

## Transport Shields

Operating Manual  
65107BA2

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**BERTHOLD TECHNOLOGIES GmbH & Co. KG**

Calmbacher Str. 22  
75323 Bad Wildbad, Germany  
[www.berthold.com](http://www.berthold.com)

Telephone +49 7081 177-0  
Fax +49 7081 177-100  
[industry@berthold.com](mailto:industry@berthold.com)

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# 1

## About this Operating Manual

### 1.1 Some prior Remarks

The product is handed over to you by the manufacturer BERTHOLD TECHNOLOGIES GmbH & Co. KG (designated as *Berthold* in the following) in a complete and functionally reliable condition.

This operating manual illustrates how to:

- transport the product
- operate the product
- carry out maintenance on the product
- dispose of the product

Read these instructions thoroughly and completely before working with the product. We have tried to compile all the information for safe and proper operation for you.

However, should questions arise which are not answered in this manual, please contact *Berthold*.

Store the instructions where they are accessible for all users at all times.

### 1.2 Storage

This operating manual as well as all product-related documentation relevant to the respective application must be accessible at all times during the life cycle near the device.

### 1.3 Target Group

The product may only be installed, operated, maintained and repaired by trained personnel.

This manual is directed at qualified specialist personnel who are familiar with handling radioactive sources and heavy system components.

Specialist personnel refers to those who can assess the work assigned to them and recognise possible dangers through their specialist training, knowledge and experience as well as knowledge of the relevant regulations.

## 1.4 Validity of the Manual

The manual is valid from the delivery of the Berthold product to the user until its disposal. Version and release date of this operating manual can be found in the bottom of each page. An alteration service is not provided by the manufacturer *Berthold*.

The manufacturer reserves the right to make changes to this operating manual at any time without stating reasons.

### NOTICE



The current revision of this operating manual replaces all previous versions.

## 1.5 Structure of the Manual

This manual has been divided into chapters. The order of the chapters should help you to familiarise yourself quickly and properly with the operation.

## 1.6 Copyrights

This manual contains copyright-protected information. None of the chapters may be copied or reproduced in any other form without prior authorisation from the manufacturer.

## 1.7 Representation

Identifier	Meaning	Example
Round brackets	Image reference	Connect the plug (fig. 1, Item 1)

## 1.8 Symbols Used

### **NOTICE**



If this information is not observed, deterioration in the operation and/or property damage may occur.

### **IMPORTANT**



Sections marked with this symbol point out important information on the product or on handling the product.

### *Tip*



Provides tips on application and other useful information.



General warning symbol



Warning symbol Danger of crushing



Warning symbol heavy loads



Warning symbol suspended load



Warning of radioactive substances



Wear protective helmet



Wear safety shoes



Do not touch the surface

## 1.9 Structure of Warnings

### Signal word



#### Source and consequence

Explanation, if required

- ▶ Measure

In case of emergency

- 
- **Warning symbols:** (warning triangle) draws attention to the hazard
  - **Signal word:** states the severity of the hazard
  - **Source:** states the type and source of the hazard
  - **Consequence:** describes the consequences if warning is ignored
  - **Measure:** states how one can avoid the hazard.
  - **In case of emergency:** states how to react in case of direct danger.

### Warning Levels used

In this manual, warning instructions in front of instructions for action refer to risks of injury or damage to property. The hazard-prevention measures described must be observed.

### DANGER



Indicates an **imminent**, major hazard, which will certainly result in serious injuries or even death if the hazard is not avoided.

### WARNING



Indicates a **potential** hazard, which can result in serious injuries or even death if the hazard is not avoided.

### CAUTION



Refers to a **potentially dangerous** situation, which can result in medium or minor physical injuries or damages to property, if it is not avoided.

## 1.10 Symbols used on the Device

### Ionising radiation



The shield is equipped with a radioactive source. Please note the handling instructions. Please observe the transport instructions in this operating manual.

# 2 Safety

## 2.1 Proper use

The transport shield was developed as shield/protective container for radioactive sources and may be used exclusively for this purpose.

A transport shield is used to shield sources during transport and storage. It is only used when sources are supplied without working or transfer shields (for example replacement sources for source replacement).

Usually, the shield contains a radioactive source. The notes on radiation protection contained in the present manual as well as any statutory requirements in this respect are to be strictly adhered to.

### The following constitutes proper use:

- Adhering strictly to the instructions and operation sequences and not undertaking any different, unauthorised practices which could put your safety and the operational reliability of the shield at risk!
- Observing the provided safety instructions!
- Carrying out the prescribed maintenance measures or having them carried out for you!

### The following constitutes improper use and is to be avoided:

- Any non-compliance with the present operating manual for the supplied products
- Applying conditions and requirements which do not conform to those stated in the technical documents, data sheets, operation and assembly instructions and other specific guidelines of the manufacturer.
- Using the product after any repair carried out by employees who have not been authorized by *Berthold*.
- Using the product in a damaged or corroded condition.
- Dismounting the unit while the radiation beam outlet is open (except for situations in which the locking mechanism is defective and the beam outlet can no longer be closed).
- Operation without the safety precautions provided by the manufacturer.
- Any modification to design and function, except for any activities provided for and described in the present manual.
- Restructuring or changing the system components.
- Manipulation or avoidance of existing safety equipment.

*Berthold* shall only accept liability for / guarantee the correspondence of the product to its publicised specifications.

If the product is used in a way which is not described in this manual, the product's protection is compromised and the warranty becomes void.



## 2.2 Ambient Conditions During Operation and Storage

The shield was specifically designed for use in rough ambient conditions. The compliance with the operating conditions specified below contributes to guaranteeing the permanent functionality of the shield and the prevention of damage.

Shields containing radioactive substances and sources are to be stored in a lockable storage room complying with the national requirements as regards the storage of radioactive substances.

Furthermore, the following prescribed ambient conditions are to be observed:

- The minimum admissible operating/storage temperature is  $-40^{\circ}\text{C}$ . Below this temperature, the closing rings of the shield may become brittle. In such case, the leakproofness of the shield can no longer be guaranteed.
- The maximum admissible operating/storage temperature is  $+100^{\circ}\text{C}$ . Above this temperature, the closing rings of the shield may be destroyed. In such case, the leakproofness of the shield can no longer be guaranteed.
- The higher the dust and dirt content of the environment, the more likely stiffness or an entire blockage of the locking mechanism is. For this reason, the functional test intervals (see chapter 6) should be adjusted to the ambient conditions.
- Highly combustible or explosive substances must not be kept in the vicinity of shields in order to prevent a fire from spreading to the radioactive substances.

## 2.3 Qualification of the Personnel

### NOTICE



A minimum requirement for all work on or with the product would be employees with general knowledge who are instructed by an expert or authorised person.

At different parts in this manual, reference is made to personnel with certain qualifications who can be entrusted with different tasks during the transport, installation, usage and maintenance.

The four groups this refers to are:

- Employees with general knowledge
- Experts
- Authorised persons
- Radiation Safety Officer

## Employees with General Knowledge

### NOTICE



Employees with general knowledge must always be guided by one expert at the very least. When dealing with radioactive substances, a radiation safety officer must also be consulted.

Employees with general knowledge are e.g. technicians or welders who can undertake different tasks during the transportation, assembly and installation of the product under the guidance of an authorised person. This may also refer to construction site personnel. The persons in question must have experience in handling the product.

### Experts

Experts are persons who have sufficient knowledge in the required area due to their specialist training and who are familiar with the relevant national health and safety regulations, accident prevention regulations, guidelines and recognised technical rules.

Expert personnel must be capable of safely assessing the results of their work and they must be familiar with the content of this manual.

### Authorised Persons

Authorised persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorised by BERTHOLD TECHNOLOGIES for particular tasks. When dealing with radioactive materials, a radiation safety officer must also be consulted.

### Radiation Safety Officer

In order to ensure proper handling and compliance with the statutory requirements, the company has to appoint a radiation safety officer in accordance with the applicable national law (in Germany: Strahlenschutzverordnung [German radiation protection regulation]). The radiation safety officer must implement the statutory radiation protection requirements in order to protect employees against damage to their health caused by handling radioactive materials.

### NOTICE



Dangerous goods officers must not perform any activities as radiation protection officers!

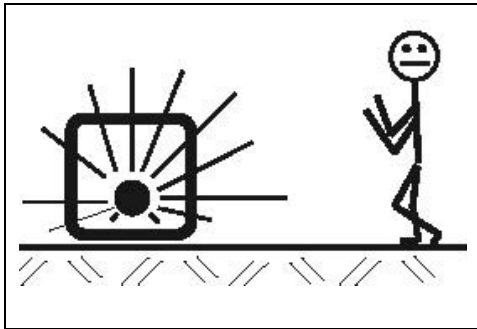
Radiation protection officers must have a special training with attendance of an officially recognized course and appropriate professional experience.

