. to the Council Directive 2013/59/Euratom of 5 December 2013 concerning basic safety standards for the protection of the health of workers and the general public against the dangers from ionizing radiations. The HYMCIS systems are registered and comply with the US FDA according to CFR21 Sec. 1020-40.
Tunnel scattered radiation shielding	Removable stainless steel curtains
Main inspection volume scattered radiation shielding	Interlocked retractable stainless steel curtains
Shielding material	Stainless steel
Conformity declaration	CE declaration 2006/42/EF with subsequent revisions, and hygienic design specifically relative to food contact materials (EU & FDA compliance)
Cleaning agents	Specific usage of strong acids and bases must be agreed on. Cleaning guidelines.
System IP rating	IP 65 (splash proof). System can be high pressure water jet cleaned.
System hygienic design	According to EHEDG and HACCP principles
System power rating	115/230 VAC single phase, 20/10 A.
Compressed air	2-4 bar. 8 mm PVC tube (push-in fitting)
System control	PLC, OMRON
X-ray specifications	18 – 30 kVp, 1-12 mA
X-ray detector resolution	0.05 to 0.1 mm
Human-Machine interface	GUI located at the system RIGHT side looking from the infeed belt, into the system inspection volume. Minimum 600 mm sideward clearance needed for service and repair, plus emergency evacuation clearance
Access for service	Service hatch on the LEFT side looking from infeed belt. Clearance needed is 750 mm minimum sidwards – plus emergency evacuation clearance.



Probability of Detection, POD

The table below has been compiled for chicken fillets 10-25 mm in thickness. False reject is estimated to be about 3 % for the sensitivity settings which correspond to the POD listed below. Detection capability deteriorates marginally with increasing fillet thickness.

A high sensitivity mode is available for detection of very small bone fragments and soft bones, this however has an estimated false reject rate around 11%.

POD for bone Chicken fillets (10-25 mm)
False bone detection rate 3%

mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD
1-2	2	60	2-3	2	75	3-4	3	82	4-5	4	87	5-6	5	88
1-2	4	70	2-3	4	80	3-4	4	85	4-5	6	92	5-6	6	93
1-2	6	85	2-3	6	87	3-4	6	90	4-5	8	95	5-6	8	96
1-2	8	90	2-3	8	92	3-4	8	94	4-5	10	97	5-6	10	98
1-2	10	92	2-3	10	95	3-4	10	97	4-5	12	98	5-6	12	98
1-2	12	94	2-3	12	98	3-4	12	98	4-5	14	98	5-6	14	98
1-2	14	95	2-3	14	98	3-4	14	98	4-5	16	98	5-6	16	98
1-2	16	95	2-3	16	98	3-4	16	98	4-5	18	98	5-6	18	98
1-2	18	96	2-3	18	98	3-4	18	98	4-5	20	98	5-6	20	98
1-2	20	97	2-3	20	98	3-4	20	98	4-5	22	98	5-6	22	98
1-2	22	98	2-3	22	98	3-4	22	98	4-5	24	98	5-6	24	98
1-2	24	98	2-3	24	98	3-4	24	98	4-5	26	98	5-6	26	98
1-2	26	98	2-3	26	98	3-4	26	98	4-5	28	98	5-6	28	98
1-2	28	98	2-3	28	98	3-4	28	98	4-5	30	98	5-6	30	98
1-2	30	98	2-3	30	98	3-4	30	98	4-5	30+	98	5-6	30+	98
1-2	30+	98	2-3	30+	98	3-4	30+	98	4-5			5-6	30+	98

POD for bone Chicken fillets (10-25 mm) High Sensitivity
False bone detection rate 11%

mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD	mm Bone diameter	mm Bone length	% POD
1-2	2	73	2-3	2	90	3-4	3	94	4-5	4	95	5-6	5	95
1-2	4	85	2-3	4	92	3-4	4	94	4-5	6	96	5-6	6	96
1-2	6	90	2-3	6	93	3-4	6	95	4-5	8	97	5-6	8	98
1-2	8	92	2-3	8	95	3-4	8	96	4-5	10	98	5-6	10	98
1-2	10	93	2-3	10	95	3-4	10	98	4-5	12	98	5-6	12	98
1-2	12	94	2-3	12	98	3-4	12	98	4-5	14	98	5-6	14	98
1-2	14	95	2-3	14	98	3-4	14	98	4-5	16	98	5-6	16	98
1-2	16	95	2-3	16	98	3-4	16	98	4-5	18	98	5-6	18	98
1-2	18	96	2-3	18	98	3-4	18	98	4-5	20	98	5-6	20	98
1-2	20	97	2-3	20	98	3-4	20	98	4-5	22	98	5-6	22	98
1-2	22	98	2-3	22	98	3-4	22	98	4-5	24	98	5-6	24	98
1-2	24	98	2-3	24	98	3-4	24	98	4-5	26	98	5-6	26	98
1-2	26	98	2-3	26	98	3-4	26	98	4-5	28	98	5-6	28	98
1-2	28	98	2-3	28	98	3-4	28	98	4-5	30	98	5-6	30	98
1-2	30	98	2-3	30	98	3-4	30	98	4-5	30+	98	5-6	30+	98
1-2	30+	98	2-3	30+	98	3-4	30+	98	4-5			5-6	30+	98

Considered bones for the POD tables above:

Rib bones:

- Down to 1.3 mm in width
- Down to 3 mm in length

Fan bones:

- Down to 10 mm in length
- Down to 3 mm in width
- Down to 1 mm in thickness



HYMCIS retractable interlocked radiation curtains

Application specific data

The application specific data are based on real production data.

