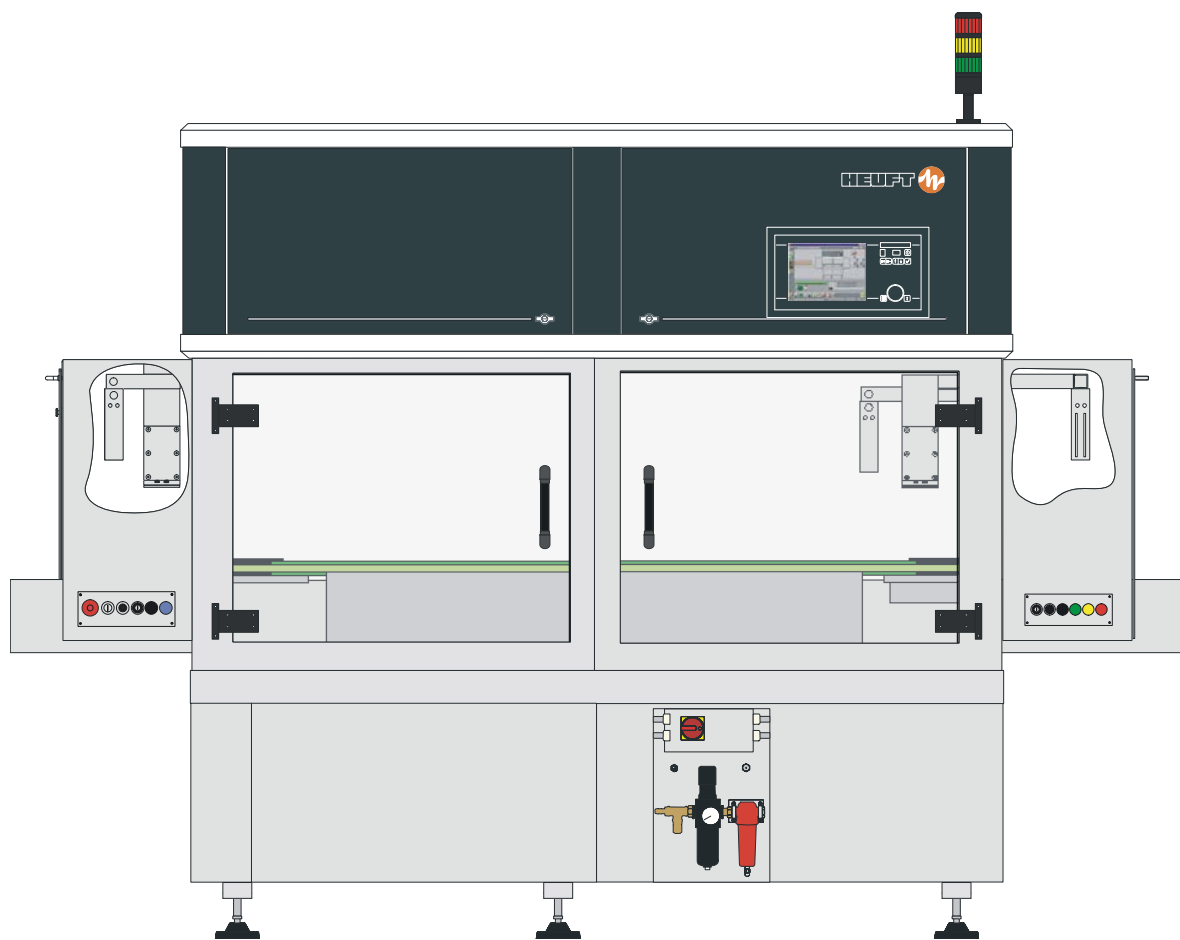


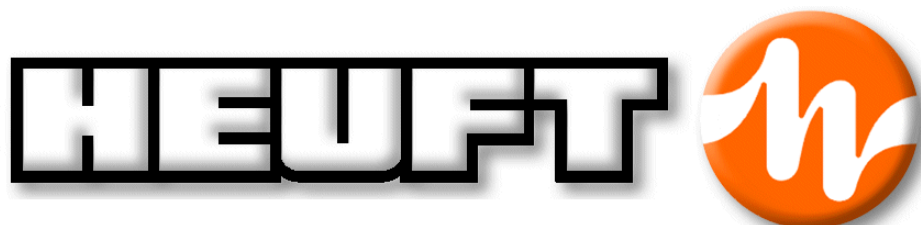
HEUFT



Technical Documents
FLD X-ray, HEUFT *squeezer QL*

HBDR1116A ENG 11.00 Technische Unterlagen Röntgen *squeezer QL*





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Version	Date	Comments
11.00.001	24.03.2011	Translation of the original German documents

It is possible that this documentation still contains printing errors. However its contents are regularly checked and all future editions are amended accordingly.