## 2.4 Radiation Protection

### Basic Principles and Regulations

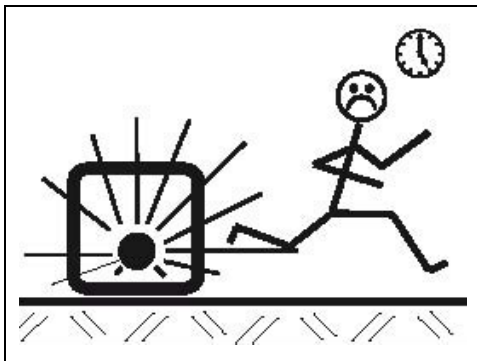
The amount of radiation absorbed by the body (exposure to radiation) is determined by three parameters from which the basic radiation protection regulations can be derived:

#### Distance



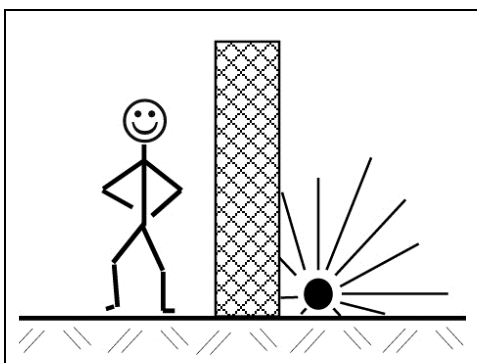
If work close to equipment containing radioactive substances is required, the largest distance possible is to be kept. In particular, this shall apply for employees which do not immediately participate in such work.

#### Time



Any work required in the vicinity of radiometric measuring systems is to be prepared carefully and to be organised in a way that the work can be executed as quickly as possible. Here, providing the correct tools and aids is particularly important.

#### Shield



When mounting and dismantling the shield, it is to be ensured in advance that the radiation beam outlet is closed.

## Exposure of Employees to Radiation

During installation, maintenance and decommissioning of the shield, employees may be exposed to radiation.

In order to keep such exposure as low as possible, the shield with the source may only be mounted and/or dismantled by authorized employees. Such authorised staff is to be instructed as regards all rules of behaviour when handling radioactive substances in advance.

It is to be ensured that the locking mechanism of the shield is closed and secured in order to prevent the emission of unshielded radiation. Modification or damage to the shield must be avoided at all times.

Work may only be executed according to the instructions and under the supervision of the radiation safety officer, who furthermore has to calculate or estimate the exposure of the employees to radiation in order to ensure that the statutory dose rate limits are not exceeded.

## Theft Protection

Radioactive substances or equipment containing radioactive substances must be secured in a way that they are protected against access by unauthorized persons. In the case of firmly installed equipment containing radioactive substances, the protection against unauthorized access is generally provided by the firmly attached installation.

Shields with radioactive sources which are decommissioned for a certain period of time must be dismantled and securely stored in a storage room complying with the national regulations as regards the storage of radioactive substances.

Portable measuring systems must never be left unsupervised. When this equipment is out of use, it is to be protected against access by unauthorised persons.

## In the Case of Fire

The shield material can melt and leak from the shield if exposed to very high temperatures for an extended period of time. During and after a fire, there is a risk of major long-time consequences for your health due to the incorporation of lead as well as a risk of increased radiation exposure.

When planning the use of radiometric measuring systems, constructional measures ensuring fire prevention are to be provided.

- ▶ In the case of fire, these measures limit the access to this area.
- ▶ Avoid the incorporation by keeping sufficient distance.
- ▶ Notify *Berthold* of the situation; you will promptly receive information on immediate measures.

## 2.5 Operator's Obligations

The operator of the product must regularly train his personnel in the following topics:

- Observation and use of the operating manual and the legal provisions.
- Proper use of the product.
- Observation of the plant security instructions and the operating instructions of the operator

## 2.6 Type Plate of the Sources

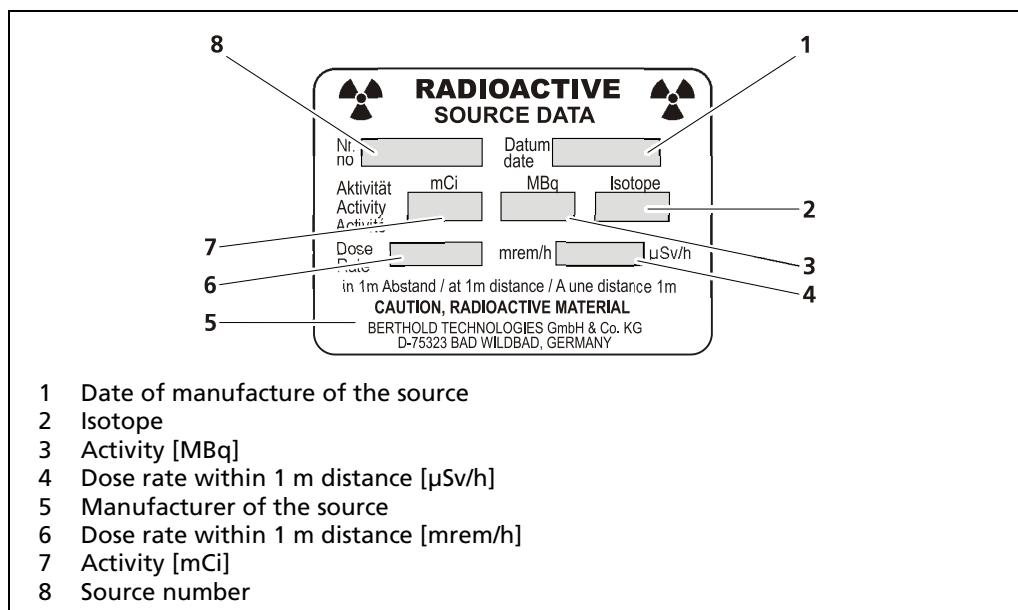


Fig. 1 Type plate of the sources

# 3

## System Description

The transport shield serves as a shielding and protective container for radioactive rod sources and point sources. The radioactive substance is contained in a tightly welded radiator capsule and installed in the transport shield.

The transport shield will only be used if sources without work or transfer shields (eg. replacement sources for source replacement) are supplied.

A transport shield consists of an inner tube and an outer tube. Between the pipes is the shielding material. The sources are stored in the inner tube.

The rod source transport shield is closed at both ends by removable plugs. These plugs are secured against unintentional or unauthorized opening by a locking screw and a padlock. To protect against damage or contamination, protective covers are located at both ends of the shield. Optionally, an source magazine is also available as an insert for transport shields. The magazine's five tubes are numbered, allowing easier identification of the source.

The transport shield for point sources is closed by a plug. This plug is secured by a padlock against unintentional or unauthorized opening. To protect against damage or contamination, a removable cover is attached.

### The Shield fulfills the following Functions:

- Shield the radiation to an unobjectionable level for the operating personnel.
- Protect the built-in source capsule from mechanical damage and environmental influences.

