

Product presentation

# HEUFT *eXaminer* ' series

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## **HEUFT *eXaminer* " series**

The devices of the HEUFT *eXaminer* series cover a wide product spectrum of full container inspections by means of pulsed X-ray technology in packaged products. This applies to different packaging materials such as glass, metal, carton and plastic as well as different packaging sizes. Different modules for inspecting different areas of the container are combined with each other for this purpose. The generation of a "pulsed" X-ray beam for detecting foreign objects is unique worldwide.

### **Target group**

The HEUFT *eXaminer* " devices are used for inspecting filled glass, metal, carton and plastic containers along food packaging lines.

### **Which HEUFT *eXaminer* should I sell?**

The packaging as well as the place where the inspection takes place along the line determines the device group. This handout deals specifically with upright containers. It is important to understand the potential customer's task and then to prepare a tailor-made offer with an excellent price / performance ratio.

## **Presentation**

I will explain below what can be seen on the presentation slides and what can be said about them. We have deliberately not used much text when creating the presentation. The text should always be in the speaker's mind and the slides should not be cluttered for a presentation to be good. This is the reason for this description. Please learn it so that you bring it to life during the presentation. In this way you will get the most out of the material.

Please send an email to [marketing@heuft.com](mailto:marketing@heuft.com) should you have any questions, suggestions or do not understand something. Therefore all of us responsible for designing and looking after the presentations can access this. Furthermore we work closely with the Product Managers when creating the presentation. You can also ask them for advice if something is unclear.

## HEUFT *eXaminer* " basic presentation

### Slide 1 – overview HEUFT *eXaminer* series

The introduction slide provides a complete overview of the **HEUFT *eXaminer* series** as well as a few sample containers and faults which can be inspected. It therefore shows that HEUFT has tailor-made solutions for a wide range of customer applications.

**HEUFT *eXaminer* " XAC:** foreign object inspection of upright containers for the food industry – one of our most powerful slogans is certainly "glass in glass" inspection in this case.

**HEUFT *eXaminer* " XOS:** foreign object inspection of upright containers for the beverage industry – optical and radiometric procedures are combined here.

**HEUFT *eXaminer* " XB:** top-down foreign object inspection of horizontal packaging.

**HEUFT *eXaminer* " XT:** foreign object inspection in the pipeline.

**HEUFT *eXaminer* " XS:** foreign object inspection of upright containers for the food industry with the focus on metal, carton and plastic packaging.

### Slide 2 – foreign object management all along the line

Most customers are familiar with the foreign object inspector as the **critical control point (CCP)**. The empty bottle inspector is an underestimated tool for increasing quality assurance along a filling line in contrast to the beverage industry. The use of new glass alone is not a guarantee for containers without faults. Empty bottle inspection means a reduction in:

- the entry of foreign objects along the filling line
- the rejection of filled containers
- as well as an increase in the glass quality during the complete filling process

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Additional safety can also be achieved in certain applications by means of a pipeline inspection prior to the filling process.

## **Slide 3 – line overview**

**Overview of a filling line:** it is very clear to see in this diagram that HEUFT not only supplies uncomplicated foreign object inspectors but is also represented along the entire production line from inspection and container transport to equipment.

## **Slide 4 – turnkey solution**

**Turnkey solution:** HEUFT not only supplies uncomplicated inspection technology but always integrates this into the filling line as a complete solution which contains the following. This applies to all HEUFT *eXaminer* devices.

- inspection unit (e.g. X-ray inspection)
- operating unit (MHI)
- container tracking
- rejector
- reject verification
- rejection table
- conveyors
- motor

This is a significant advantage with regard to many competitors and should also be considered when comparing prices with the competition. The advantage for the customer is:

- no interfaces from different suppliers at the CCP
- no other suppliers are necessary for integration purposes
- solutions according to customer requirements possible

## **Slide 5 – easy access**

Easy access to all the components of the device for cleaning and maintenance –

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whether the inner inspection area, the infeed or the outfeed. All the detection modules and triggers can be accessed quickly. HEUFT *CleanDesign* → inclined surfaces allow fluids to drain off and result in easy cleaning and maintenance.

## **Slide 6 – clean design**

Accessible, clean and safe: its HEUFT *CleanDesign* predestines the system for use in hygienically sensitive areas.

Sloping surfaces facilitate cleaning and prevent the accumulation of stubborn dirt. Special channels and openings allow the liquids required for cleaning purposes to be drained off completely. Consequently dangerous germs and bacteria have no contact surface whatsoever. Specially constructed casings and doors create optimum accessibility. The electronics are totally encapsulated. Sensitive areas such as the inspection units are dust-proof and protected against contact as well as water jets.

## **Slide 7 – pulsed X-ray technology**

What does **pulsed X-ray technology** mean? The X-rays are generated electrically by means of high voltage and penetrate the container and the product. HEUFT only generates the X-rays when a container to be examined passes the respective inspection unit. The duration of the pulse lasts 1 ms (1/1000 second) and X-rays are only emitted in this short time. By way of comparison: a lightning bolt lasts 100 ms namely a 100 times more. The generation of an X-ray pulse (switching the high voltage) for inspecting foreign objects is unique worldwide.

## **Slide 8 – physical limitation / invisible? / visible!**

The object sinks if the density of a material is greater than the density of water (1 g / cm<sup>3</sup>). The object floats if the density of the material is less than 1 g / cm<sup>3</sup>.