We reserve the right to make modifications which may become necessary due to technical progress.

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Technical documents FLD X-ray, HEUFT *squeezer QL*

1. Rating of the X-ray generator unit

Maximum operating value of the X-ray generator:

60 kV / 120 μ A

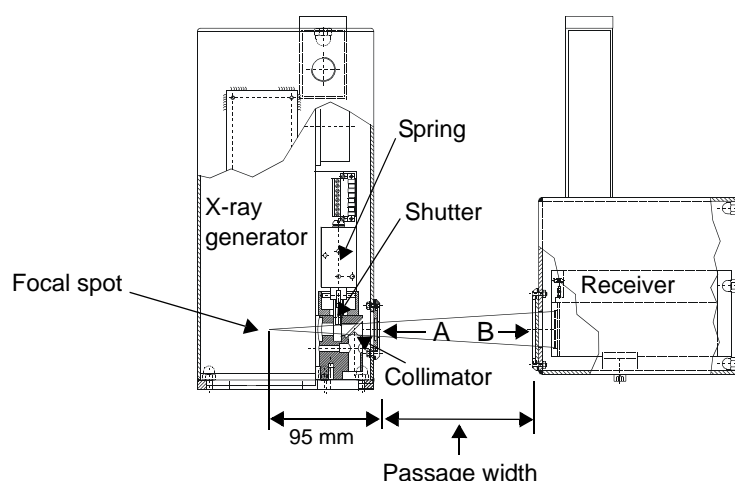
The X-ray tube, high-voltage generator and protective casing for the tube form a unit the manufacturing number of which can be read on the outside and is applied underneath the measuring bridge.

The active radiation is completely absorbed on the side of the receiver casing so that no direct rays pass the casing.

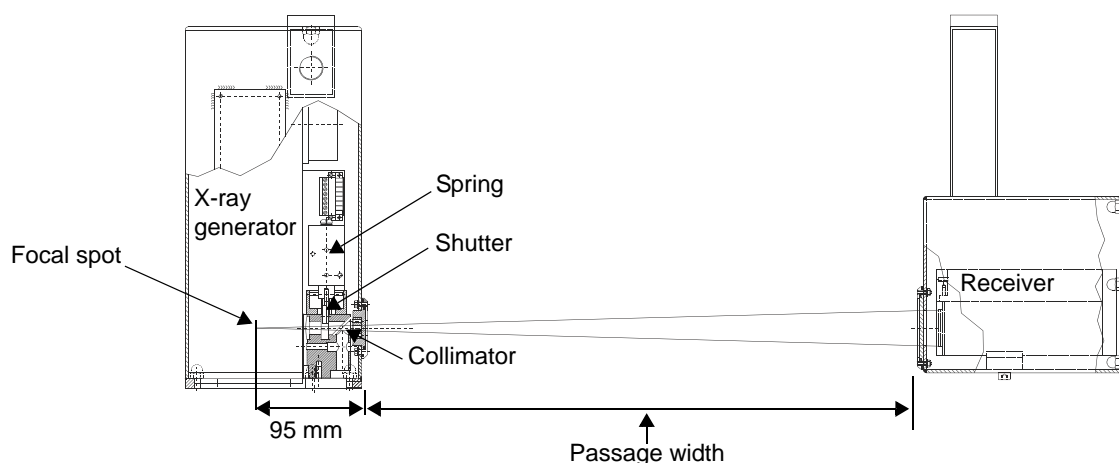
The size of the radiation exit angle is limited by a collimator:

Variant	1	2
Dimensions of the surface "A" exposed to radiation on the emitter side (slot):	4 mm x 9 mm	4 mm x 9 mm
Dimensions of the surface "B" exposed to radiation on the receiver side (slot):	10 mm x 22 mm	24 mm x 54 mm
In the case of a standard passage width:	130 mm	467 mm
Manufacturer of the X-ray generator unit:	HEUFT SYSTEMTECHNIK GMBH	
Type approval:	BfS 20/04 R R6V	

Variant 1 (measuring bridge outside conveyor belts area):



Variant 2 (measuring bridge inside conveyor belts area):



2. Function of the fill level detection

In the drink filling and food industries metal and non-metal containers are filled with products. According to legal regulations the actual filling quantity may only deviate from the respective nominal filling quantity within narrow limits. For this reason checking and possibly regulating the automatic filling process is of great importance to the operator of such a bottling plant.