### 3.1 Variant Locking Cylinder

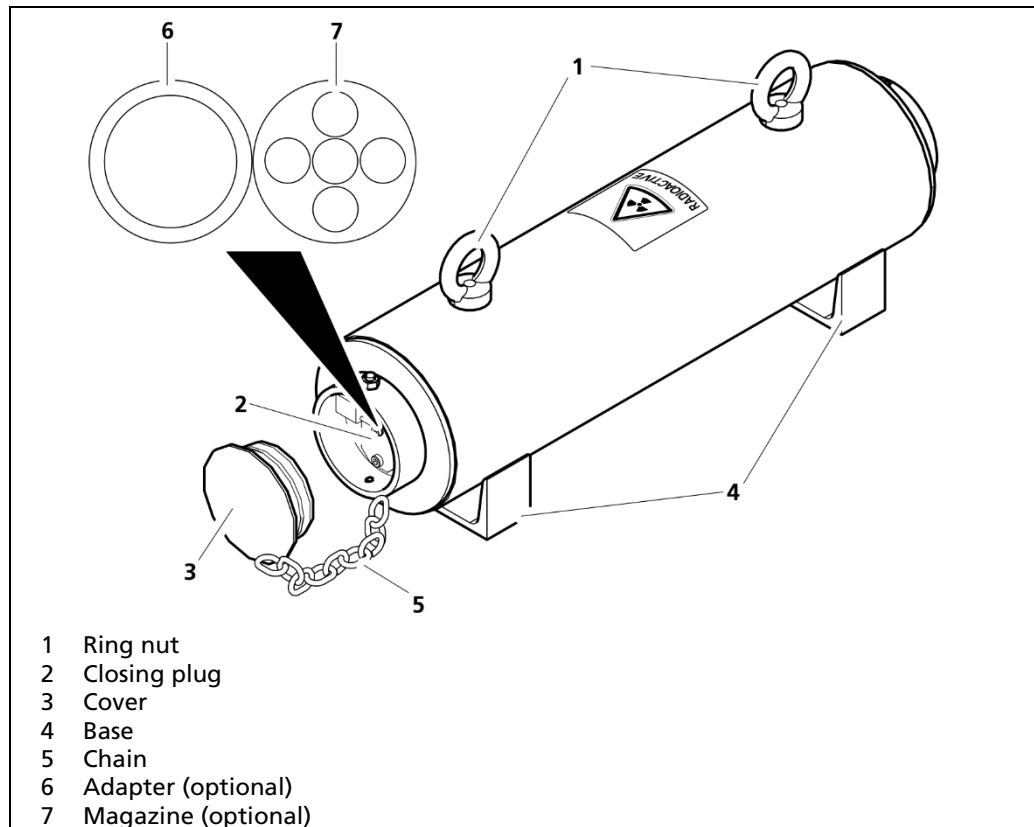


Fig. 2 Basic structure transport shield for rod sources

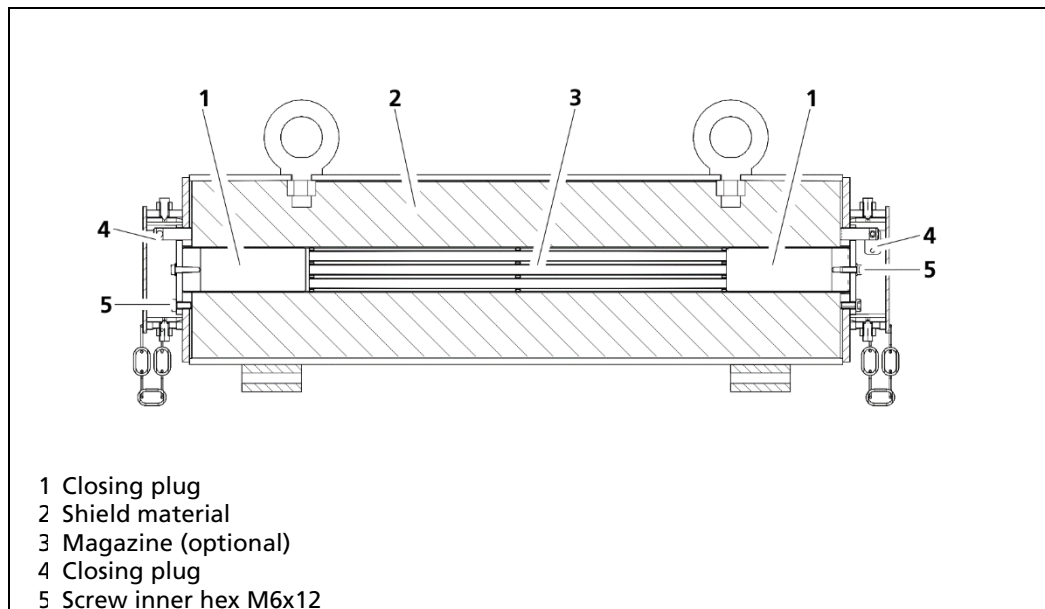


Fig. 3 Sectional view transport shield for rod sources

### 3.2 Variant Lock Slide with Magazine

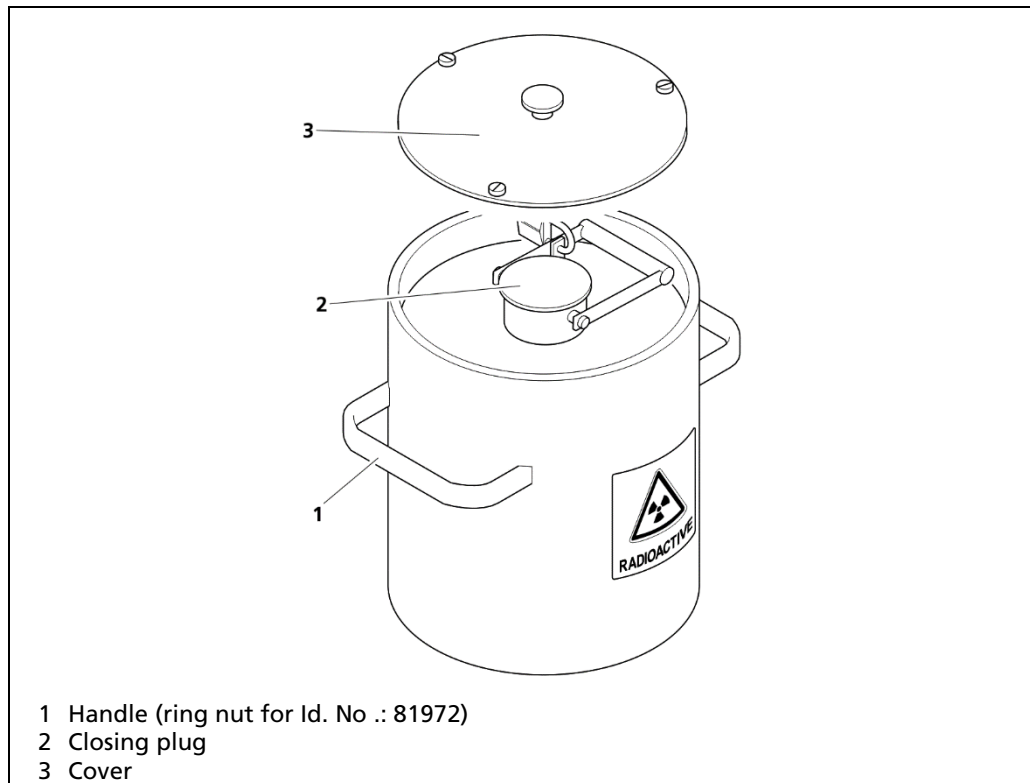


Fig. 4 Basic layout transport shield for point sources

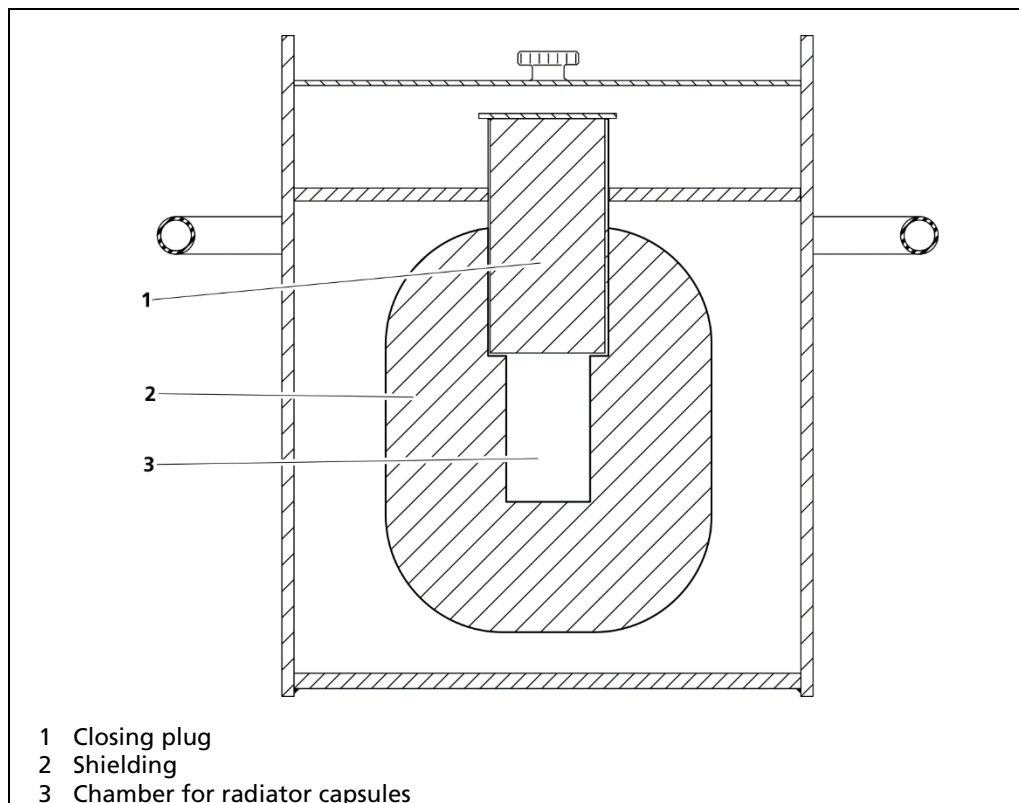


Fig. 5 Basic layout transport shield for point sources



# 4 Installation

## 4.1 Safety Instructions

### WARNING



#### Danger of injury by falling loads

- ▶ Exclusively use the provided fixing possibilities (lifting brackets) for attaching the sling gear.
- ▶ Never stand underneath a lifted or suspended load, keep at a safe distance.
- ▶ Only use tested sling gear components appropriate for the transport weight.
- ▶ Observe the marking for the centre of gravity on the outer packaging, if applicable.
- ▶ Wear head protection and safety shoes.



