

# User Manual

## Water Phantom

### T41023



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## General Information

- The product bears the CE-mark "CE" in accordance with the Council Directive 93/42/EEC about Medical Devices and fulfills the essential requirements of Annex I of this directive.  
The product is a class I device without measuring function (MDD).
- The user manual is an integral part of the product. It should always be kept near the product. Observance of the manual is a prerequisite for proper product performance and correct operation.
- Operator safety, specified measuring accuracy and interference-free operation can be guaranteed only if original products and parts are used. Furthermore only the accessories listed in this manual are approved by PTW-Freiburg and may be used in conjunction with the product, or else accessories whose use has been expressly permitted by PTW-Freiburg. Safe operation and proper product performance are not guaranteed if accessories or consumables from other manufacturers are used.
- PTW-Freiburg cannot be held liable for damages resulting from the use of accessories, consumables from other manufacturers or when the user ignores the instructions and information given in this manual.
- The warranty period is 1 (one) year and begins on the day of delivery.  
It is unaffected by repairs covered by the warranty regulations.
- PTW-Freiburg considers itself responsible for safety, reliability and performance of the product only, if assembly, extension, readjustment, modification or repair is carried out by PTW-Freiburg or by persons authorized by PTW-Freiburg, and if the product is used in compliance with the technical documentation.
- In case of any questions concerning service, support or warranty please contact your supplier.
- This manual is in conformity with the product specifications and all applicable safety standards valid at printing date. All rights are reserved for devices, circuits, techniques, software and names referred to in the manual.
- No part of the technical documentation may be reproduced without written permission from PTW-Freiburg.
- PTW-Freiburg is registered manufacturer according to the ElektroG (Elektro- und Elektronikgeräte-Gesetz).  
Elektro-Altgeräte-Register (EAR) Registration number DE15599992
- PTW-Freiburg works in strict accordance with a quality management system which is continuously updated according to national and international standards.

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## Intended Use

The water phantom type 41023 has been designed for calibration measurements in radiation therapy using a horizontal beam. For this purpose up to 3 ionization chambers and / or TLD probes can be placed at different water depths.

## Safety Information



This is the safety alert symbol. It is used to alert the user to potential hazards. Obey all safety messages that follow this symbol to avoid possible bodily injury or equipment damage.

All safety messages consist of the following components:

- Safety alert symbol and signal word
- Type of danger
- Source of danger
- Consequence
- Measures to prevent hazard

### Signal Words

#### **DANGER**

Indicates an imminent hazard. If not avoided, the hazard will result in death or serious injury.

#### **WARNING**

Indicates a hazard. If not avoided, the hazard can result in death or serious injury.

#### **CAUTION**

Indicates a potential hazard. If not avoided, the hazard could result in minor injury or product / property damage.

#### **NOTE**

Provides useful information to assure that you get the most from your equipment.

**Safety Information****⚠ DANGER**

Operation in areas where an explosion hazard may occur or in oxygen-enriched atmospheres

**Explosion Hazard!**

The product is not suitable for operation in areas of risk where an **explosion hazard** may occur. Explosion hazards may be caused by the use of combustible anaesthetics, skin-cleansing agents and disinfectants.

Furthermore the product is not suitable for application in **oxygen-enriched atmospheres**. The atmosphere is considered to be oxygen-enriched when more than 25 % of oxygen or nitrous oxide is added to the ambient air.

**⚠ WARNING**

Improper handling.

**Patient Hazard!**

The product is a medical electrical device and must only be handled by persons who are trained in the use of such equipment and are capable of applying it properly. The operator must be trained in the use of the device.

**Exclusion of operation in the patient environment:** Neither the product nor any peripheral devices may be operated in the patient environment (refer to Figure 1).

**Exclusion of operation as device with patient contact:** The device is not intended for use in direct contact with the patient. Neither the device nor any peripheral device may have contact to the patient.

Never touch the patient and open connectors of the device at the same time.

