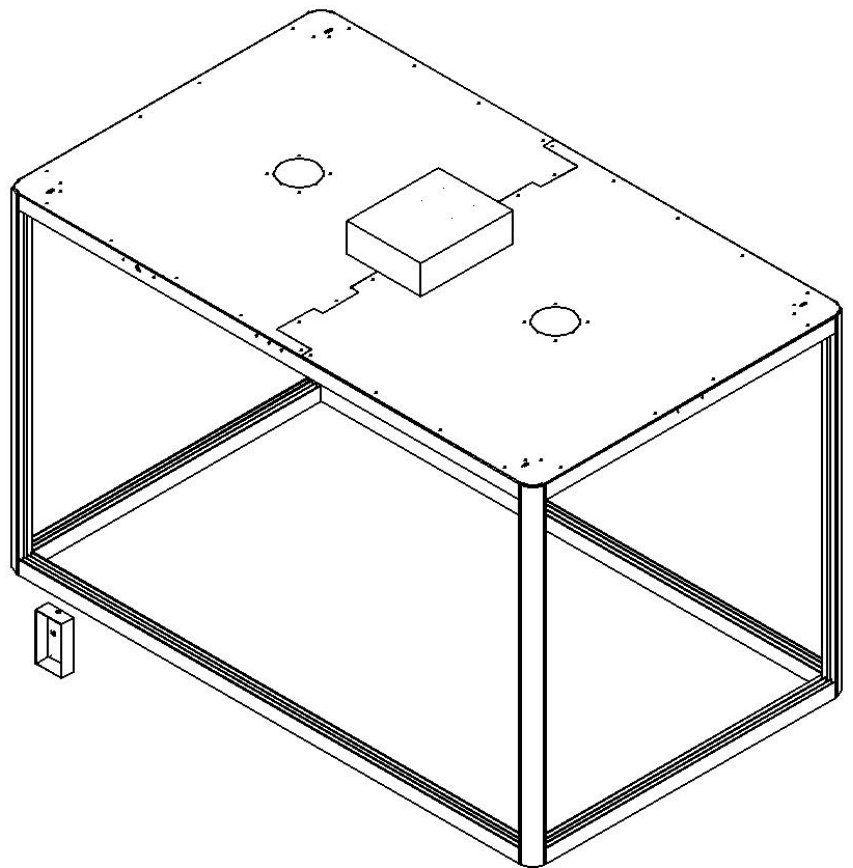




## **marenclosure**

Radiation Enclosure  
for X-ray Sources



# **marenclosure**

## Radiation Enclosure for X-ray Sources

### Manual

### Version 3.0

### April 2018

Written by Dr. Claudio Klein

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## 1. How to use this manual

Before you start to operate the **marenclosure** please read the Manual and the Technical Documentation included in the documentation package carefully.

### 1.1 Address and support

Should you have questions concerning the system or its use, please contact us via phone or email.





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## 1.2 Intended use

The radiation enclosure is intended to protect the user against ionizing radiation, especially against X-rays in the energy range of < 18 keV. This system is only fully functional and only provides optimal protection if it is connected properly to the safety system of the radiation source.

The radiation enclosure is located in the control area and is only allowed to be operated by authorized personnel.

It is prohibited to modify the product in any way. It is also prohibited and can be very dangerous to use the enclosure for any other purpose than described above. Read the manual carefully and keep it in reach for future reference.

Hazard	Description
	The radiation enclosure is intended for indoor use only. Place the instrument in a dry location that is free of dust and protected from moisture.
	Never let liquids get inside the instrument. Otherwise, electric shocks or short circuits may result.
	Do not open the radiation enclosure doors while the X-ray source is producing X-rays and the generator shutter is open. Before opening the doors, close the X-ray shutter. Keep in mind, though, that the whole purpose of the radiation enclosure is to automatically close the shutter if the generator is producing X-rays. If a data collection is going on, the data collection will continue, but without X-rays!!
	Make sure that the ventilation slits in the detector are unobstructed. The ventilation slits provide for air cooling of the components inside the enclosure.

## 1.3 Disclaimer

This document is provided to customers as a courtesy of marXperts GmbH. The described operations require knowledge about mechanical and electrical components and should only be carried out by properly trained persons. While every precaution has been taken in the preparation of this document, marXperts GmbH assumes no responsibility for errors or omissions. Accordingly, marXperts GmbH cannot assume responsibility for damage to electrical or mechanical components of the instrument that occurred while following this guide. The entire risk of the operation remains with the person or institution carrying out the operation.