A very precise and reliable possibility of checking the fill level is to measure the absorption rate of an X-ray which depends on the fill height inside the container. This method can even be used if other technologies (e.g. the high-frequency measuring technology) are not applicable due to special boundary conditions (e.g. in the case of metal containers or metallised labels on the packaging).

In the arrangement explained here an X-ray generator unit is assembled in such a way that the X-rays emitted run horizontally through the containers to be checked in a very narrow area. The X-ray tube is adjusted approximately to the height of the nominal fill level. A receiver is assembled accordingly on the other side of the container which records the rate of the incoming X-rays. The damping of the rate is then directly proportional to the current fill height of each container running between the transmitter and the receiver. Downstream measuring and evaluation software is able to determine the respective fill height from the damping and reject incorrectly filled containers from the flow of correctly filled containers. Two measuring bridges can be operated in parallel if a container is to be checked for underfilling as well as overfilling.

Due to the physical features of the radiation used it is important that apart from meeting the requirements concerning the measuring method the radiation protection regulations of the device are always particularly observed. The long years of experience gained by the HEUFT SYSTEMTECHNIK GMBH company concerning the handling of similar measuring equipment have thus served as a basis for the present safety concept.



HEUFT SYSTEMTECHNIK GMBH uses ionising radiation exclusively for checking and control purposes in accordance with the European Directive 1999/2/EC / Article 1 / Paragraph 2. The radiation dose used for this is too low to be employed for preservation purposes and it is not intended to apply the radiation for this purpose.

3. Safety concept of the X-ray fill level detection

3.1 Screening of the X-ray tube

The X-ray tube and the high-voltage generator form an inseparable unit. Both components are placed in a cylindrical metal casing and then encapsulated. The cylinder and the shutter unit are placed upon a base plate. This unit is referred to as the X-ray generator. The X-ray generator is the smallest replaceable unit (it must not be disassembled into individual parts on site at the customer's under any circumstances). There is a name plate with the serial number of the X-ray generator on the lower side of the base plate of the X-ray generator.

The X-ray generator is integrated into a measuring bridge casing made of V2A steel which attenuates the leakage radiation of the casing outside the effective radiation beam to values below 1 $\mu\text{Sv/h}$. The radiation only proceeds within the intended radiation path because the X-ray generator can only be installed in the measuring bridge in one intended direction.

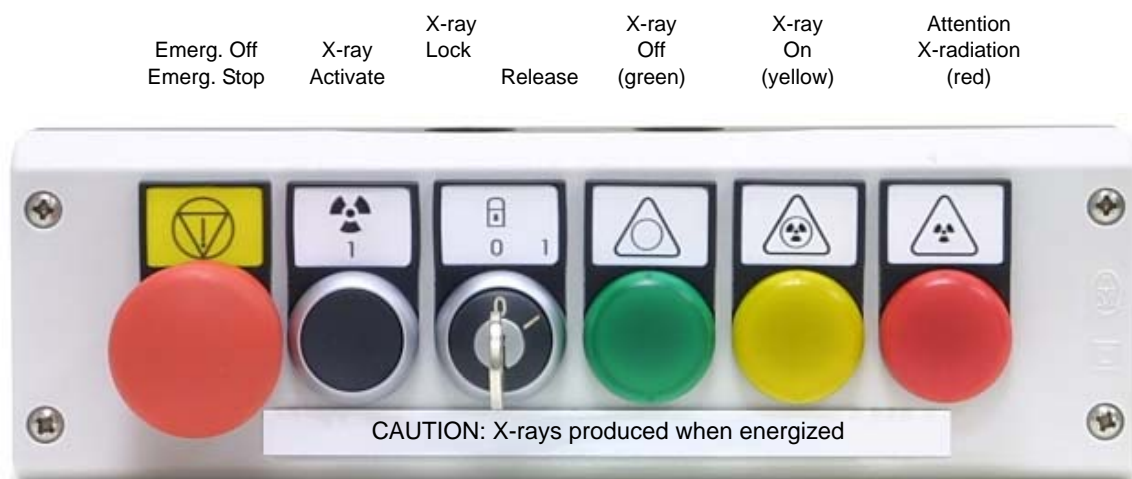
There is no increased radiation outside the radiation path of the measuring bridge. The active radiation is completely absorbed by the side of the receiver casing so that no direct rays pass the casing. The emitted radiation is simply limited to the radiation path of the measuring bridge and does not penetrate the surrounding area of the measuring bridge.