**Exclusion of operation as controlling instrument:** The device is only designed for use as a measuring device. The device must not be used to control radiodiagnostic equipment or radiotherapy units.

**⚠ WARNING**

Hazards originating from other system components.

**Patient Hazard! Equipment Damage!**

Observe the safety information provided in the user manuals of the system components.

**⚠ WARNING**

Electricity is a source of risk, particularly when the product is not in perfect operating condition or when it is operated inappropriately.

**Shock Hazard!**

Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and other persons involved.

**Use of peripheral devices:** Devices may be connected to other devices or to parts of systems only if it has been ascertained that this connection does not impair the safety of the patient, the operator or the environment.

If the device specifications do not contain information as to connecting the device to other equipment, you must consult the manufacturer of the other equipment or an expert about the effects of the connection on the patient, the operator or the environment.

**⚠ CAUTION**

Use of the product without observing the user manual.

**Bodily Injury! Equipment Damage!**

Always use the product in compliance with the user manual. Otherwise the intended protection can be reduced.

**⚠ CAUTION**

Operation under inadequate ambient conditions.

**Equipment Damage!**

Always observe the ambient conditions as indicated in the `Technical Specifications`.

**⚠ WARNING**

Packaging material is a source of risk.

**Suffocation Hazard!**

Dispose of the packaging material, observing the applicable waste-control regulations. Keep the packaging material out of children's reach.

**⚠ WARNING**

Confusion of chemicals.

**Risk of Poisoning!**

Chemicals required for application or maintenance of the device, for instance, must under all circumstances be stored, prepared, and kept at hand in their specific containers. Failure to observe this instruction may result in severe consequences.

**NOTE**

Please observe the user manuals of all connected devices!

**NOTE**



**This symbol means:**  
Refer to user manual.



**This symbol means:**  
Separate collection for electrical and electronic equipment!  
(refer also to section Disposal of the Product)



**This symbol means:**  
The product bears the CE-mark.

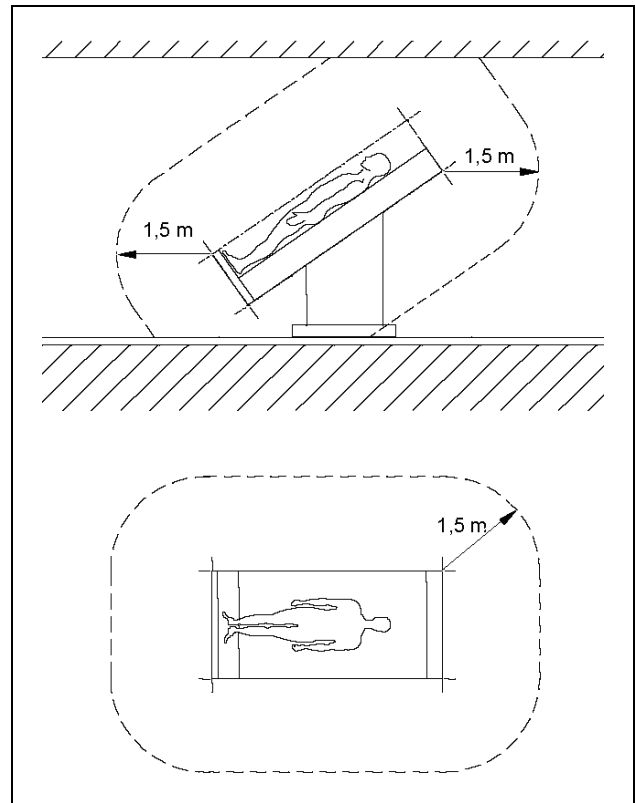


Figure 1: Definition of patient environment



# Operating Manual

## 1 Description of the Water Phantom

The water phantom type 41023 - according to ICRU Report No 48 and the PTB report, volume 16 (PTB Braunschweig is the German Federal Institute of Physics and Metrology) - consists of a tank with 4 walls and a base plate of 10 mm acrylic (PMMA) which is filled with water. The outer dimensions are approximately 300 mm x 300 mm x 300 mm.