## 2. Overview

### 2.1 Scope of delivery

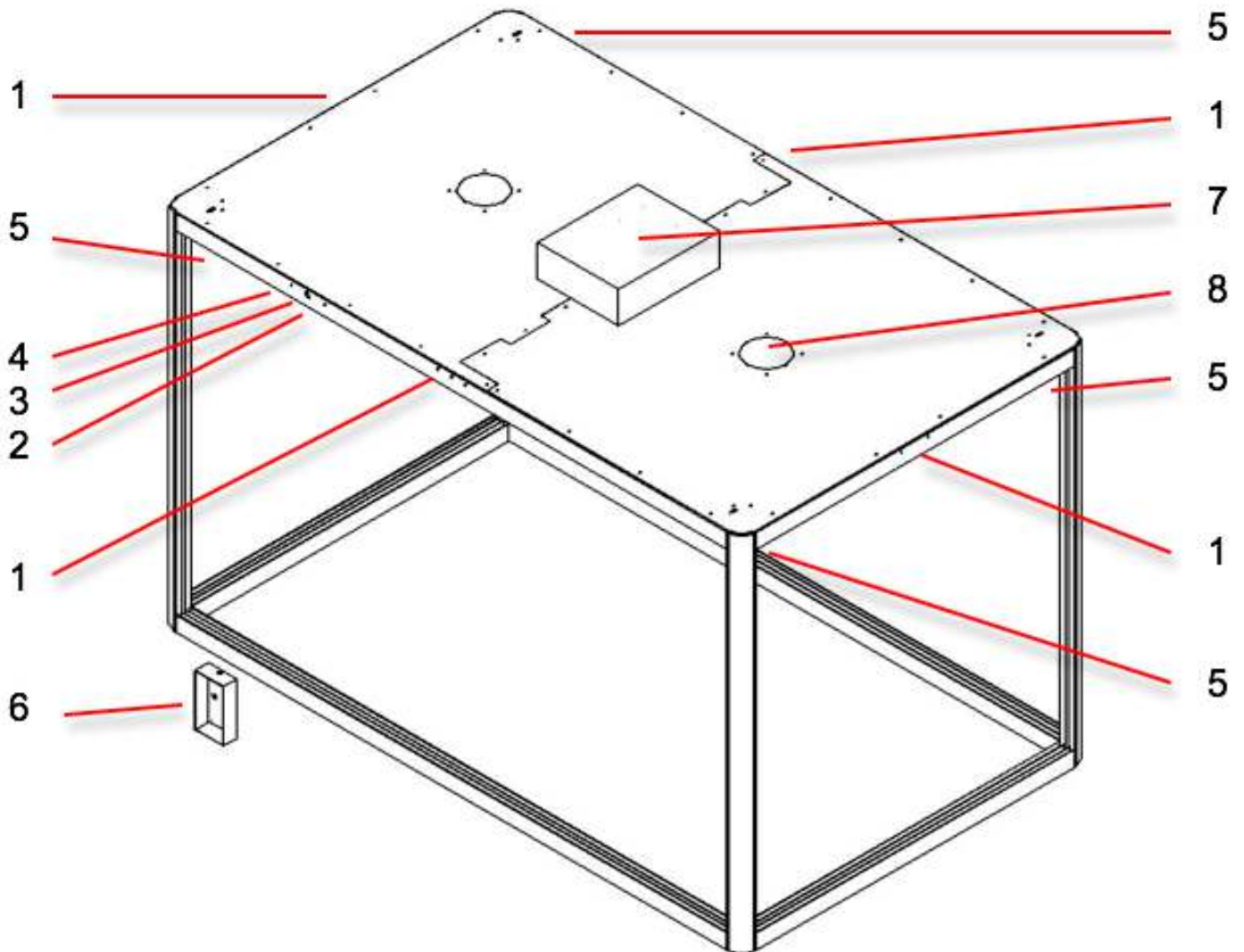
- radiation enclosure
- 10 acrylic glass doors, optionally side doors replaced by metal case
- 2 lead sandwich panels (optional)
- 4 halogen lamps
- manual

### 2.2 Principle of operation

- The radiation enclosure has 10 acrylic glass doors. Their state (open/closed) is indicated by LEDs. An electrical signal tells the radiation source whether all doors are closed or not. It is the responsibility of the radiation source manufacturer to make correct use of that signal according to local radiation safety regulations. If there is no electrical contact to the radiation source, it is the responsibility of the user to follow the radiation safety regulations.
- The acrylic glass doors do not provide effective protection against the primary beam of a radiation source. Also, they do not provide protection against high-energy radiation (> 18 keV), e.g. hard X-rays or gamma radiation.
- Via means of a key switch, a “manual service mode” is accessible. This mode allows the user to reach inside the radiation enclosure while the doors are open. It is the responsibility of the radiation safety officer to ensure that this key is only accessible by authorized personnel. During “normal operation mode” it is to be kept in a safe place.
- A fan is located on the roof of the radiation enclosure. The fan leaves a small open hole in the roof. For safety reasons it is therefore prohibited to approach the radiation enclosure from above while the beam shutter of the radiation source inside the enclosure is open.