The green steel ball sinks because steel has a greater density than water (about 7.8 g / cm<sup>3</sup>).

The grey wooden ball floats but half its volume sinks into the water because the density of wood is about 0.5 g / cm<sup>3</sup>.

The red plastic ball also floats and sinks even less because the density of plastic is only about 0.017 g / cm<sup>3</sup>.

## **Slide 9 – physical limitation**

What can be detected with X-ray technology? Can HEUFT detect plastic, bones, wood, stones, glass splinters and many other foreign objects? Can the competition do it?

1. Yes, X-ray technology can make all these foreign objects visible.
2. The packaging material has the greatest influence on what can be identified as a foreign object. The influence of the product is of no small importance either but this is not as strong as the packaging material.

What does this example show?

An alutray with pet food is inspected here: the foreign objects (each shown on the left) are placed on the alutray and then inspected.

The foreign objects made of plastic foil cannot be detected because their contrast is lower than the basic contrast of the alutray.

The foreign objects made of wood and rubber are easily visible in the X-ray image but they cannot be distinguished from the product reliably because the contrast is similar to that of the alutray / the product.

The foreign objects made of steel can all be detected reliably because their contrast is greater than the basic contrast of the alutray and the product together.

The foreign objects made of stone are easy to distinguish from the product. However it is evident that a certain material thickness is necessary here in order to be detected reliably.

## **Slide 10 – inspection technology influences**

Container structures

X-ray technology is based on the physical basis of absorption. Each material has a specific absorption with regard to X-rays. The strength of this absorption depends on the substances of which the material is made.

Materials can therefore differ in how well they can be identified / distinguished from each other depending on their composition.

A certain amount of X-ray energy is required when filling such materials in packaging in order to be able to illuminate the packaging. For example if this energy is too low the container and the product cannot be illuminated: the image is black.

The amount of energy required depends on how much the product itself absorbs but also on the container design.

Embossing, glass facets (angular containers) and alignment marks in the base or sidewall area are nothing more than glass enlargements which appear darker in the

X-ray image – the absorption is therefore higher.

Therefore faults which absorb the same amount can "hide" behind these structures and make a detection more difficult.

HEUFT relies on the nbx filter technology in this case. This is capable of filtering glass structures and ensuring a sensitive detection. Furthermore product inhomogeneities can be separated from foreign objects reliably.

## **Slide 11 – X-ray technology components**

Technologically HEUFT takes a fundamentally different approach. This also applies to X-ray technology. We use a so-called X-ray flash that acts on a full surface receiver in order to avoid the weak points of the scanner technology. The resulting sharp image and extremely high resolution are optimally adapted to the HEUFT image processing card. The device software uses the sharp X-ray image in order to distinguish and reject even the smallest glass fragments / foreign objects from the good product.

## **Slide 12 – HEUFT philosophy shifting register 1**

We see a conveyor belt with two trigger photocells, a detection and a rejector. The conveyor is running. The conveyor speed is calculated by counting the pulses of the encoder and multiplying by a conversion factor. The conversion factor (predivisor) depends on the size of the sprocket.

A virtual data sheet is generated when a container enters the device and interrupts the first photocell. This contains the information "fault yes" or "fault no" for each available detection. All the detections are set to "fault yes" at the time of generation. This ensures that there is no security risk should the detection malfunction.

The data sheet is shifted at the calculated conveyor speed and in principle moves with the real container.

A measured value is determined and compared to a nominal value at the position of the detection. The data sheet entry for this detection changes to "fault no" if the container is evaluated as "good".

This procedure is repeated for all the detections of the device.



The data sheet is evaluated before the rejection. This container is rejected if at least one data sheet entry is set to "fault yes".

This is not the case in this example. The container passes the rejector(s) and the last trigger photocell the so-called outfeed check. The data sheet is then deleted at a defined virtual location. The container continues in the good flow of the line to the next station.

## **Slide 13 – HEUFT philosophy shifting register 2**

A measured value is determined and compared to a nominal value at the position of the detection. The data sheet entry for this detection does not change but remains on "fault yes" if the container is evaluated as "faulty".

This procedure is repeated for all the detections of the device.

The data sheet is evaluated before the rejection. This container is rejected if at least one data sheet entry is set to "fault yes". Therefore the container is removed from the good flow. The data sheet continues to the next position – the outfeed check. The data sheet is deleted there if plausible.

## **Slide 14 – HEUFT philosophy shifting register 3**

The data sheet entry for this detection does not change but remains on "fault yes" if the container is evaluated as "faulty".

This procedure is repeated for all the detections of the device.

The data sheet is evaluated before the rejection. This container is rejected if at least one data sheet entry is set to "fault yes". The container arrives at the photocell of the outfeed check if the container is not correctly rejected at the rejector or returns to the good flow for some other reason. The plausibility of the data sheet is checked at the outfeed check. The container is found at the outfeed check although there is a data sheet entry with "fault yes". An error message is emitted immediately and the conveyor belts are stopped because this is only possible due to a malfunction and therefore there

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is an acute risk that a faulty container could pass through. The operator can and must remove the containers which pose a risk.