One wall has an entrance window of 17 cm x 17 cm and 3,05 mm thickness (corresponding to 3,5 mm H<sub>2</sub>O).

The phantom is supplied with a precision holding device for the exact location of detectors. On top of the tank there is a bridge with holes into which acrylic adaptors for different detectors can be inserted, avoiding air gaps between chamber wall and adaptor. The adaptor position can be varied using a spindle drive adjustable to 0.1 mm precision. The measuring depth is continuously variable between 6 mm and 260 mm (parallel plane chambers and TLD probes) respectively between 14 mm and 264 mm (compact chambers).

The bridge allows the simultaneous use of up to three adaptors for comparison measurements in a maximal lateral distance of 60 mm.

The phantom is supplied with handles, adjustable stands and a drain tap. The maximum water content is 17.6 liter. The total weight without water is 9 kg.

### CAUTION

Improper handling.

#### **Equipment damage!**

The water phantom type 41023 may only be filled with water continuously for 8 hours maximum in order to avoid a damage of the tank due to the hygroscopic character of PMMA.

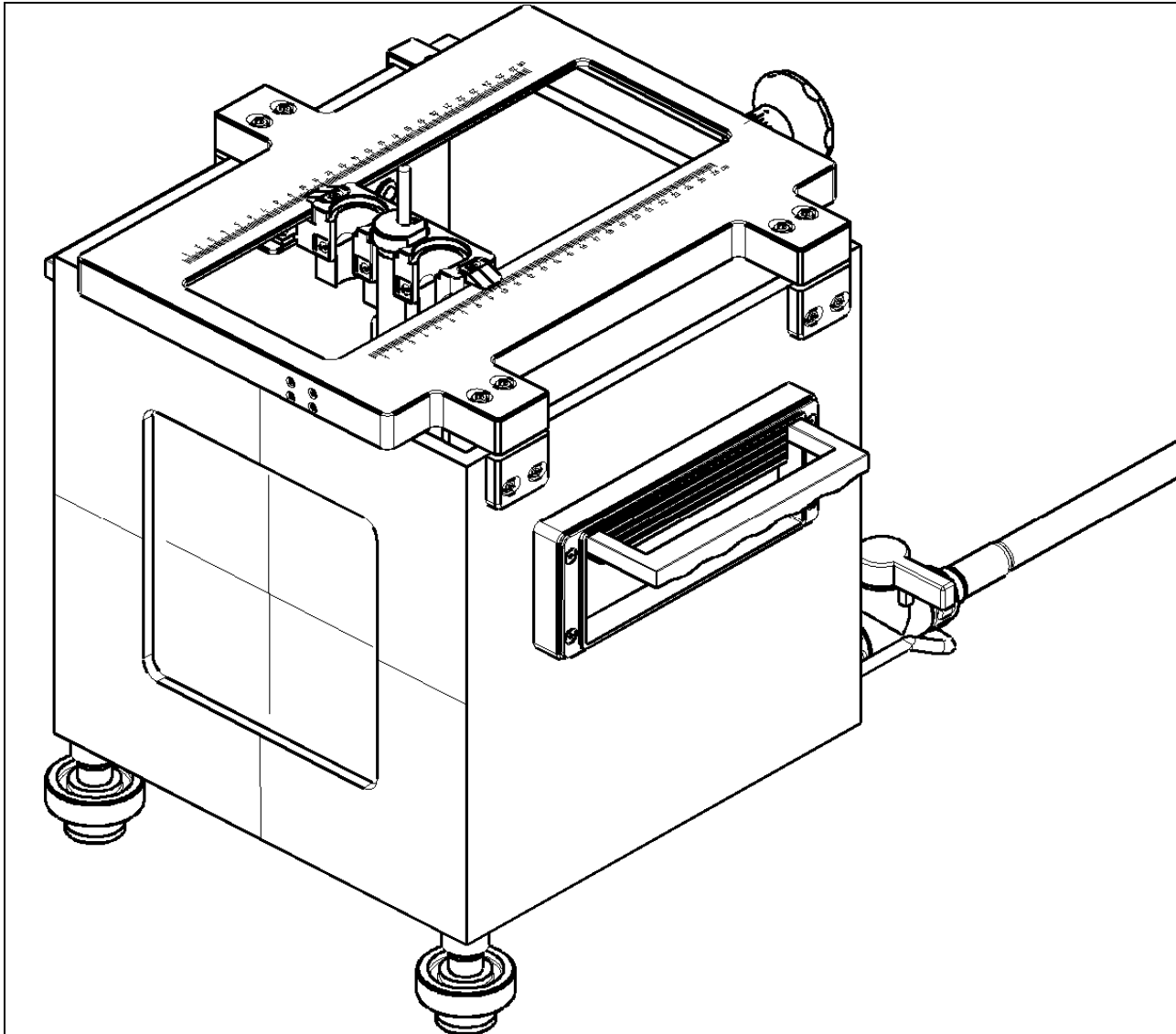


Figure 2: View of the phantom type 41023 with a chamber holder and a chamber

## 2 Performing a Measurement

### 2.1 Notes

The water phantom type 41023 can be used for simultaneous measurements with up to three chambers. When using more than one chamber, due to possible field inhomogeneities the chambers should be exchanged in their position to obtain equivalent doses for each chamber in each position.

When using chambers of different construction at the same time, the possibility of a mutual influencing of the radiation field should be considered; this is not necessary when comparing two chambers of the same construction since mutual influences then are equivalent.

#### NOTE

Different scattering due to different chamber construction could be investigated, for instance, by calibrating the chambers versus a monitor transmission chamber.

If irradiating several chambers the necessary field size should be observed.

#### NOTE

Especially with chambers and adaptors with recesses (e.g. Roos chamber) the user must make sure that no bubbles remain in the recesses.

#### NOTE

Please observe the user manuals of all used detectors!