1 Test with manually verified bone containing fillets:

Population: 40

Detected bone containing fillets: 40

Detection success rate: 100%

2 Test with manually verified bone free fillets, manual in-feeding:

Population: 1444

Bone free fillets: 1363

Small bone containing fillets (type 1): 61

Large bone containing fillets (type 3): 20

Verified small bone containing fillets (type 1): 21

Verified large bone containing fillets (type 3): 4

Verified errors in image (infeed errors): 4

Actual false rejects: 54

False reject percentage: 3.74

Of the false rejects, 27 images were rejected due to wrong positioning of the fillet (fillet placed incorrectly so the image does not contain the entire fillet). In another 17 images, the inner fillet was detached from the fillet causing folds. Finally, meat fragmentation was noticed in 9 images.

Disregarding these the false reject number is 1, and the False reject percentage < 0.1 %

Hence, the false reject is caused mainly by incorrect positioning and/or folds caused by the infeed arrangement. Due to the nature of fillets, the above false rejects are difficult to avoid in full.

3 Production data – extended false positives test sequence – automatic functioning:

Fillets total 18282 (all MANUALLY inspected to be bone free)

Rejected, total 591 (i.e. of 18282 different fillets, the system has detected bones in 591 fillets)

Reject percentage: 3.2 %

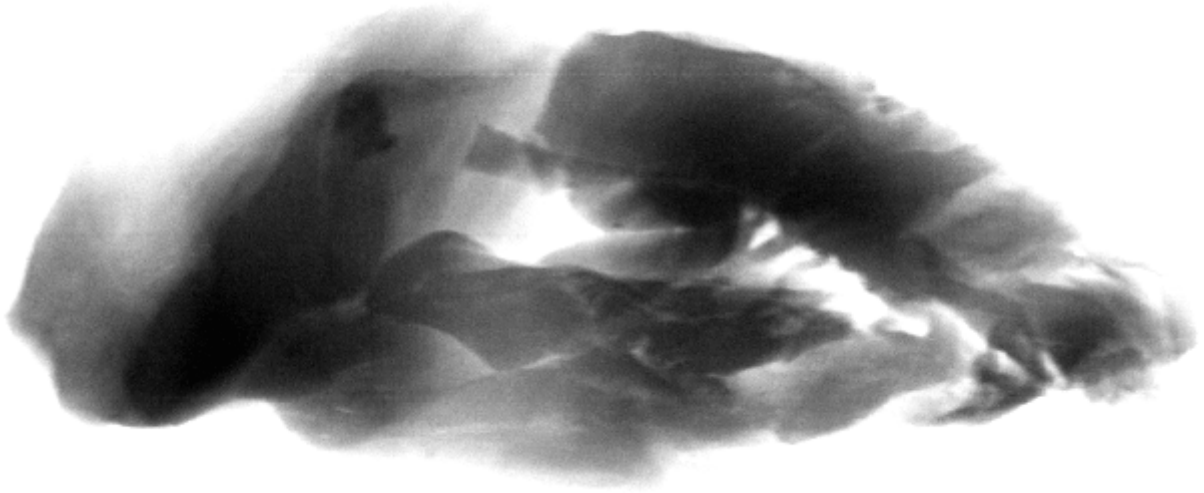
Notes Subsequent inspection of the rejected fillets, has established that the fillets rejected by the system typically has bones in 28% of the rejected fillets. **Out of the remaining false rejects of 72%, 37%** actually are correctly rejected even though there have been no bones. The reasons for these so-named false rejects are: errors in images (typically caused by wrong in-feed timing, about 5%), by fillets with cartilage (varying but typically this is about 5-10% of the total rejects), fragmented fillets (fillets which are spread out and where the meat is very inhomogeneous, typically 10% of rejects), and fillets which have been fed into the system accidentally, causing folds or wrong positioning (typically 15-20% of the false rejects).

This means, that in the above example of 591 rejects, **true FALSE REJECTS** are 207 fillets, **i.e. a false reject rate of 1.1 %**.

Please refer to the examples below on images where the system may cause false rejects.