### WARNING



#### Danger of injury caused by heavy and bulky system components

- ▶ Heavy and bulky system components should only be handled using aids and by at least 2 persons.
- ▶ Observe the guidelines for safe handling of heavy loads.
- ▶ Ensure stability and use the provided fixing possibilities.

### CAUTION



#### Danger caused by ionising radiation

Shields usually contain radioactive sources. An increased exposure to radiation may lead to damage to health.

- ▶ Consult the radiation safety officer responsible for your company.
- ▶ Transport the source exclusively inside the closed and secured shield.
- ▶ The locking mechanism must be in position CLOSED and secured during transport and assembly of the shield.

### *IMPORTANT*



The applicable national regulations of the country of use have to be observed.

## 4.2 Packaging

Shields with the radioactive source is delivered in a packaging which complies with the regulations for the transport of radioactive material (Type A packaging).

## 4.3 Intermediate Storage of the Source

If the source must be intermediately stored at the site of use between delivery and installation, please observe the following notes:

- ▶ Store the source exclusively inside a closed and secured shield.
- ▶ Store the shield in a lockable and properly marked room. The storage room must comply with the national requirements regarding the storage of radioactive substances.
- ▶ Accessible areas of increased radiation exposure must be marked and closed off, if required.

## 4.4 Moving the Shield

### ⚠ WARNING



#### Danger of injury by falling loads

Falling loads can endanger people.

- ▶ Never step under suspended loads, keep safety distance.
- ▶ Adhere to the guidelines for safe handling at high weight.
- ▶ Ensure good stability and use the prepared mounting options.
- ▶ Secure the danger zone by means of covering strips.

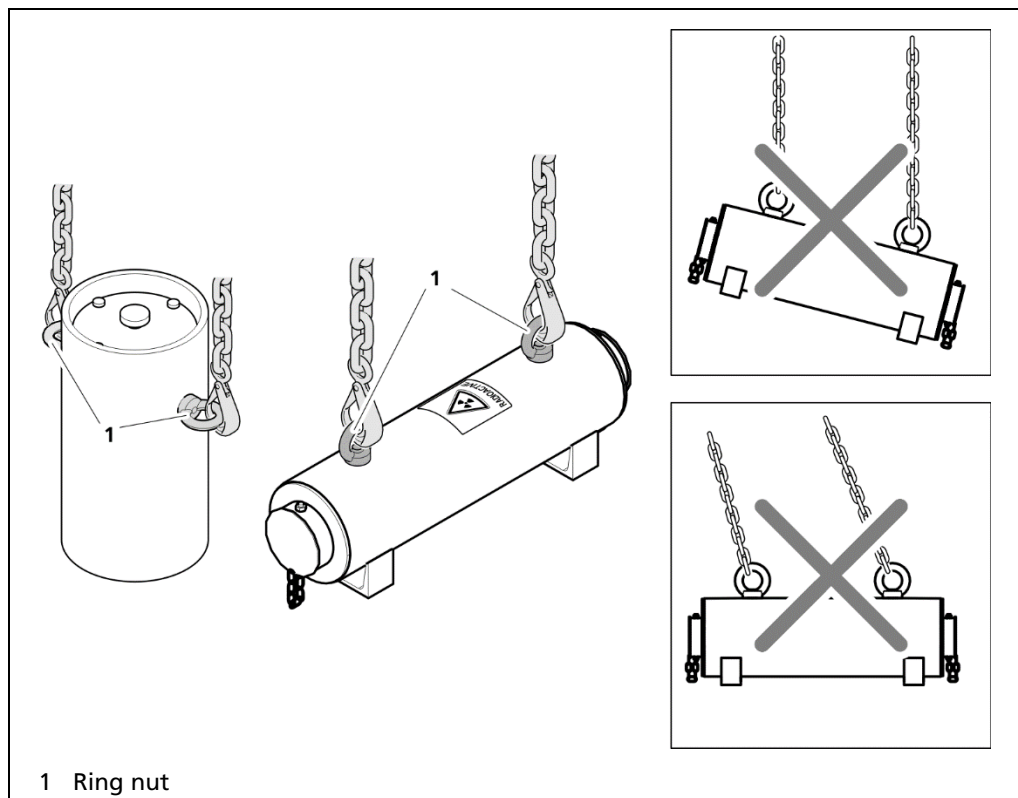


Fig. 6 Moving the shield

1. Check that the shield is closed and secured.
  - The closing plugs are mounted and screwed.
  - the padlocks are mounted.
  - the covers are mounted.
2. Attach the shielding to the ring nuts with adequately dimensioned and tested slings.
3. Lift shield vertically.
  - Avoid diagonal pull!
4. Carefully set off shield.

# 5 Unloading and Loading

## 5.1 Safety instructions

### CAUTION



#### **Danger caused by nuclear radiation**

Shields usually contain radioactive sources. An increased exposure to radiation may lead to damage to health.

- ▶ Consult the radiation safety officer responsible for your company.
- ▶ Ensure that the shield does not show any signs of damage or functional limitations.
- ▶ Please observe the instructions on regular maintenance.

## 5.2 Prepare for Replacement

In order to avoid unnecessary radiation exposure, the duration of contact with the source (even in the shielded state) should be kept as low as possible during assembly. It is therefore advisable to carry out the following steps before the delivery of the source:

- Planning of the assembly (including estimation of the radiation exposure)
- Instruction of the workforce
- Cleaning and cleaning of the installation site
- Provision of the required tools and hoist
- Removal of all obstacles that could obstruct the installation of the source

## 5.3 Check Delivery

1. Check the delivery for completeness according to the packing list.
2. Check if the padlocks are attached, closed and undamaged.
  - Inform the transport company and the manufacturer immediately if damaged.
3. Check the integrity of the seal and the seal wire.
  - If the seal or the closing wire is damaged, inform the transport company and the manufacturer immediately.
4. Check the shield for damage.
  - In case of damage contact the transport company and the manufacturer immediately.
5. Clean the parts if necessary.

## 5.4 Remove and Install Source

### NOTICE



The removal and installation of sources may be carried out by at least competent persons who are instructed by a competent or authorized person. If the shield contains a radioactive source, the responsible radiation protection officer must be consulted.

The following tools are required for installation:

- Flat-head screwdriver, to turning the screws on the cover.
- Gripping tool (pliers or similar) to securely grip the source or the source container.
- Allen key size 5, for loosening the closing plug at the rod source shield.

### 5.4.1 Remove Point Source without Source Holder

#### IMPORTANT



Sources with screwed-on source holders can also be transported in transport shields for rod sources, see section "Removing point sources from rod source shields".