## 2.2 Assembly

### Mounting the phantom

The phantom type 41023 is used for calibration measurements in a horizontal beam. The horizontal alignment of the phantom can be adjusted using the three adjustable leveling supports. The alignment can be checked using the crosshairs with the half filled phantom like a spirit level.

Before the first usage of the water phantom the three adjustable stands must be screwed into the bottom of the phantom.

To avoid impurities the phantom is best used with distilled water. This should be boiled to minimize the air content and cooled before use. Do not store the phantom filled with water for any length of time (max. 8 h).

To ensure temperature equilibrium with the surroundings, the phantom should be set up several hours before measurements. In case of changing ambient temperature the temperature in the water phantom should be continuously monitored.

The phantom must be positioned with its entrance window towards the radiation source.

The positioning scale shows in which water equivalent depth the reference point of the detector is positioned. The depth is measured from the outside of the beam entrance window. The design of the scale considers density and thickness of the material from entrance window and detector holder. For parallel plate chambers also the detector material in front of the reference point is considered. The reference point is for compact chambers (thimble chambers) the chamber axis and for parallel plate chambers the inside of the entrance window. For TL or alanine detectors the reference point is the front edge or the center of the detector material. For their precise positioning you have to use the container marked with "front" (reference point in front edge) or "center pos" (reference point in center).

The thickness of the PMMA holders for compact chambers is 0.87 mm in front of the measuring volume (corresponding to 1 mm water).

The calibration factor given from PTW for a compact chamber refers to the usage of these holders.

Observe the following hints for positioning the detectors with the effective point of measurement instead of the reference point to a specified depth.

For thimble chambers: The effective point of measurement is displaced about the half radius of the measuring volume towards the radiation source. The chamber has to be shifted about  $\frac{1}{2} r$  of the measuring volume to a higher depth.