Examples

Example X-ray images of incorrectly presented products:



Fragmented fillet

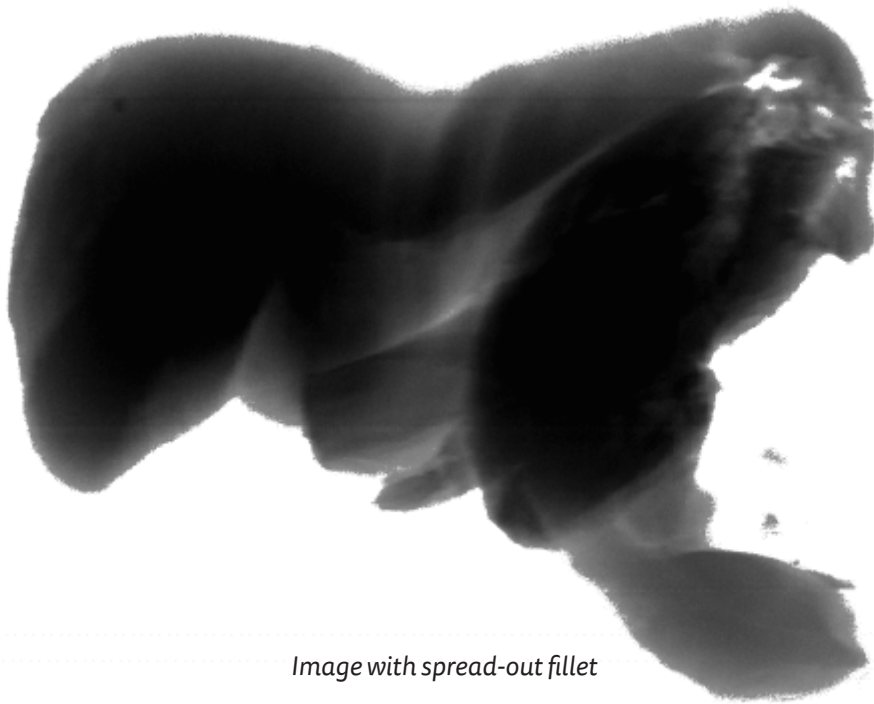


Image with spread-out fillet

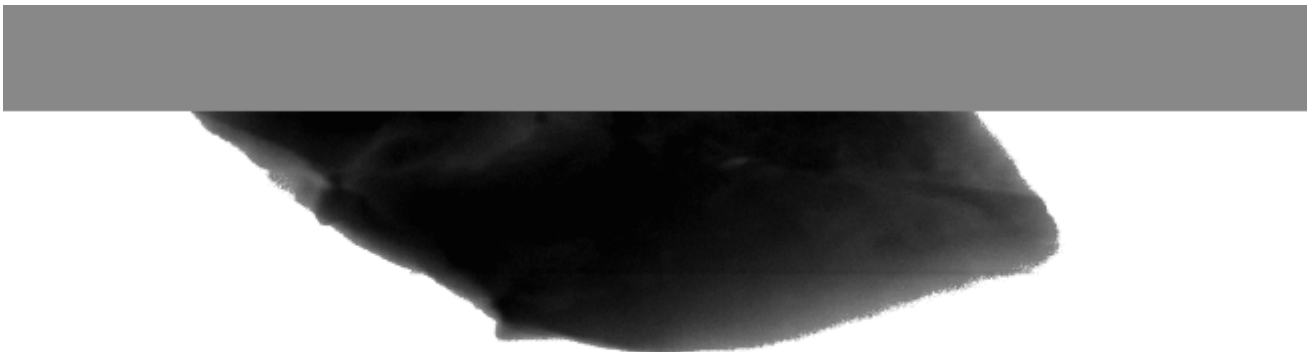


Image with cut-out (misplaced) fillet

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X-RAYS: Our expertise

InnospeXion uses the knowledge on X-ray interaction with matter to develop innovative techniques for inspection and characterisation, by X-ray imaging or by measurement of the spectrum of transmitted or scattered X-radiation.

We apply these principles for numerous industrial systems, e.g. manufacturing control, core analysis for petroleum research, can quality control, on-line conveyor inspection of food, castings and many others.

We develop and manufacture special controllers, complete tailored shielding solutions, software and perform installation as well as continuous monitoring services.

Products General

InnospeXion finds 4 things particularly essential in the development, production and utilization of quality X-ray systems:

Reliance

First and foremost, the systems are developed in close co-operation with the clients, where a mutual trust is fundamental. The trust is not only important in the relationship between the client and InnospeXion, but also in connection with the use of suppliers, which is why only trusted suppliers are

used that have had or will have a long co-operation with InnospeXion. By choosing InnospeXion as supplier, the client gets a collaborator who is committed to the task and a cost effective solution. In return, an active engagement of the client is required, for instance in the matter of implementing the solution.

Security

InnospeXion produces systems in agreement with present regulations concerning the use of X-rays. The security of both the user and InnospeXion's employees is fundamental in order to run an efficient company. The awareness of correct use of X-ray systems and relevant security rules is therefore big.

Quality

InnospeXion's systems are often used for quality control, and the finished products are of high standards. The focus on

which components used in the systems and that these quality levels match InnospeXion's quality standards is of that reason big.

Growth

Because of the high quality level, InnospeXion often chooses collaborators and suppliers in Denmark. That ensures growth in smaller Danish companies and reduces outsourcing of Danish businesses. InnospeXion consider a common growth strategy in relations with the supplied products as a fundamental element in the co-operation between client and supplier. Contact

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