**Further advantages of the HEUFT shifting register:**

- continuous container tracking and assignment of the error condition in the data sheet to the corresponding container position
- automatic confirmation or repositioning of the container position at each trigger photocell
- no position adjustment necessary after replacing the encoder
- universal but nevertheless flexible system with a basic function which is the same in all the HEUFT devices
- malfunctions can be located very quickly by means of the help and information which the system can provide
- safety functions cannot be manipulated by the operator
- containers which have slid around a great deal can no longer be clearly assigned to the data sheet and are rejected as a precaution and do not represent a safety risk (stopping the line is therefore not necessary in most cases)

**Advantages that can be "grasped" by the customer:**

- reduction in the false rejection rate
- safe rejection because we know where the container is
- a container which slides around cannot be inspected => rejection for safety reasons so that this container does not reach the customer
- malfunctions at the device lead to a rejection for safety reasons because an inspection cannot be carried out => no uninspected containers reach the customer => CCP
- containers which are next to the container to be inspected are not taken into consideration during the inspection and therefore do not lead to a misinterpretation (this is the case with a scanner)

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## Slide 15 – additional equipment

This deals with additional equipment. HEUFT not only supplies a device but a turnkey solution. We have all the necessary equipment in our portfolio for this. And this is also at the usual high HEUFT level.

## Slide 16 – rejectors

The different rejection systems are introduced here.

**Please note:** the HEUFT *e-mono* has been revised and now has (among other things) a longer stroke which was further developed in response to projects with heavy (filled) containers! This is, to put it simply, an electrically powered HEUFT *mono*. Therefore it was never intended for a dynamic distribution of the containers onto parallel conveyors and into a bin. Such a compact rejection system is being designed.

## Slide 17 – conveyors

We offer everything from conveyor mechanics to conveyor drive and conveyor control in the field of container transport.

The HEUFT *conveyor* stands for high-quality and well thought-out solutions regarding conveyor construction. Thus HEUFT has developed an extensive and flexible modular conveyor system which is suitable for every installation position based on decades of experience in project planning. The construction is precisely tailored to the special requirements of the inspection and rejection sections. Only a stable construction makes a permanently quiet inspection and trouble-free rejection possible. Investments in this area pay off with regard to an increase in effectiveness in production.

The conveyors can be driven highly efficiently with the motors of the HEUFT *beetec* series. They not only use considerably less electricity in the course of this but are also almost wear-free because they drive the conveyor directly and additional gears are not necessary.

**Please note:** in the meantime a version of the HEUFT *beetec* is also available with more power for mass transport. Therefore fully equipping filling lines with HEUFT *beetec* motors is possible without restrictions!

Conveyor construction and drive are also always combined with the conveyor control system. We have the HEUFT *synchron* on offer here. It ensures an efficient, careful

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and quiet container transport at all times. Our customers benefit from our many years of experience here too.

Important! The HEUFT *beetec* only makes sense if entire sections are to be renewed because a complete HEUFT electronic system has to be used. Individual drives in a "normal" motor environment make no sense because the technical and financial investment is very high.

### **Why do we also deal with "what's around" the device?**

A good container transport is also always required for the inspection to function correctly. Containers which slide around can cause high false rejection rates because the container tracking does not function correctly. As a result a large number is rejected after the inspector and even though it is not responsible in any way the device is blamed.

False rejection rates and even crashes can also occur when containers are pushed into the inspector due to a bad conveyor control system which can cause a stop with complex clearing up work. This happens inside the inspector and therefore the blame is also placed here again.

Furthermore the best inspection is of no use if the faulty containers are not rejected consistently and reliably. This is all about a perfect interaction between the conveyor control system and the rejector.

Past experience has shown that this has caused major problems again and again regarding co-operation with third party manufacturers. Thus the blame was passed back and forth and the customer suffered. That is why all these important components are available from one source at HEUFT. In this way we ensure that our inspectors operate efficiently and reliably.

## **Slide 18 – PDA**

We also provide solutions for every application in the area of production data acquisition (PDA) and line analysis in real time with the HEUFT *PROFILER* family.

The HEUFT *PROFILER elemental* is the entry level variant. It is installed on one of the customer's PCs and only covers production data acquisition for the HEUFT devices.

The HEUFT *PROFILER* is a server solution in conjunction with a HEUFT *STRATEGY*. Here too only the data from the HEUFT devices can be captured.

The HEUFT *PROFILER advanced* also makes the connection and acquisition of non HEUFT devices possible in addition to the HEUFT *PROFILER*.

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## HEUFT *eXaminer* " XAC

The HEUFT *eXaminer* " XAC is the further development of the HEUFT *eXaminer* XAC based on the HEUFT *SPECTRUM* " generation. The components for generating the X-ray beams, the image processing in the hardware and software, the automatic brand change by means of servomotors as well as the HEUFT *NaVi* machine human interface have been further developed.

### What does the abbreviation XAC stand for?

The HEUFT *eXaminer* refers to the full container inspector in general.

The HEUFT *eXaminer* " XAC stands for a foreign object detection by means of X-rays for liquid and paste-like products (XA) and a table version with the HEUFT *CleanDesign* (C).

HEUFT *eXaminer* " XA = foreign object detection by means of X-rays for liquid and paste-like products

C = table version with the HEUFT *CleanDesign*

### Target group

The HEUFT *eXaminer* " XAC is used for inspecting filled glass, metal, carton and plastic containers along food packaging lines. Typical products are disposable glass containers as well as metal cans.