For parallel plate chambers: The reference point and the effective point of measurement are same.

### Mounting the adaptors

#### NOTE

When assembling the chamber adaptor, the user must make sure that the parts are put together to a tight fit.

Adaptors for compact chambers are inserted from above into the receiving holes of the bridge so that the flat side of the upper ring corresponds to the flat side of the receiving hole.

Adaptors for parallel plate chambers are rotated by  $90^\circ$  around the vertical axis and inserted from the front side into the reception bridge then rotated again to bring the flat side of the upper ring over the corresponding flat side of the reception hole and pushed down into the measuring position until locking with an audible click (see figure 2).

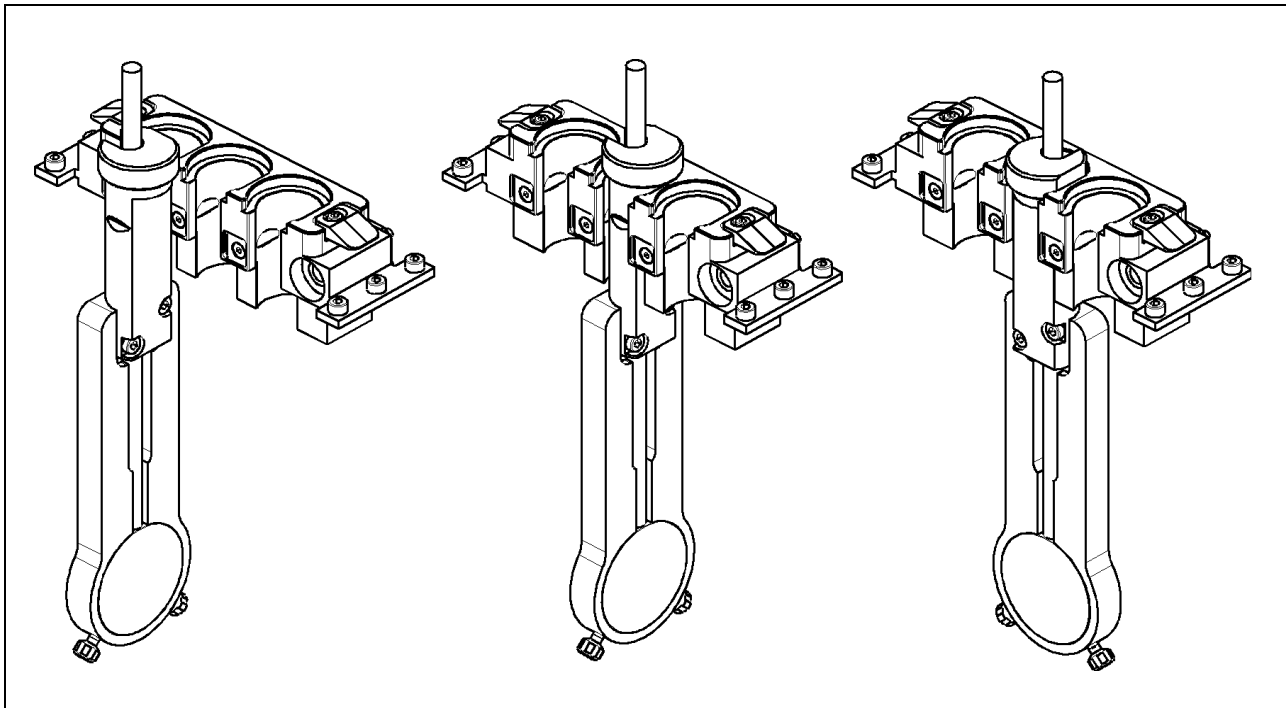


Figure 3: Mounting chamber holder

## Mounting the chambers

To insert parallel plate chambers into the adaptor without damaging the cable the chamber is pushed through the adaptor slot (see figure 3) and fixed with the focus side to the front in the reception hole of the adapter using the two screws. The cable is lead up through the slot in the chamber adapter stem.