3.2 Checking the radiation emission

3.2.1 Triggering the X-ray tube

The electrically operated X-ray generator is normally not in operation. The 24 V power supply must be released purposefully in order to start the emission of cathode rays which are required to generate the X-rays. The supply voltage of the X-ray generator may only be activated when the emergency off button has not been pressed. Therefore if the emergency off button is pressed or the control electronics fail the supply voltage is always switched off and the radiation emission ceases immediately.

A key switch must be turned at both operating panels on the device and one of the two start buttons pushed in order to release the 24 V power supply. The supply voltage can be permanently interrupted and secured against being inadvertently switched on by means of the key switch.

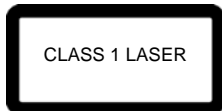


Three display lights installed in the operating panel indicate the condition of the supply voltage and the shutter position (\Rightarrow 3.2.2 Shutter control, page 8). LED lights with an extremely long service life are used for this.

Red and yellow lights are on	\rightarrow The shutter is open and the X-ray generator has been activated.	\rightarrow radiation
Yellow light is on	\rightarrow The shutter is closed and the X-ray generator has been activated.	\rightarrow no radiation
Green light is on	\rightarrow The shutter is closed and the X-ray generator has been deactivated.	\rightarrow no radiation

The function that closes the radiation path (shutter) is linked to the function of the red LED in the safety circuit. The tube closes immediately should the LED fail. Operation can only be resumed after the signal light has been repaired.

There is a red light spot on the receiver when the radiation path is open to aid the commissioning of new container brands. The light spot can also be seen on the container and is used for orientation purposes when determining the vertical adjustment of the measuring bridge. At the same time the red light spot signals the X-radiation between the X-ray generator and the receiver.



A class 1 laser generates a red light spot.

The housing doors are used as a splash guard. They are provided with safety switches. The shutters of the X-ray measuring bridges are closed and the conveyor stops when the doors are opened. Radiation cannot be emitted. When the conveyor starts running again the shutters open automatically.

3.2.2 Shutter control

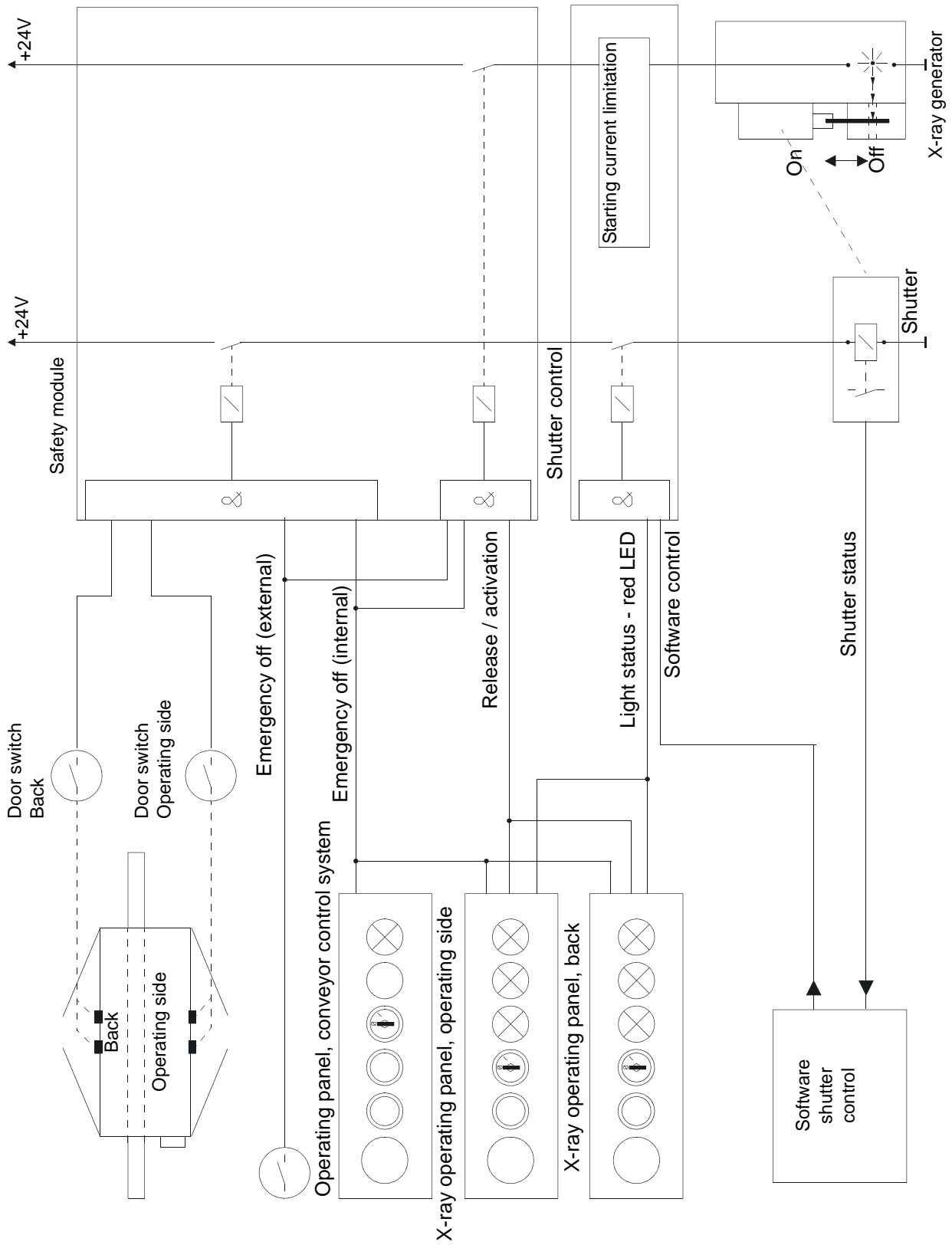
Additional protection is provided by an electromagnetically operated shutter made of lead which can close the exit where the radiation emits from the casing of the X-ray generator. This is normally closed. It can be kept open by means of a 24 V coil if required. The tube exit closes automatically if the voltage supply fails because the shutter is no longer held and the force of gravity reinforced by a spring force immediately causes the radiation source to close.