The warranty is void if any of the instructions in this manual are ignored or neglected. MarXperts will not accept liability for damages resulting from such attitude. This is also applicable for bodily injuries, resulting from improper handling of the radiation enclosure, in particular the non-compliance of the safety notes. In such cases, the warranty terminates.

### 3. Features



**Figure 1: Features**

- 1. Red LEDs: door position control
- 2. Green LED: operator protection fulfilled
- 3. Key switch for manual service mode
- 4. Red LED: manual service mode active
- 5. Halogen lamps
- 6. Power socket and switch for halogen lamps
- 7. Distribution box
- 8. Fan

## 4. Commissioning

- Check carefully that the fan (8) is not blocked and that no equipment is connected to the power socket (6). If the enclosure has been shipped with lead sandwich panels, these should be positioned in the middle of the short edge sides.
- Connect the interlock cable of the enclosure to the controller of the radiation source. Please note, that the wiring of the interlock cable is specific for a particular type of radiation source. In case of the I $\mu$ S-tube (Incoatec GmbH), use the 9-pin D-Sub9-input marked "Interlock" located at the rear of the generator. In case of the Genix-tube (Xenocs S.A.), use the 9-pin D-Sub9-input marked "X03" located at the rear of the generator.
- Connect the power cable of the enclosure to mains.
- Turn the key (item 3 in Fig. 1) to the default position (12 o'clock). The red service-mode LED (item 4 in Fig. 1) is off and no acoustic signal is to be heard.
- Place the 10 acrylic glass doors at their corresponding positions. Please note that the doors cannot be combined at random. Each door has two magnets (in some models there is only one magnet) in the corners of the top edge of the door. Via induction, these magnets close a contact with a solenoid located in the frame of the enclosure. On each side of the frame of the enclosure there are three separate guide rails, intended for the insertion of the doors. The magnets are mounted in such a way, that they can only make contact in one single position. In the figure below, the position of the magnets, as well as the door handles of the door, are marked in red. If you have purchased a model with two magnets, the positions of the second magnet are marked in grey.
- Move the doors until all of them are closed: the red LEDs for the door position control (item 1 in Fig. 1) must be switched off and the green LEDs next to the service-mode key (item 2 in Fig. 1) lights up. The enclosure is now operational.