If using different adaptors it must be kept in mind that not all adaptors are watertight; the Markus chamber and the Advanced Markus chamber must be used with its watertight build-up cap.

### NOTE

Especially with chambers and adaptors with recesses (e.g. Roos chamber) the user must make sure that no bubbles remain in the recesses.

The drain tap can be used for a complete emptying of the phantom.

### NOTE

If the phantom is packed for transport the feet in the ground plate must be unscrewed before packing.

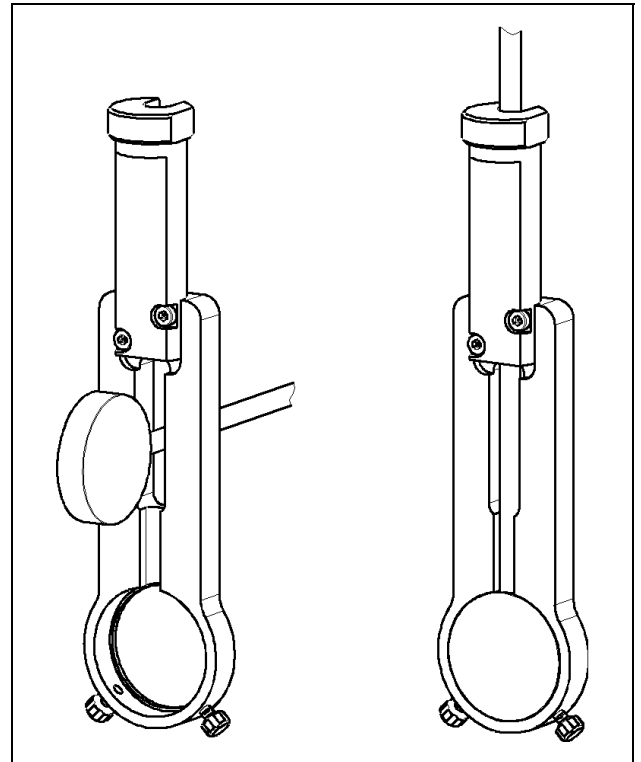


Figure 4: Assembling the parallel plate chamber into the adaptor

## 2.3 Hints for use with Parallel Plate Chambers and TLD Probes

When assembling the chamber adaptors, especially when assembling the adaptors for parallel plate chambers or TLD containers, the user must make sure that the parts are put together to a tight fit.

Parallel plate chambers and TLD containers can be shifted to the effective point of measurement of different thimble chambers with the help of spacers (included). In this assembly first insert the spacer ring then insert the parallel plate chamber or the TLD container with the open side (back side) first so that in assembled state the chamber is slightly displaced towards the entrance window.

Observe the reference point of the used TLD container; mark "Front Pos" or "Center Pos".

# Technical Manual

## 3 Technical Specifications

Only values with specified tolerances or limits are guaranteed. Values without tolerances are for information only.

<b>Device designation</b>	Water Phantom Type 41023
<b>Manufacturer</b>	PTW-Freiburg
<b>Intended Use</b>	Calibration measurements in horizontal therapy beams
<b>Operating mode</b>	continuous operation
<b>Material</b>	Tank, Holder and Adaptors: PMMA Bridge and rails: Al Worm drive: stainless steel
<b>Outer Dimensions</b>	300 mm x 300 mm x 300 mm
<b>Wall Thickness</b>	10 mm
<b>Entrance Window</b>	170 mm x 170 mm x 3.05 mm (according to 3.5 mm water thickness)
<b>Minimum Measuring Depth</b>	6 mm (Parallel plane chambers and TLD probes) 14 mm (PTW Farmer chambers) 13 mm (other PTW Compact chambers)
<b>Maximum Measuring Depth</b>	260 mm (Parallel plane chambers and TLD probes) 264 mm (Compact chambers)
<b>Depth increments</b>	Continuously adjustable to 0.1 mm
<b>Volume</b>	17.6 l
<b>Weight</b>	Approx. 9 kg without water filling