The shutter is only opened by the control software when the fill level detection requires radiation. The production containers then pass through the measuring bridge very closely behind one another and therefore it is not possible to put one's hands in the area exposed to radiation without interrupting the container flow. Every gap in the container flow, whether caused by the operator or for other reasons, will lead to the closure of the radiation path after a short time.

The shutter is closed and only opened again when the next container arrives if for example a gap between containers is detected during the production process due to the corresponding conveyor movement without the triggering of a new container. The shutter is also closed when the conveyor stops. This ensures that the containers which have stopped in the radiation area are not exposed to excessive radiation and that the operators who clear the conveyor section manually during a conveyor standstill are not at risk.

The container transport is constantly monitored in order to eliminate danger to people due to unintentional contact with the device or malfunctions whilst the conveyor is running. If the photocell is defective or an object interrupts the optical path of the trigger photocell which monitors the entry of a container over a programmable distance, the control software will immediately generate a stop pulse which will stop the conveyor and cause the closing of the shutter.

Basic wiring diagram of the safety circuit



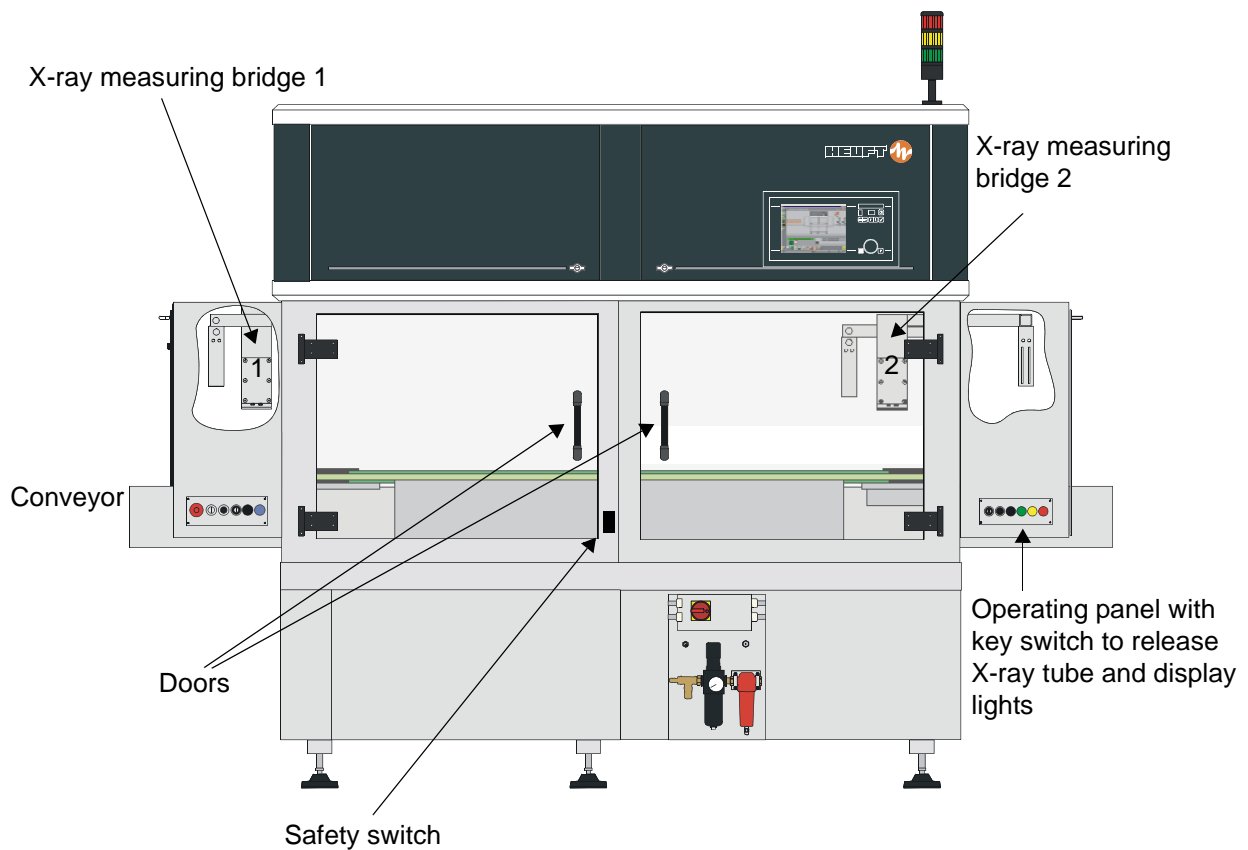
4. Marking

There is a warning sign attached to the front of the measuring device and at the entrances of the infeed and outfeed which indicates that the radiation path should be closed using the switch before accessing the measuring area. Both the switches are marked with the key switch positions 0 and 1.

5. Dose rate

5.1	Emitter side at the casing		$< 1 \mu\text{Sv/h}$
5.2	Detector side at the casing		$< 1 \mu\text{Sv/h}$
5.3	In the radiation path with an open shutter	Measuring bridge 1	$100 \mu\text{Sv/h}$
		Measuring bridge 2	$940 \mu\text{Sv/h}$