## Slide 19 – introduction slide HEUFT *eXaminer* " XAC

Overview slide as can also be seen in the food brochure. This creates a recognition value.

## Slide 20 – containers

This is an overview of which containers are inspected as standard with the HEUFT *eXaminer* " XAC (from left to right):

**Preserving jar with gherkins** – large containers are very often inspected here with a height of 160 mm and a diameter of up to 150 mm. Focus: "glass in glass".

**Food can** – different sizes with a filling capacity of 200 g up to 5 kg. Focus: "metal in metal".

**Angular jam jar** – the glass containers usually have an appropriate design (embossing, corners, oval or facets) in order to influence the consumer's purchasing decision at the point of sale in favour of the visual appearance. The challenge here is to tolerate structures and logos in the glass and to carry out an inspection even in these critical areas. Another challenge is that the foreign objects usually sink to the base (as in water) during the hot filling process and the resulting low viscosity. Here the double base inspection from HEUFT makes an important contribution to the detection of weakly absorbing foreign objects in the base area.

**Round baby food jar** – these glass containers have fewer limitations on the inspection of foreign objects.

**Preserving jar with olives** – the packaging is often filled with highly inhomogeneous products. The challenge here is to tolerate the air bubbles and product fluctuations which occur there and to carry out an inspection even in these critical areas.

**Plastic bottle with mayonnaise** – plastic containers are usually very good to inspect because they vary significantly less regarding the material thickness of the sidewall as well as the base. The container is transported upside down as shown in this example.

## Slide 21 – turnkey solution

**Turnkey solution:** HEUFT not only supplies uncomplicated inspection technology but always integrates this into the filling line as a complete solution which contains the following:

- inspection unit (e.g. X-ray inspection)
- operating unit (MHI)
- container tracking
- rejector
- reject verification
- rejection table
- conveyors
- motor

This is a significant advantage with regard to many competitors and should also be considered when comparing prices with the competition. The advantage for the customer is:

- no interfaces from different suppliers at the CCP
- no other suppliers are necessary for integration purposes
- solutions according to customer requirements possible

The HEUFT *eXaminer* " XAC with a length of 2,469 mm (without a rejection table) and a width of 1,066 mm is space-saving compared to our competitors. It is important to remember that up to three X-ray inspection units can be accommodated here. It is important to note that the entire inspection is provided including radiation and mechanical intervention protection implemented by means of infeed and outfeed tunnels. The necessary tunnels are often not offered by our competitors and have to be retrofitted subsequently.

## Slide 22 – the detection modules

Section of the HEUFT *eXaminer* " XAC to show the **arrangement of the individual inspection modules**. It is possible to equip up to three X-ray inspection modules with a total of four X-ray generators. An individual solution is possible for the different requirements of the customer. The minimum equipment is the sidewall inspection.

**Example:** the **glass in glass** inspection for liquid products. Here it makes sense to use the double base inspection as well as one or two sidewall inspections depending on the height of the container. This makes maximum inspection performance on the base and a sufficient height coverage of the container possible.

**Example:** the **inspection of large cans**. It makes sense not to use the base inspection in order to achieve the maximum height coverage of the container height. This may lead to a reduction in the inspection performance on the base but it has the advantage that the maximum container height of 240 mm can be reached with three sidewall inspection modules and blind areas for larger containers can be excluded. The possible configurations of the inspection modules should always be selected according to container, product and customer requirements.

## **Slide 23 – double base inspection**

**Double base inspection:** here the X-ray examination is carried out at an angle from below and above by means of two X-ray generators so that foreign objects in front as well as behind the base curvature can be projected onto the image converter without interference. Blind areas are thus prevented. Furthermore the detection has a very compact design due to this special arrangement of the X-ray generators. This particular type of X-ray examination is only possible because a special conveyor chain, made of a material which is transparent to X-rays, is used inside the HEUFT *eXaminer*.

The diagram shows clearly how both X-ray beams spread conically from the generators through the container base and the special conveyor chain and arrive at the image converter. It is possible to inspect 360° of the container base due to this arrangement. The diagram on the right is the result of the double base inspection: the arrangement of the generators provides a view behind as well as in front of the dome. The dome covers the glass fragment and there are blind inspection areas into which foreign objects can disappear if this base area is only inspected from the side.

## **Slide 24 – explanation of the double base inspection**

Modern inspection systems have to adapt more and more to the increasing flexibility along filling lines. This includes different products in the same packaging or the same product in a variety of packaging. This applies to different packaging materials such as glass, metal, carton and plastic as well as different packaging sizes.

The biggest challenge from the inspection technology perspective is the strong fluctuation of the containers to be inspected due to different suppliers for the same packaging. These fluctuations are now tracked dynamically during the double base inspection and individually for each incoming container. On the one hand this makes a reduction in the false rejection rate possible but also a significant increase in sensitivity:



thick or thin glass bases no longer protrude into the formerly static masks and thus cause rejections.

**Video 1:** double base inspection – natural variations

Shows the double base inspection in the original view. It can be clearly seen here how much the glass thickness varies in the base area. This can be seen by the thickness of the base on the one hand but also by the wall thickness in the outer area.