<b>Environmental conditions for operation</b>	
<b>Temperature</b>	(+10 ... +40) °C
<b>Rel. humidity</b>	(10 ... 85) %, no condensation (max. 20 g/m <sup>3</sup> absolute humidity)
<b>Atmospheric pressure</b>	(600 ... 1200) hPa
<b>Environmental conditions for transport and storage</b>	
<b>Temperature</b>	(-20 ... +60) °C
<b>Rel. humidity</b>	(10 ... 85) %, no condensation (max. 20 g/m <sup>3</sup> absolute humidity)
<b>Atmospheric pressure</b>	(600 ... 1200) hPa

## 4 Accessories

Detectors, Adapters, holder and container are available on request from PTW-Freiburg.



# Service Manual

## **WARNING**

Improper execution of service tasks.

### **Hazards to Persons! Equipment Damage!**

The following service tasks must only be performed by specially trained staff.

Further service tasks may only be carried out by PTW-Freiburg or by persons authorized by PTW-Freiburg.

## 5 Cleaning

### Surface of phantom and adaptors

## **CAUTION**

Disinfection of the surface with disinfectants on a phenol base or peroxide compounds.

### **Equipment Damage!**

Do **not** use disinfectants on a phenol base or peroxide compounds to disinfect the surface.

Rub the devices down with a dry or slightly moist cloth. For this purpose use soap water. The devices cannot be sterilized or disinfected.

Due to its surface geometry, the product cannot be thoroughly disinfected. Furthermore, the product cannot be sterilized.

### Perspex Tank

- First of all, the Perspex tank is drained. Therefore connect the water hose to the drain plug at the Perspex tank. Place the open end into a water receptacle.
- Open the drain plug to empty the Perspex tank.

The inclination required to completely drain the Perspex tank can be attained by adjusting one of the adjustable legs accordingly. Do not tilt the tank manually.

The bridge is adjusted by PTW-Freiburg. Do not remove it.

For cleaning, use a mild cleaning agent suitable for plastic material or soap water.

After cleaning, thoroughly remove all remains of the cleaning agent.

You should coat the Perspex tank for storage with a cover.

## **NOTE**

For cleaning the detectors, please observe the indications in the corresponding user manuals.

## 6 Preventive Maintenance

### Check before each use

Before each use, visually inspect the device and the cables for signs of mechanical damage.

Also, conduct a constancy check.

If damages or malfunctions are identified, the device must be repaired before it is used again.

The product does not require any other, regular maintenance measures.

## 7 Disposal of the Product

The typical lifetime of the product is about 10 years.

At the end of the product life the components must be disposed of in compliance with the applicable waste control regulations. The different materials must be separated and recycled as appropriate.

The product does not contain hazardous materials.

The cost for a potential return at the end of the product life time is to be borne by the customer.

## Literature

- [1] Council Directive 93/42/EEC concerning medical devices  
(Medical Device Directive - MDD)
- [2] IEC 60601-1-2  
Medical electrical equipment  
Part 1: General requirements for safety;  
2<sup>nd</sup> Collateral Standard: Electromagnetic compatibility - Re-  
quirements and tests
- [3] IEC/CISPR 11  
Industrial, scientific and medical (ISM) radio-frequency  
equipment - Radio disturbance characteristics - Limits and  
methods of measurement.
- [4] IEC 61140  
Protection against electric shock -  
Common aspects for installation and equipment
- [5] IEC 60950-1  
Information technology equipment - Safety  
Part 1: General requirements
- [6] IEC 60601-1  
Medical electrical equipment –  
Part 1: General requirements for basic safety and essential  
performance
- [7] IEC 60601-1-1  
Medical electrical equipment  
Part 1: General requirements for safety;  
1<sup>st</sup> Collateral Standard: Safety requirements for medical elec-  
trical systems

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