5.4	In the radiation path with a closed shutter		$< 1 \mu\text{Sv/h}$

6. Overview



Function checks

Safety information



X-radiation! (X-ray fill level detection)

ONLY place your hands in the radiation path if the green light is on (shutter closed). **NEVER** place your hands in the radiation field when the detection is switched on (the red warning light is on). The shutter is open in this case and the emitter is constantly emitting radiation.

The measuring bridge may ONLY be opened by people trained and licensed by the HEUFT company for repairing X-ray devices.

Switch off the standard device and secure the main switch to prevent it being switched on again before replacing the receiver.



Improper intervention and the removal of protection devices can result in an increased intensity of X-rays occurring. A device modified in such a way no longer meets the approval requirements and it is consequently prohibited to operate such a device.



The requirements and safety regulations laid down by the competent authority and in the X-ray ordinance as well as the country-specific regulations when the device is operated outside of Germany must be strictly adhered to.

Safety devices

X-ray
Activate

X-ray
Lock
Release



Key switch and activation

An operating panel is installed on each side of the conveyor.

The X-ray generators are released with a key switch which can be turned to the "Lock" and "Release" positions and with the "Activate X-ray" button.

The radiation window of the X-ray generator is opened and closed by means of a shutter. The supply voltage of the X-ray generator is switched on and the yellow light is on when the key switch is in the "I" position (X-ray Release) and the "Activate X-ray" button is pressed. The red light is also on as soon as the control software opens the shutter.

For safety reasons switching off has priority. The supply voltage of the X-ray generator is switched off and the shutter remains closed when one of the key switches is in the "0" position (X-ray Lock) or one of the emergency off buttons has been pressed. The green light is on and the detection is inoperative.