**Video 2:** double base inspection – inner edge centring

The position of the inner edge is recorded for each individual container in order to inspect the base area reliably. This determination takes place individually for each single container (dynamically).

**Video 3:** double base inspection – dynamic tracking of the inspection masks

The dynamic tracking of the inspection masks is possible due to the inner edge centring – in this case the histogram detection. The result for each individual image of the container base: the inner edge is recorded and the inspection masks adapted accordingly → **dynamically and flexibly towards varying bases.**

**Advantages of the double base inspection:**

1. 360° coverage of the base.
2. View confirmation from both views as well as the histogram detection increase the detection of weakly absorbing faults such as glass fragments.

## **Slide 25 – enlightenment base inspection**

**Video 12:** sidewall 1 – rotation foreign objects base

This video shows a glass fault (ball) lying directly on the base in the outer area (knurling mark area). We want to show here that faults which are directly on the base are covered by the glass dome of the jar when looking at a glass container with only one sidewall. Therefore a 360° coverage of the base area is not possible with only one sidewall inspection. Detection is only possible if the fault is really on the outside (on the left as well as on the right). This type of inspection corresponds to that offered by most of our competitors.

**Video 13:** base – rotation foreign objects base

The video shows the same container with the same fault as in Video 12 but recorded with our base inspection. It is clear to see that there are no blind areas on the container base when compared to a pure sidewall inspection. 360° coverage of the container base and that twice. The second time is very important and another strength of our base detection (see Video 14).

**Video 14:** base objects – rotation foreign objects base

This video shows the same container with fault as in Video 13. Except that the object marking has been activated in this case. Therefore the fault is marked by the individual detection modules (in colour, with an arrow and a blue / yellow rectangle).

It is important that the fault is illuminated by means of a second 360° coverage of the base from different angles and that the detection performance increases as a result: this is not the case with only one base detection (competition). This is shown in red by the object detection (pixel counting).

Furthermore we mark the fault with an arrow – the so-called view confirmation. This is a further "weapon" in order to be able to detect a foreign object more reliably.

Both views ask whether the other has detected the fault or not. When only one view is sure that it is a fault but the other one is not we amplify the uncertain area by 27 dB and the fault which was not detected before now becomes visible. This is made visible by means of the two arrows: both views confirm one another.

A view confirmation cannot be carried out if there is only one base detection with one image because the second image is missing. The fault is not detected and passes through if the one view is not certain.

The last software evaluation is the histogram detection – the blue / yellow rectangle.

An X-ray image is always black and white. Thus the colour spectrum cannot be evaluated as, for example, with a HEUFT *InLine*. This area is shown darker if there is now a glass fragment on the base. This darkening can be evaluated by the histogram detection and assessed as a fault.

Thus the histogram detection evaluates the distribution of the shades of grey in the X-ray image. We also work with a confirmation in this case. Therefore there are blue and yellow masks in order to show that they belong to each other. This evaluation is not given with a base detection either but is our greatest weapon and one of the biggest advantages in the evaluation particularly with broken pieces of glass.

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This whole package is the reason why we have the strongest market solution in the base area.

## **Slide 26 – sidewall module**

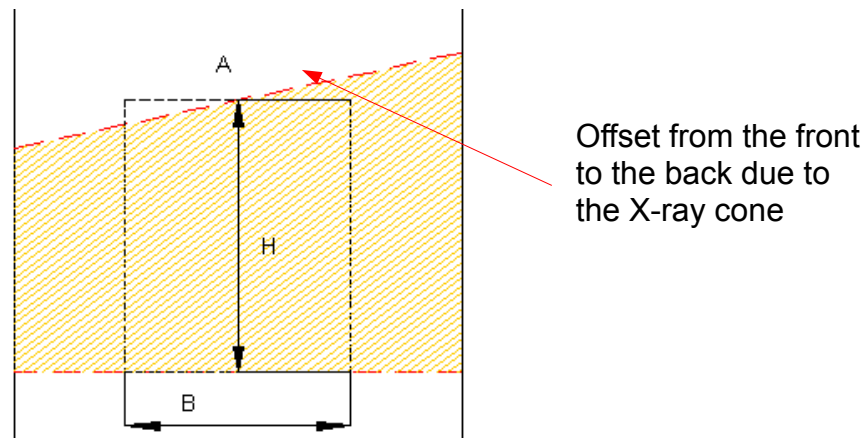
### **Sidewall 1 & sidewall 2 – overview**

The sidewall inspection is indispensable particularly in the case of containers with paste-like or solid products. Here a foreign object does not necessarily sink to the base of a container but can remain in the lateral area of the container in contrast to liquid products. The base inspection cannot detect such a foreign object. Therefore it makes sense to use a sidewall inspection in addition to the base inspection for paste-like products.

Two sidewall inspections have to be used as from a certain container height. In this case one sidewall inspection is in the infeed and another one in the outfeed of the device.

### **Why does HEUFT use two separate sidewall emitters?**

The front and rear edge of the upper section of a container are offset when one emitter is used. This offset occurs because the X-ray beam is emitted from the generator in the shape of a cone:



Faults which are now in the front area of the container are projected upwards towards

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the back by means of the X-ray cone and are then in the lid area where a detection is no longer possible.

Thus a large part of the upper area of the container is not inspected.