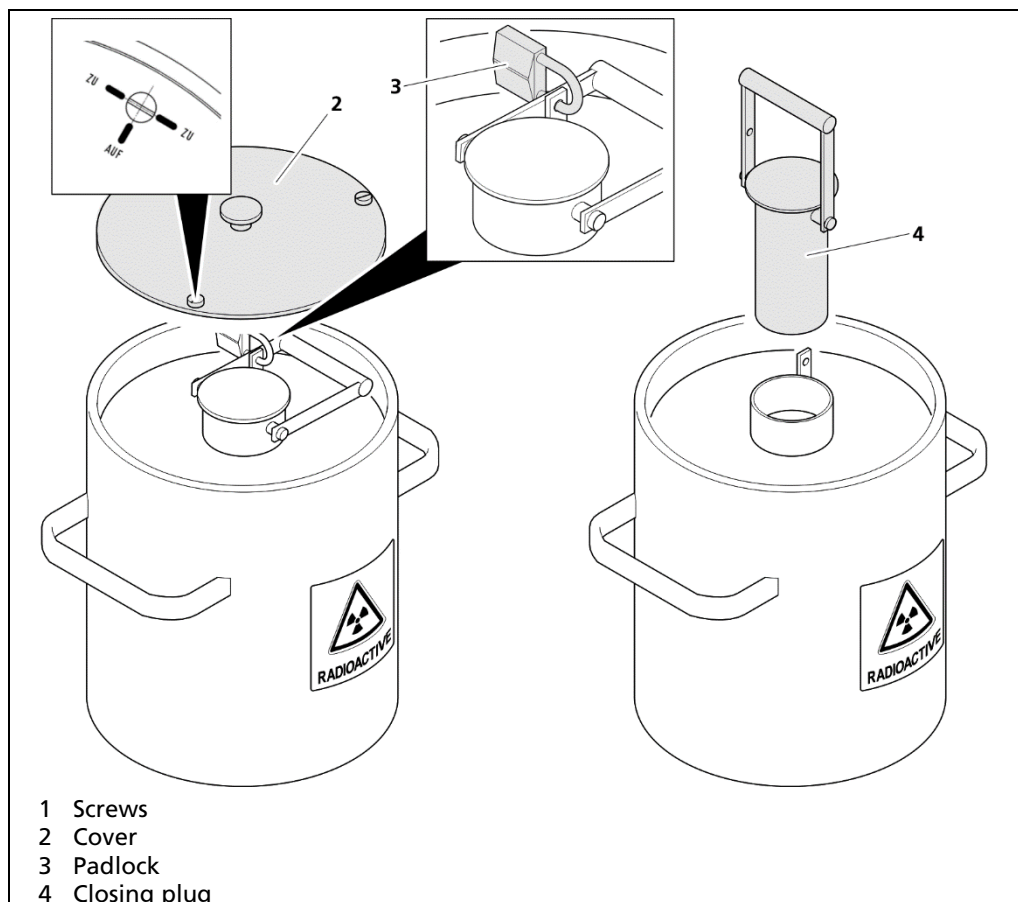


Fig. 7 Open Transport Shield

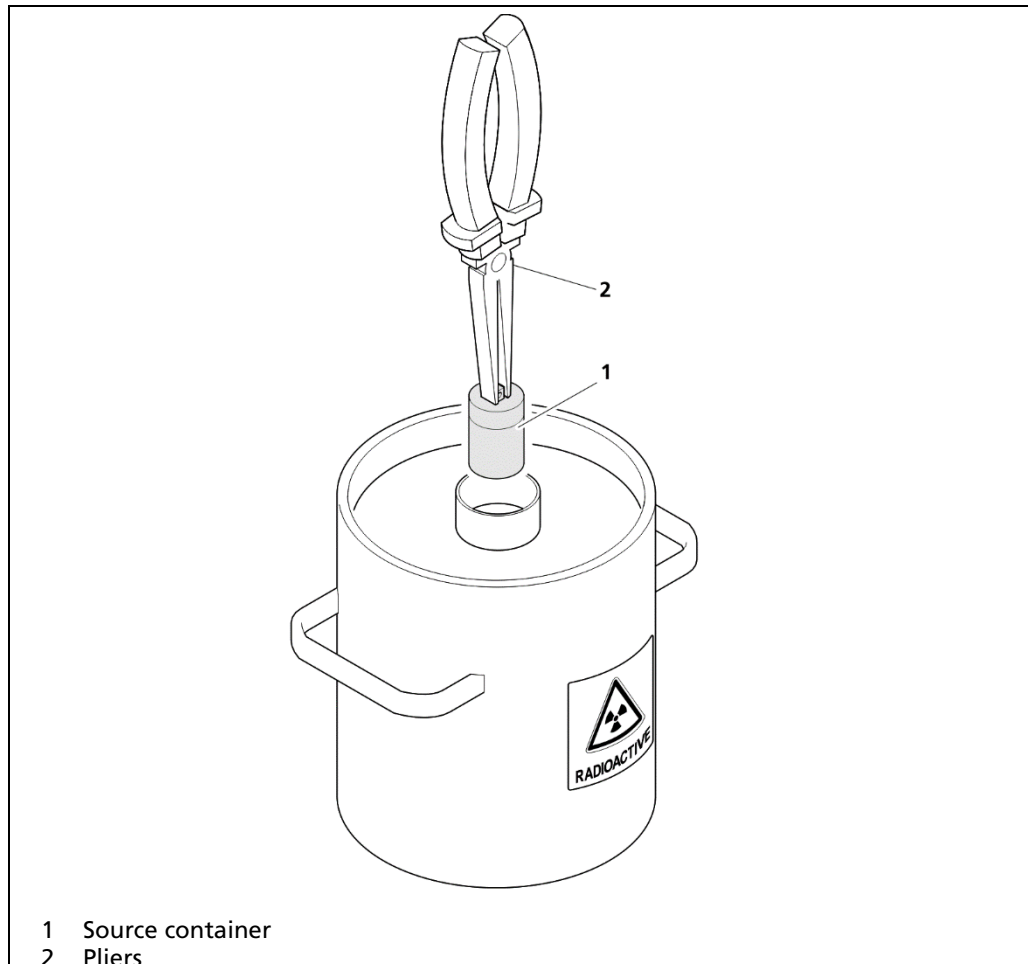
1. Provide the transport shield in the immediate vicinity of the intended use of the source.
2. If necessary, remove the seal wire.
3. Turn the three slotted screws to the OPEN position (Fig. 7, Item 1) and remove the cover (Fig. 7, Item 2).
4. Remove the padlock (Fig. 7, Item 3).
5. Pull the closing plug (Fig. 7, Item 4) vertically upwards on the lever.
  - ▶ The source container becomes visible.

**⚠ CAUTION****Danger from ionizing radiation**

When replacing the source, you must temporarily use the unshielded source. An increased radiation dose is harmful to your health.



- ▶ Only hold the source container with a pair of pliers.
- ▶ Keep the source container far away from the body.
- ▶ Make sure that no persons are in the radiation area during the work.



- 1 Source container  
2 Pliers

Fig. 8 Pull the source out of the shield

6. Pull the source container (Fig. 8, Item 1) with a pair of pliers or similar (Fig. 8, Item 2) from the shield.

## Removing Point Sources with Source Holder from Rod Source Shields

### IMPORTANT



If there are several sources with source holders in the rod source shield, remove both covers / plugs for removal.