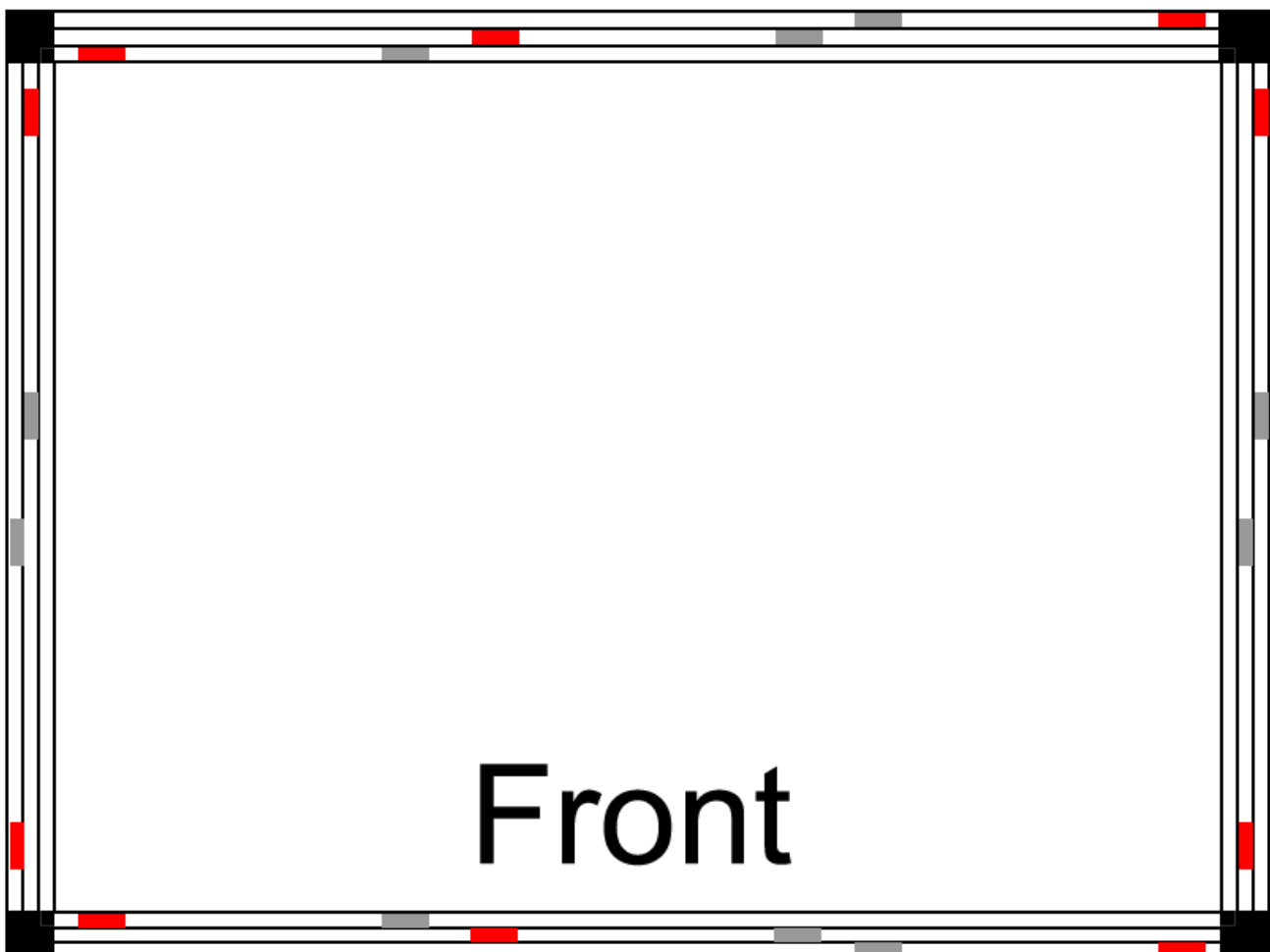


Figure 2: Door scheme

## 5. Usage

### 5.1 Modes of operation

There are 2 distinct modes of operation of the radiation enclosure:

- User mode: does not require a key
- Service mode: requires a key

In case of a power cut, the controller of the radiation source will receive a signal to close the shutter.

#### User mode



**Figure 3: User mode**

The key in the key switch (item 3 in Fig. 1) is in the default position (12 o'clock) and may be removed. The red service-mode LED (item 4 in Fig. 1) on the left hand side of the key is not lit. The generator cannot open the beam shutter, if one of the doors is open. If the beam shutter is already open, it will be closed immediately, once a door is opened.

In user mode, it is suggested to keep the key in a safe place.

#### Service mode



**Figure 4: Service mode**

The key in the key switch (item 3 in Fig. 1) is in service position (2 o'clock) and cannot be removed. The red service-mode LED (item 4 in Fig. 1) on the left hand side of the key is on and an acoustic warning signal is heard. In this mode, a closed radiation enclosure is simulated. Thus, the generator can open the beam shutter even if a door is open.

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### 5.2 Door position control

On the upper frame of each side of the radiation enclosure, there are either three (horizontal sides) or two (vertical sides) red LED's, respectively (item 1 in Fig. 1) for the position control of each door. If one LED is illuminated, the corresponding door is open. Once the door is closed, the corresponding LED will shut off. In figure 5, all three doors are open.

If all doors are closed, the green LED on the right-hand side of the key switch (Fig. 4) is illuminated.



## 6. Technical Data

Dimensions L x W x H:	1745 x 1045 x 1190 mm
Power Supply:	230V AC
Acrylic glass doors:	8 mm acrylic glass
Lead sandwich panels:	2 mm Alu, 3 mm Lead, 2 mm Alu
Frame:	Aluminium
Weight of Frame without doors:	approx. 30 kg
Weight of acrylic glass doors:	approx. 55 kg
Lamps:	Socket „GU10“, 230 V 50W for halogen lamps or $\leq 5$ W for LED lamps
Radiation Protection:	Acrylic glass only deters scattered low-energy X-Rays ( $< 18$ keV) Lead sandwich panels absorb the entire Cu-radiation



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