This offset does not occur with HEUFT – firstly due to the two separate generators and secondly because the height of the second generator is electrically adjustable and can be optimally moved into the fill level.

The lower generator is aligned so that it looks straight over the base area.

This is necessary so that the glass dome fluctuations of a glass container can be absorbed dynamically. The fluctuations of the glass distribution generally lead to the fact that the sensitivity in this area has to be reduced considerably in order to be able to absorb all the fluctuations. This is not necessary due to the separate sidewall arrangement in conjunction with the dynamic HEUFT filtering.

Another innovation is that a glass fault in the sidewall area is illuminated from different angles due to the oblique angle of vision of both the generators in relation to each other.

Thus the double sidewall principle is taken up where both generators are at the same height but not the weak point so that a gap has to be created between the containers.

The containers can be transported close together due to the new illumination from above and below. The advantage that the glass fragment is illuminated from different angles is of enormous benefit for the sensitivity.

## **Slide 27 – sidewall inspection**

### **Sidewall 1**

The sidewall inspection in the outfeed (sidewall inspection 1) has a fixed installation height and inspects the lateral area directly above the conveyor belt (lower part of the container as from the container base). It is important to mention the glass dome of each glass container here which can fluctuate upwards and downwards as well as to the left and right side at random. Statically absorbing these fluctuations reduces the maximum sensitivity but also provokes a high false rejection rate because the glass dome can fluctuate in the sensitive area of the mask (Video 5).

Improved process regarding the **centring for the sidewall inspection**. The base is measured separately for each individual container and the inspection masks adapted to this → dynamically and flexibly towards varying container dimensions.

## **Slide 28 – explanation of the sidewall inspection**

### **Sidewall 1 – videos**

#### **Video 4:** sidewall inspection 1 – fluctuation dome

Shows the view of sidewall inspection 1 with the focus on the lower area of the container. Since we are looking straight over the dome this is easy to see and fluctuations in the dome area are clearly visible.

#### **Video 5:** sidewall inspection 1 – rim filter

Shows sidewall inspection 1. It can be clearly seen here how every single dome of a container is measured. The starting point of the sensitive inspection mask is determined above the dome based on this measurement.

#### **Video 6:** sidewall inspection 1 – fault in the base area

Shows sidewall inspection 1. It can be clearly seen here how every single dome of a container is measured and how the rim filter adapts to the varying base structures. Everything above this detected dome line will be inspected. This can be seen here with the foreign objects next to the dome. They are all distinguished from the structure of the dome and detected as foreign objects.

## **Slide 29 – double sidewall inspection**

### **Sidewall 2**

The second sidewall inspection with the focus on the fill level area is used to ensure an optimum detection of faults in the fill level area. It is adjusted by motor and automatically for the respective height of the fill level during the automatic brand changeover.

## **Slide 30 – explanation of the double sidewall inspection**

### **Sidewall 2 – videos**

#### **Video 7:** sidewall 2 – fault in the fill level area

HEUFT uses a separate, second sidewall detection in order to be able to cover the entire height of a container. This sidewall is placed on the first sidewall in order to be able to cover higher containers. In addition the second sidewall can be vertically adjusted by motor so that it is always possible to look straight through the fill level area

for containers of different heights.

Faults in the fill level area are critical when using an X-ray generator to inspect the sidewall with a fixed vertical position. The physical background is that X-rays spread conically. The fill level area is inspected at an angle and foreign objects cannot be detected 100% if the focus is e.g. in the middle of the container. These blind areas do not occur with the second sidewall inspection because the focus of the X-ray generator is always on the fill level for each brand. Thus we always look straight through the fill level – faults in the fill level area are detected with 100% reliability!

#### **Video 8: sidewall 1 and 2 – overlapping**

The unique solution of using two generators at different heights not only has the advantage that the fragment is illuminated from different angles (double beam solution) but the fragment is also always seen twice in the sidewall area depending on the container height and the overlap between both the detections.

This further increases the reliability of the detection of glass fragments.

Optimal overlapping in the middle sidewall area is always guaranteed because the upper sidewall can be adjusted optimally by motor depending on the brand.

## **Slide 31 – enlightenment sidewall inspection**

#### **Video 10: sidewall 1 – rotation foreign objects fill level**

This video (see also text Slides 15 and 19) shows a foreign object in the fill level area.

The container is rotated 360° in the detection by motor.

The upper sidewall generator looks from the X-ray cone from bottom to top through the fill level area.

It can be clearly seen that the foreign object on the generator side (namely in the front of the container) is visible due to the oblique illumination. The foreign object moves upwards into the lid or threaded area of the container due to the oblique illumination if the foreign object turns towards the receiver side (at the back of the container).

Dark areas can be seen in these areas which absorb similarly or identically to the foreign object. Thus a detection is prevented.

This is the problem with an oblique illumination. The inclination in this video is still harmless. Sometimes the lid of our competitors is really "opened up" so that you think you are looking at it from above:



Lid which has burst open badly – example can. The ring pull is also in the image.

12 oz. can with needle inside

This "oblique viewing angle" prevents:

- 360° coverage of the fill level area
- a sensitive inspection of the fill level area because structures such as the ring pull or the thread and lid area are in the image

#### **Video 11:** sidewall 2 – rotation foreign objects fill level

The HEUFT solution: the straight view! Second sidewall adjustable by motor. Always a straight view of the foreign object through the fill level. No interfering structures in the image which cover the foreign object or have to be tolerated.