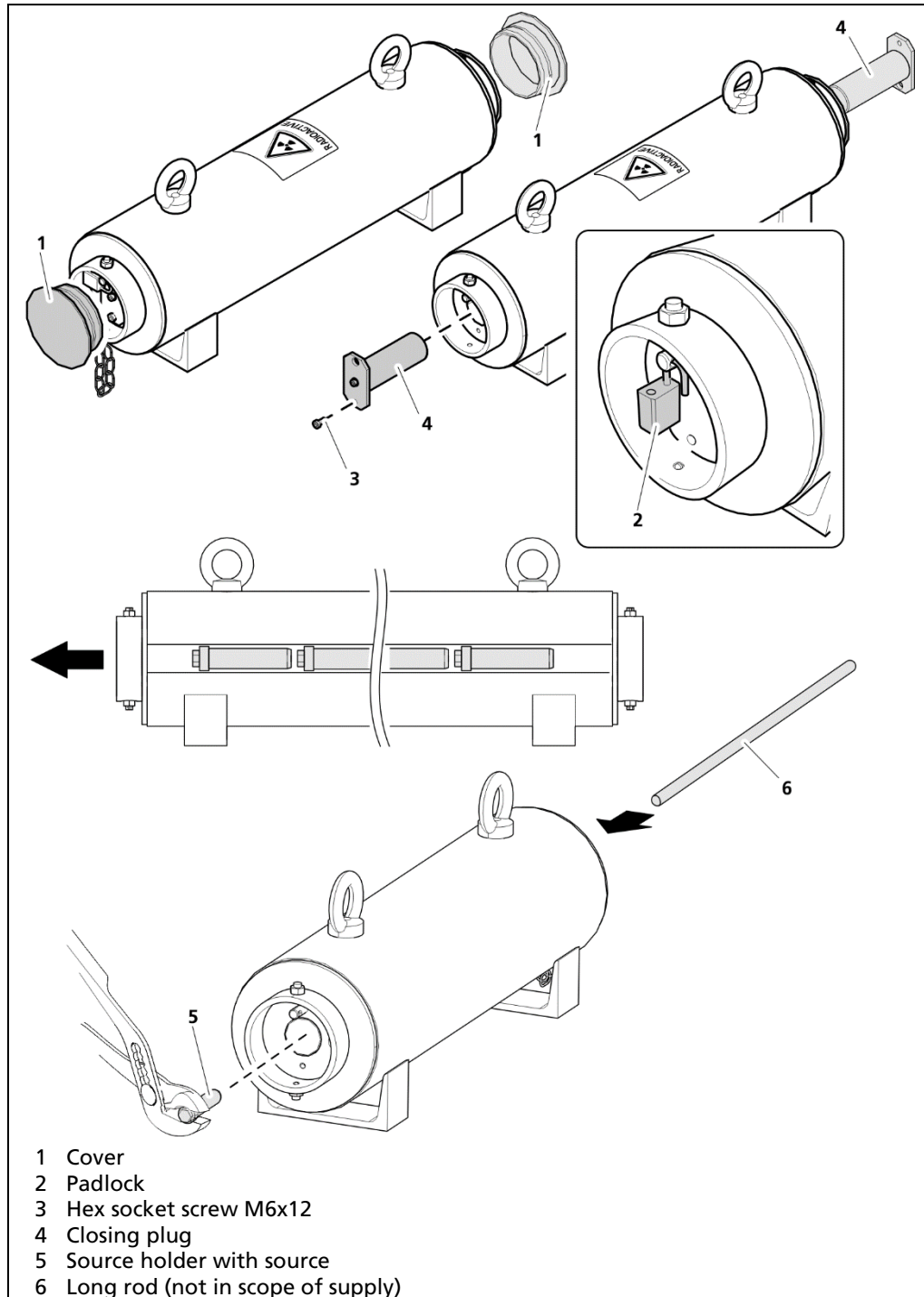


Fig. 9 Removing point sources from rod source shields

1. Remove the covers (Fig. 9, Item 1).
2. Remove the padlocks (Fig. 9, Item 2).
3. Loosen the hexagon socket screw (Fig. 9, Item 3) and remove the closing plugs (Fig. 9, Item 4).
  - ▶ The source holder becomes visible.
4. Pull the source holder with source (Item 5) with pliers or similar from the shield.
5. If several sources are installed, insert a long rod (Fig. 9, Item 6) into the opening to push the sources out of the transport shield.
6. Grasp the required source with the pliers from the shield and guide the source as quickly as possible into the prepared working shield.



## 5.4.2 Remove Point Sources without Source Holders

### **IMPORTANT**



Sources with screwed-on source holders can also be transported in transport shields for rod sources, see section "Insert point sources into rod source shields".

### **CAUTION**



#### **Danger from ionizing radiation**

When replacing the source, you must temporarily use the unshielded source. An increased radiation dose is harmful to your health.



- ▶ Only hold the source with a pair of pliers.
- ▶ Keep the source far away from the body.
- ▶ Make sure that no persons are in the radiation area during the work.

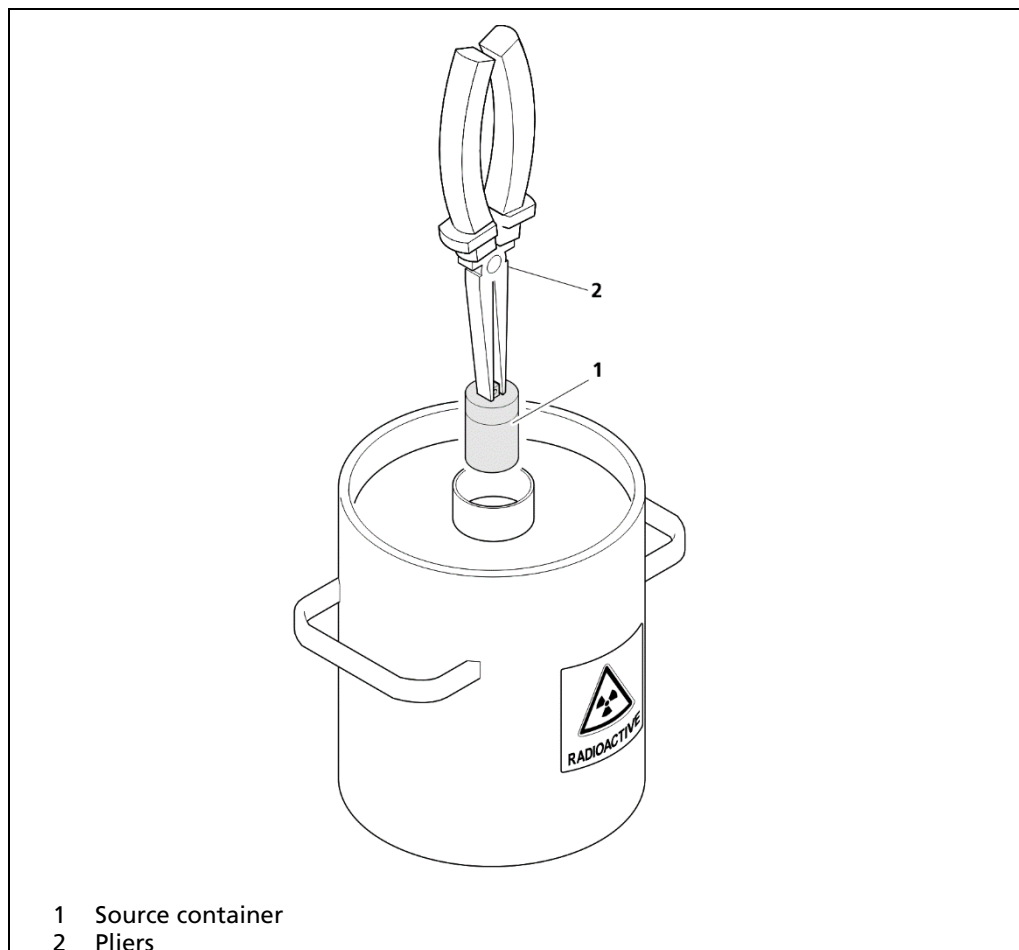


Fig. 10 Insert source into the transport shield

1. Make sure that the sources are in the source container and the source container is tightly closed.
2. Place the source container (Fig. 10, Item 1) with pliers or similar (Item.2) as quickly as possible in the shield.

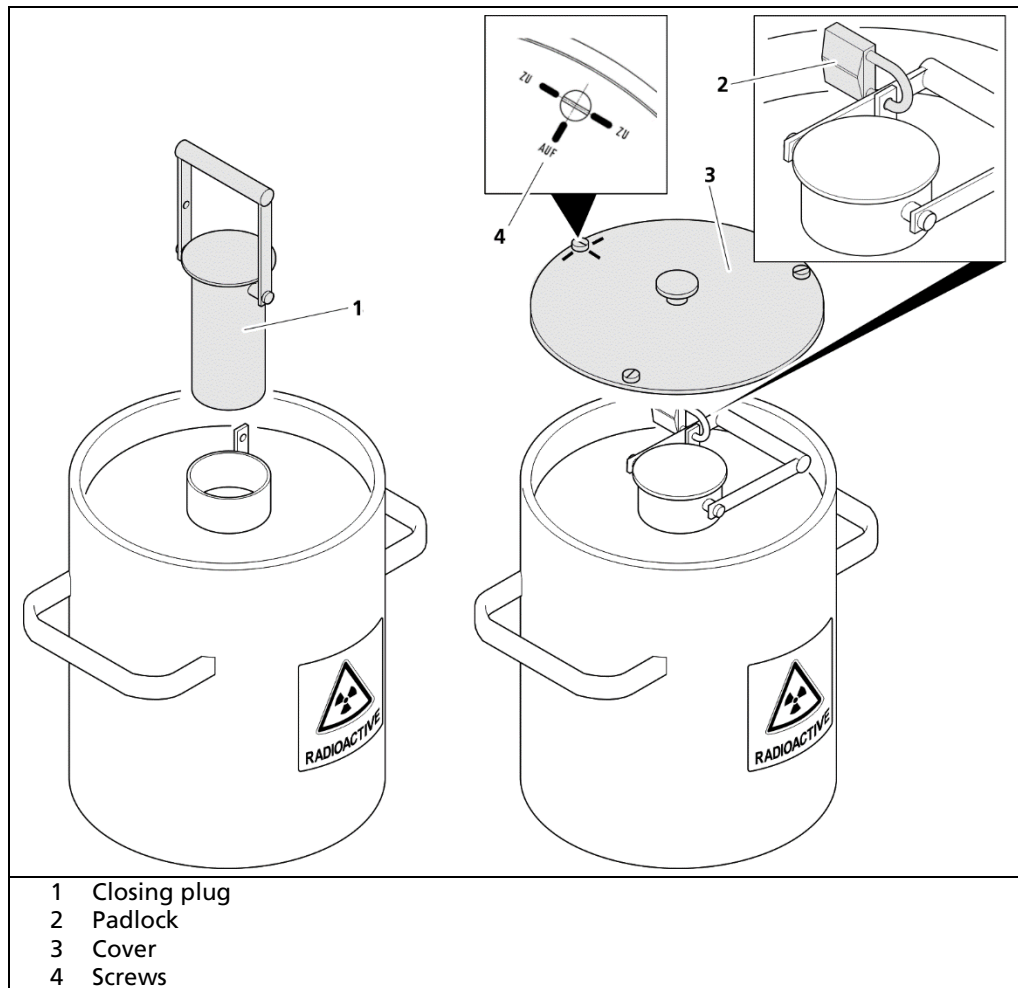


Fig. 11 Close transport shield

3. Insert the closing plug (Fig. 11, Item 1).
4. Attach the padlock (Fig. 11, Item 2).
5. Attach the cover (Fig. 11, Item 3).
6. If necessary, attach the seal wire and the seal.
7. Turn the three slotted screws to the CLOSED position (Fig. 11, Item 4).
  - ▶ The transport shield is correctly closed.