Emerg. Off
Emerg. Stop

X-ray
Activate

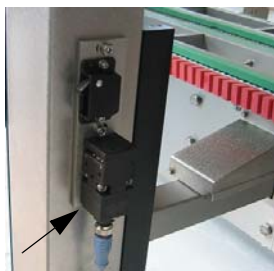
X-ray
Lock
Release

X-ray
Off
(green)

X-ray
On
(yellow)

Attention
X-radiation
(red)



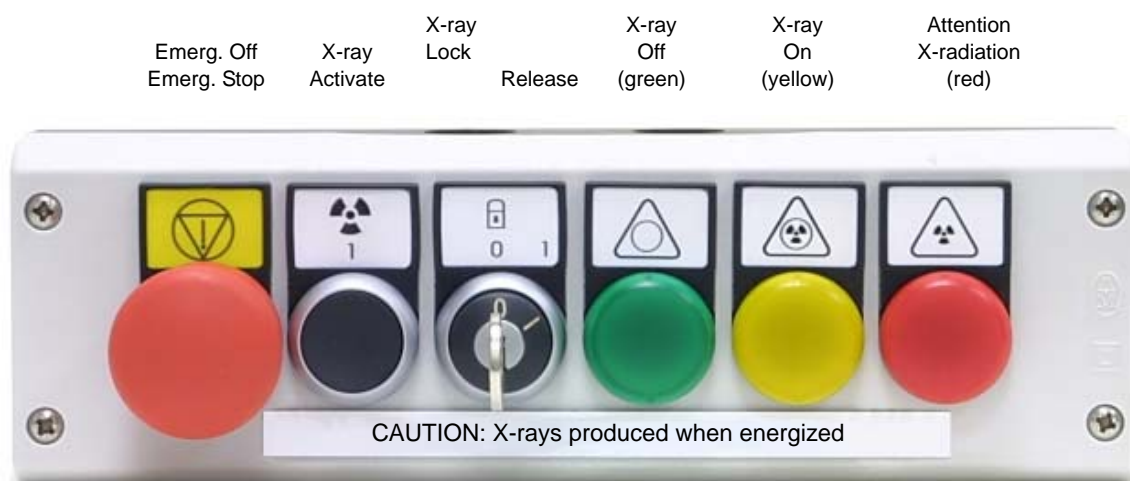


Safety contact of the housing

The machine is immediately braked to a standstill and the emergency off function of the machine is activated when one of the housing doors is opened.

Checking the function of the safety devices

The LED lights on the operating panel indicate whether the supply voltage of the X-ray generators is switched on and the shutter is open:



Red and yellow lights are on	→ The shutter is open and the X-ray generator has been activated.	→ radiation
Yellow light is on	→ The shutter is closed and the X-ray generator has been activated.	→ no radiation
Green light is on	→ The shutter is closed and the X-ray generator has been deactivated.	→ no radiation

System reaction during production with the fill level detection using X-rays

The X-ray generators are only switched on and the shutter is only opened by the control software when radiation is required for the fill level detection. The radiation window of the X-ray generator is opened and closed by means of a shutter. The shutter of the X-ray generator is open and the yellow and red lights are on when the key switch has been turned to "I" (X-ray Release), the "Activate X-ray" button has been pressed and containers are passing through the detection module.

1. Turn the key switch to the 1 position (X-ray Release) on both operating panels.
2. Press the "Activate X-ray" button.
3. Start the conveyor.

Every gap in the container flow, whether caused by the operator or for other reasons, will lead to the closure of the radiation path after a short time. The shutter is closed and only opened again when the next container arrives if for example a gap between containers is detected during the production process due to the corresponding conveyor movement without the triggering of a new container. Two independent conditions cause the shutter to close:

- A container gap between 1 m and 10 m can be entered on the *PILOT* operating surface after which the shutter closes. A container gap of 1 m is configured ex works.
- The shutter closes if a container gap lasts longer than 10 seconds. This duration of 10 seconds cannot be changed.

The condition which is fulfilled first determines when the shutter closes: either the distance entered or the period of 10 seconds.

4. Check whether the LED lights on the operating panel light up correctly.

Action	LED lights			
	Green	Yellow	Red	
Conveyor is running without containers	Off	On	Off	→ no radiation
Containers are passing through the device	Off	On	On	→ radiation
Container gap	Off	On	Off	→ no radiation

The shutter is closed when the conveyor stops. This ensures that the containers which have stopped in the radiation area are not exposed to excessive radiation and that the operators who clear the conveyor section manually during a conveyor standstill are not at risk.