## **Slide 32 – evaluation extension (fill level detection)**

### **Fill level optional**

#### **Video 9:** sidewall 2 – fill level detection

A great advantage of the second sidewall is that the fill level in the container can be checked without an additional measuring bridge. Therefore an underfilled container can be clearly detected. It is important to understand that the products of the food industry do not only consist of liquid but usually contain solid products. Therefore there is no exact fill level measurement in this case as with beverages. It is not wrong to speak of a "rough" fill level detection here and this does not raise false expectations.

## **Slide 33 – equipment option for maximum inspection height**

It is possible to replace the double base inspection with a sidewall inspection if the double sidewall inspection cannot cover the entire container height. This triple sidewall inspection can inspect very high containers reliably from the lowest to the highest point of the container.

## **Slide 34 – additional inspection**

A fundamental strength of the HEUFT device philosophy is that meaningful inspections can be combined in one device. Therefore additional devices are not required.

Detections can also be retrofitted later.

Foreign object detection combined with: pressure detection, closure presence, BBD examination and label presence.

Of course HEUFT can ensure that the different faults are separated onto different rejection lanes. Better safe than sorry.

## **Slide 35 – summary as video**

Summary of advantages and USP

The video summarises the above arguments well in pictures:

no container gaps necessary, variable conveyor speed, low radiation exposure, sharp images, start / stop possible in the device, straight view into the fill level area, optional conveyor control and conveyor construction etc.

We would like to assign individual sequences from this video to the points in this document in order to provide visual support for the written word. The so-called "aha, now I get it" effect.

## **Slide 36 – summary as slide**

Full detection reliability during the high-speed examination of up to 1,200 products per minute using a pulsed X-ray inspection for food cans, doypacks, beverage cans or carton and plastic packaging.

Foreign object inspection using X-rays as a turnkey solution (see Slide 4 – turnkey solution)



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For the customer everything from a single source means that every HEUFT device contains in-house developed hardware and software components. These are based on a common device platform as well as their own operating system. The hardware and software for image evaluation and network technologies are standardised components. This reduces the OPEX cost structure in the case of several HEUFT devices. In addition these components have a spare parts availability of at least 12 years which makes a flexible amortisation period possible.

The compact system of the new generation can be extended by means of further modules and is available in different variants depending on the type of packaging.

The HEUFT *SPECTRUM*'' head as the central control unit of the highly automated modular solution can be positioned almost anywhere – even far away from the actual foreign object inspection. In addition further detections and inspection units from the HEUFT *SPECTRUM*'' VX portfolio can be used.

Customer-specific integration solutions according to customer requirements: integration into the overall concept of the system is an integral part of the HEUFT philosophy regarding testing technology. This enables standardised integration solutions and a one stop shop approach which result in cost savings and standardisation.

The worldwide unique pulsed X-ray technology from HEUFT: optimised high-voltage components and X-ray generators are integrated in a casing in order to generate the X-ray flash. This simplifies the certification of the X-ray components and makes the fast replacement of the components possible.

The HEUFT *reflexx* real-time image processing system clearly differentiates between harmless product inhomogeneities and critical foreign objects or defects which leads to a higher detection performance with a low false rejection rate.

Different sizes of full-field image converters are used for a high resolution on the receiver side which allows a greater variance in product height.

Start and stop within the machine is possible due to pulsed X-ray technology and reliable container tracking.

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An unequalled low radiation dose for products and environment due to pulsed X-ray technology.

The HEUFT *NaVi* creates the separation between the user interface and the adjustment interface for product and production safety. Manipulation and intervention by unauthorised persons are strictly reduced which ensures the continuous use of the inspection device with a validated inspection range.

The audiovisual user guidance is supported by HEUFT *checkPoints* and shows the user exactly where he has to intervene by means of flashing tags.

Simple operation by means of a touchscreen and the real-time display of the inspection images in a widescreen format in order to make it easier for the operator to draw conclusions.

Regular checking of the functionality of the detections during ongoing production by means of test bottle logs.

This makes the new HEUFT *eXaminer* <sup>II</sup> XS a real turnkey solution at the end of the line which can be tailored to a wide range of requirements and applications flexibly and provides clear results not only for the targeted detection of foreign objects.

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## HEUFT *eXaminer* " XB

### Slide 37 – introduction slide HEUFT *eXaminer* " XB

Top-down inspection with pulsed X-ray technology based on the HEUFT *SPECTRUM* "

### Slide 38 – turnkey solution

**Turnkey solution:** HEUFT not only supplies uncomplicated inspection technology but always integrates this into the filling line as a complete solution which contains the following:

- inspection unit (e.g. X-ray inspection)
- operating unit (MHI)
- container tracking
- rejector
- reject verification
- rejection bin
- belt
- motor

This is a significant advantage with regard to many competitors and should also be considered when comparing prices with the competition. The advantage for the customer is:

- no interfaces from different suppliers at the CCP
- no other suppliers are necessary for integration purposes
- solutions according to customer requirements possible

The HEUFT *eXaminer* " XB with a length of 2,060 mm and a width of 1,125 mm is comparable with the solutions from our competitors. It is important to note that the entire inspection is provided including radiation and mechanical intervention protection implemented by means of infeed and outfeed tunnels. The necessary tunnels are often not offered by our competitors and have to be retrofitted subsequently.