## Insert Point Sources into Rod Source Shield

**NOTE**

Observe the maximum load of source with sources holders in transport shields. See in the supplied "Loading schedule".

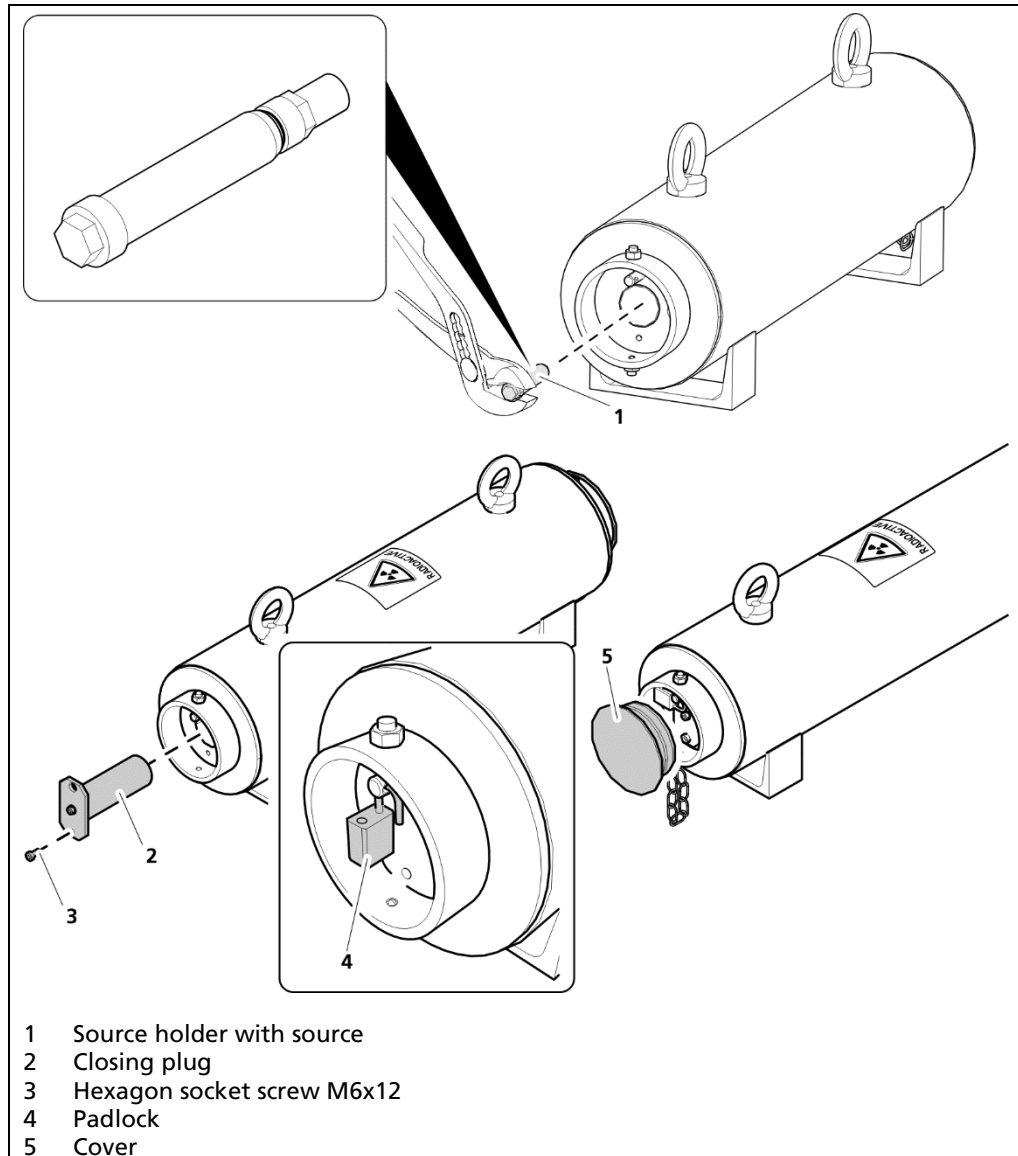


Fig. 12 Insert point sources into rod source shield

1. Insert the source holder with source (Item 1) into the shield as quickly as possible.
2. Attach the closing plug (Item 2) and screw it with a hex socket screw (Item 3).
3. Attach the padlock (Item 4).
4. Attach the cover (Item 5).
  - ▶ The point sources are inserted correctly and the shield is closed.

### 5.4.3 Remove Rod Source

#### ⚠ CAUTION



#### Danger from ionizing radiation

When replacing the source, you must temporarily use the unshielded source. An increased radiation dose is harmful to your health.



- ▶ Only hold the source with a pair of pliers.
- ▶ Keep the source far away from the body.
- ▶ Make sure that no persons are in the radiation area during the work.

#### Source Identification

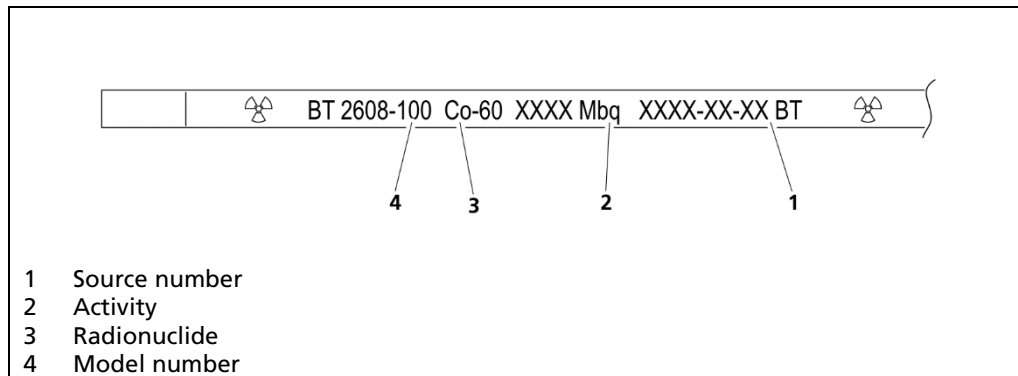


Fig. 13 Source labeling

#### IMPORTANT



If the transport shield contains several sources, the correct sources must be identified before removal.

- ▶ Use the supplied loading plan to determine the magazine tube in which the required source is located.