5. Stop the conveyor.
6. Check whether the red LED goes out and the yellow LED is still on at the operating panel.

Checking the key switches

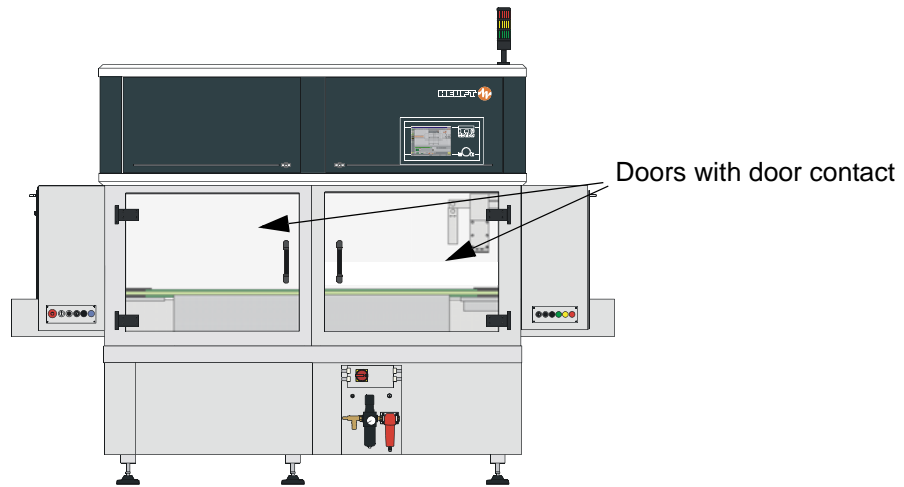
An operating panel with a key switch is installed on each side of the device. The X-ray generator can generally only be started when both key switches are in the "1" position (X-ray Release) and the "Activate X-ray" button has been pressed. The switches are connected in series so that both must be switched on at the same time in order to operate the X-ray generator. The key switches are assembled on both sides of the device. This ensures that the operator always has access to a switch with which he can deactivate the X-ray generator if necessary.

1. Turn the key switch to the 1 position (X-ray Release) on both operating panels.
2. Press the "Activate X-ray" button.
3. Check whether the yellow LED on the operating panel lights up.
4. Turn the key switch on the front of the operating panel (operating side) of the device to the 0 position (X-ray Lock).
5. Check whether the yellow LED goes out and the green LED lights up on the operating panel.
6. Turn the key switch at the front (operating side) of the device to position 1. As a result both key switches are in the "1" position again.
7. Press the "Activate X-ray" button.
8. Check whether the green LED goes out and the yellow LED lights up on the operating panel.
9. Turn the key switch on the operating panel at the back of the device to the 0 position (X-ray Lock).
10. Check whether the yellow LED goes out and the green LED lights up on the operating panel.

Checking the door contacts

The *squeezer* is closed with doors at the front and at the back. When the doors are opened, the shutters are closed via the door contacts. This prevents the occurrence of dangerous X-rays outside the device when a door is open.

Front (operating side)



1. Turn the key switch to the 1 position (X-ray Release) on both operating panels.
2. Press the "Activate X-ray" button.
3. Check whether the yellow LED on the operating panel lights up.
4. Start the conveyor without containers.
5. Open the door on the left on the operating side.
6. Check whether the conveyor stops.



A message on the *PILOT* operating surface shows that the housing is open.

7. Check whether the yellow LED on the operating panel is still on.
8. Close the door on the left on the operating side.
9. Open the door on the right on the operating side.
10. Check whether the conveyor stops.
11. Check whether the yellow LED on the operating panel is still on.
12. Close the door on the right on the operating side.
13. Repeat the test with the two doors on the back.

The function check has been successfully completed when all the tests have functioned as described.

Overview of the function checks and the system reactions					
Action	Condition of the safety circuit	Shutter	LED lights		
			Green	Yellow	Red
Key switch "0"	Interrupted	Closed	On	Off	Off
Key switch "1" ("Activate X-ray" button not yet pressed)	Interrupted	Closed	On	Off	Off
Key switch "1" and "Activate X-ray" button pressed	Closed	Closed	Off	On	Off
Key switch "1" and "Activate X-ray" button pressed - containers are passing through the device	Closed	Open	Off	On	On
Key switch "1" and "Activate X-ray" button pressed - door open	Interrupted	Closed	Off	On	Off