## **Slide 39 – top-down inspection single lane**

The product is illuminated from top to bottom by an X-ray flash at the optimal position (controlled by a photocell) whilst being transported. The X-rays reach the receiver through the product and the conveyor belt. There is a maximum displayable height for the different product widths because the X-rays leave the X-ray generator in a conical shape:

the top-down inspection with a single lane uses an X-ray generator and a receiver. This single beam version is suitable for small products.

The inspection has to be carried out using several photographs (the so-called multiple flash) if the length of the product to be inspected is greater than that of the radiation cone of the X-ray flash.

## **Slide 40 – top-down inspection single lane wide**

The product cannot be covered by one receiver if it is wider. For this reason two generators and two receivers are used for the top-down inspection with a single lane. The staggered arrangement one behind the other makes it possible to inspect larger product dimensions. This double beam version is suitable for wider products.

The inspection has to be carried out using several photographs (the so-called multiple flash) if the length of the product to be inspected is greater than that of the radiation cone of the X-ray flash.

## **Slide 41 – summary as slide**

See Slide 36

## **HEUFT *eXaminer* '' XS**

### **Slide 42 – introduction slide HEUFT *eXaminer* '' XS**

Overview slide as can also be seen in the food brochure. This creates a recognition value. Also a brief overview of which containers are inspected as standard with the HEUFT *eXaminer* '' XS (from left to right):

**Food can**

**Plastic bottle**

**Carton package for bulk goods**

**Carton package for beverages**

**Stand-up pouch (doypacks)**

**Beverage can**

### **Slide 43 – turnkey solution**

Turnkey solution: HEUFT not only supplies uncomplicated inspection technology but always integrates this into the filling line as a complete solution which contains the following:

- inspection unit (e.g. X-ray inspection)
- operating unit (MHI)
- container tracking
- rejector
- reject verification
- rejection bin
- chain
- motor

This is a significant advantage with regard to many competitors and should also be considered when comparing prices with the competition. The advantage for the customer is:

- no interfaces from different suppliers at the CCP
- no other suppliers are necessary for integration purposes
- solutions according to customer requirements possible

The HEUFT *eXaminer* " XS with a length of 1,980 mm (casing) and a width of 1,065 mm is more compact than most of the solutions from our competitors. It is important to note that the entire inspection is provided including radiation and mechanical intervention protection implemented by means of infeed and outfeed tunnels. The necessary tunnels are often not offered by our competitors and have to be retrofitted subsequently.

## **Slide 44 – single sidewall inspection**

The sidewall inspection has a generator and a receiver. The viewing angle is horizontal at the base and therefore there is no need for a vertical adjustment or a special chain for X-rays. The sidewall inspection is suitable for packaging with a low height as well as packaging with a higher height where only the lower part has to be inspected.

## **Slide 45 – double sidewall inspection**

The double sidewall inspection has two generators and two receivers. Each generator / receiver unit is on a vertical level. The upper level can be vertically adjusted by motor so that it can be adapted to different packaging heights. The viewing angle of the upper level is horizontal to the fill level. The viewing angle of the lower level is horizontal at the base analogous to the sidewall inspection. A special chain for X-rays is not necessary. The double sidewall inspection is suitable for packaging where a greater packaging height has to be covered and a high detection performance over the entire sidewall area is required especially in the fill level area.

## **Slide 46 – extended sidewall inspection**

A panorama generator and a double flat panel are used for the extended sidewall inspection. The viewing angle is horizontal at the base and therefore there is no need for a vertical adjustment or a special chain for X-rays. Considerably more height can be

covered by the panorama generator and the larger flat panel compared to the sidewall inspection. The lower area of the packaging can be reliably inspected. The angle of the X-ray beam increases with an increasing packaging height which has an impact on the detection performance in the upper area of the packaging. The extended sidewall inspection is suitable for high packaging with a low fill height. It is also an attractively priced "just enough" solution (like competitors) for large packaging with a limited detection performance in the upper range.

## **Slide 47 – Single base inspection**

A generator and a panel are aligned so that the container base is illuminated at an angle from above for the base inspection. It is used to detect foreign objects exclusively in the base area of the container. Note: the special conveyor chain for X-ray inspections from HEUFT must be provided for this inspection. Therefore the selection of a HEUFT *conveyor* in the configurator is binding. The base inspection is suitable for packaging made of weakly absorbent materials and a simple base structure for inspecting the container base.

## **Slide 48 – Base and sidewall inspection**

A panorama generator and a double flat panel are used for the base and sidewall inspection. The panorama generator, which can be vertically adjusted by motor, is aligned in such a way that the fill level is displayed horizontally. The base of the container is illuminated at an angle from above at the same time. Note: the special conveyor chain for X-ray inspections from HEUFT must be provided for this inspection. Therefore the selection of a HEUFT *conveyor* in the configurator is binding. The base and sidewall inspection is suitable for packaging where the filling area must be inspected reliably and the entire container height has to be covered by the inspection. The oblique view into the base area can provide advantages for certain packaging in terms of detection performance.

## **Slide 49 – base and sidewall inspection**

The same as Slide 46 but with carton packaging for bulk goods.

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## **Slide 50 – summary as slide**

See Slide 36

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