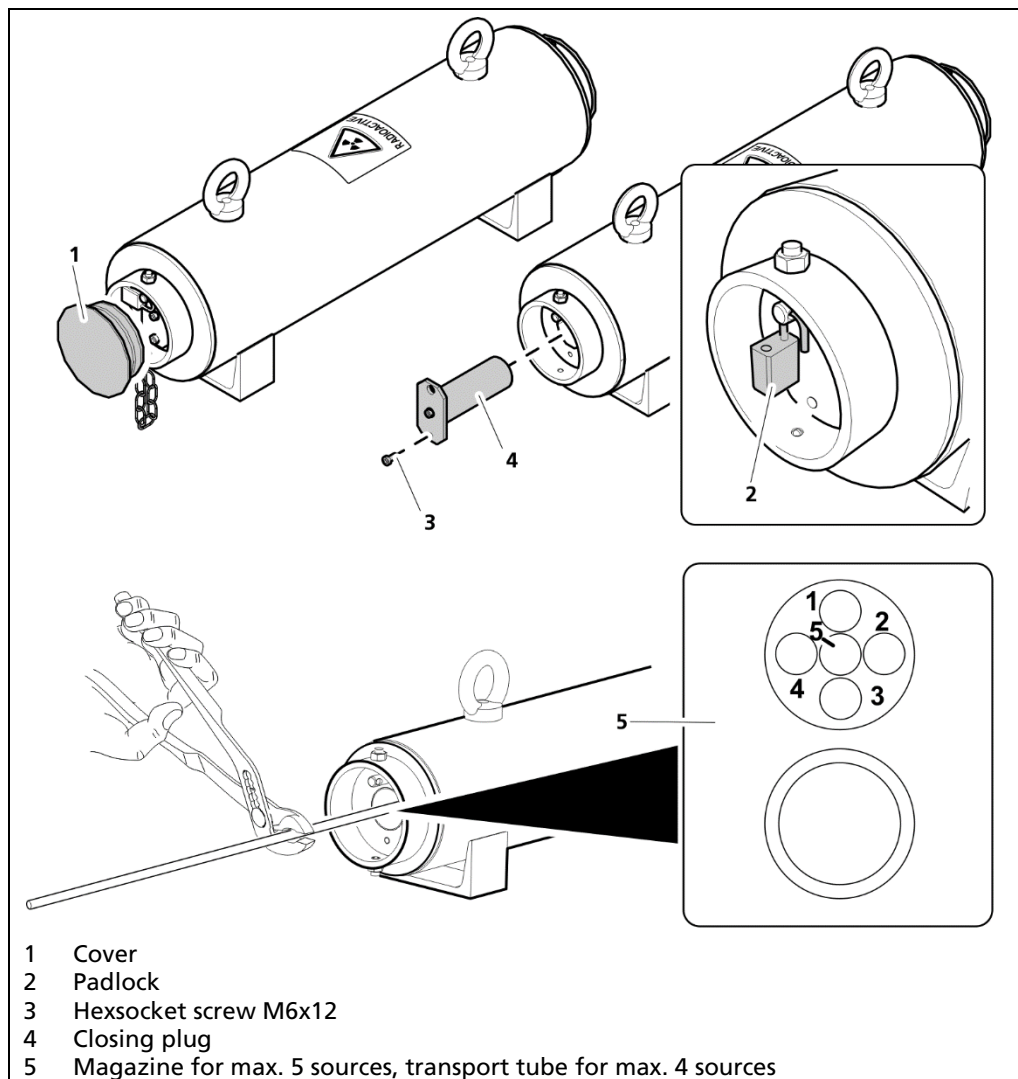


Fig. 14 Open shield

1. Remove the covers (Item 1).
2. Remove the padlocks (Item 2).
3. Loosen the hex socket screw (Item 3) and remove the closing plugs (Item 4).
  - ▶ The sources become visible.
4. If the shield contains multiple sources, you must identify the correct source prior to removal (see previous section).
5. If the transport shield does not have a source magazine, you must read the source number on the source. To do this, hold the source with the gripper tool (pliers) and pull the source out of the shield only far enough so that you can read the source number.
  - Unnecessary sources must be pushed back into the shield immediately!
6. Pull the identified and required source out of the shield with the pliers and guide the source as quickly as possible into the prepared working shield.
7. Close the transport shield after removal.

## 5.4.4 Insert Rod Source

**⚠ CAUTION****Danger from ionizing radiation**

When replacing the source, you must temporarily use the unshielded source. An increased radiation dose is harmful to your health.



- ▶ Only hold the source with a pair of pliers.
- ▶ Keep the source far away from the body.
- ▶ Make sure that no persons are in the radiation area during the work.

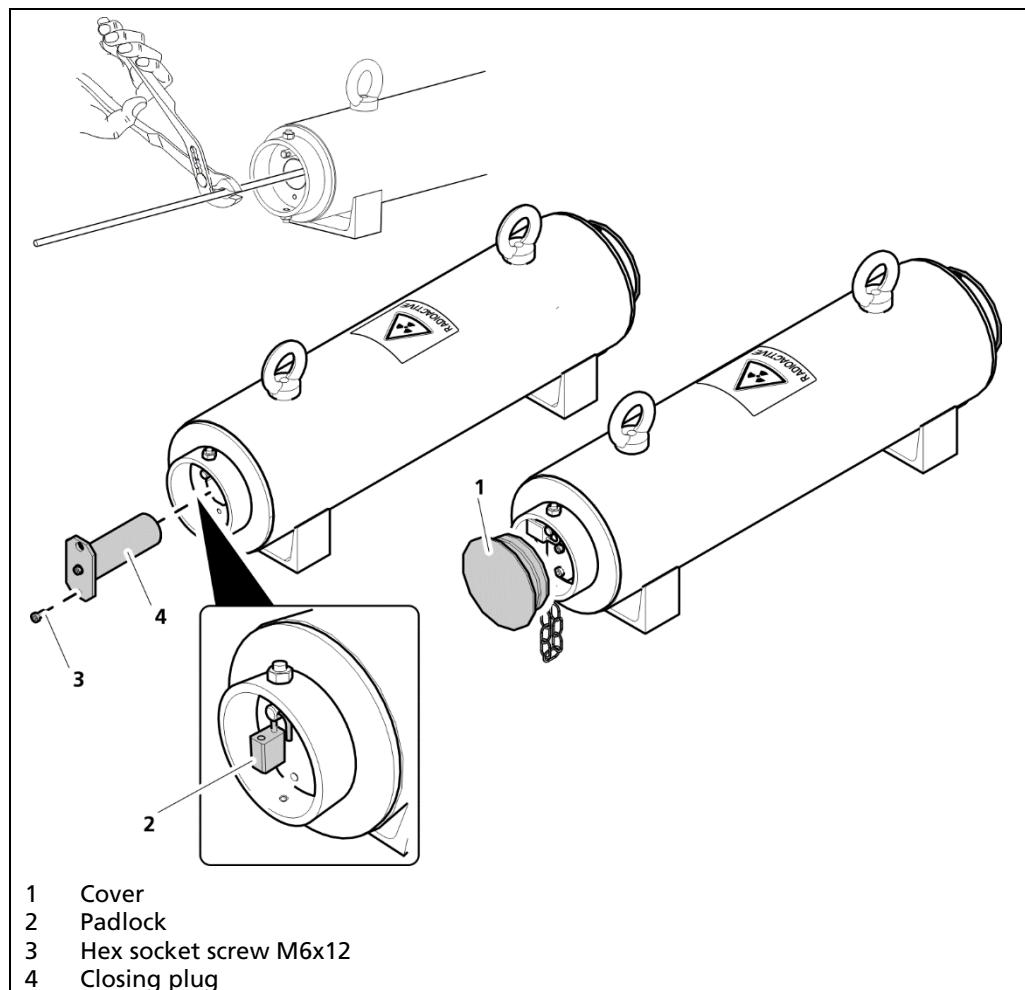


Fig. 15 Close shield

1. Insert the sources as quickly as possible into the transport shield.
2. Fit the closing plug (Item 4) and screw it with a hex socket screw (Item 3)
3. Attach the padlock (Item 2).
4. Attach the cover (Item 1).
  - ▶ The shield is closed correctly.

# 6 Maintenance and Repair

## 6.1 Safety Instructions

### ⚠ CAUTION



#### Danger caused by nuclear radiation

Shields usually contain radioactive sources. An increased exposure to radiation may lead to damage to health.

- ▶ Consult the radiation safety officer responsible for your company.
- ▶ Ensure that no one is in the radiation beam during operation.
- ▶ Longer repair and maintenance work on shields must not be carried out with the source installed. If a removal of the source is not possible, please contact the manufacturer.

### IMPORTANT



The applicable national regulations of the country of use have to be observed.

### IMPORTANT



Document the results of the tests you conducted using the check list in the appendix. This documentation as well as the seal test certificates must be kept during the entire life cycle of the shield.

### NOTICE



Adjust the intervals of the visual inspection and the functional check to the ambient conditions. If the ambient conditions are especially rough, the atmosphere is corrosive and / or there is a serious threat of contamination, the intervals should be shortened accordingly.

### NOTICE



If damage affecting the secure function of the shield is detected during handling, maintenance or regular checks, the damage must be repaired after consultation with *Berthold* before the system is used again. Only spare parts specified by *Berthold* may be used and required repair work may be carried out exclusively by authorized persons.

## 6.2 Visual Inspection

The visual inspection must be carried out by persons who are at least employees with general knowledge at the following intervals:

- before initial commissioning
- with every repair that may be required
- regularly at least every six months
- before dispatch

When determining the intervals for the visual inspection, the following conditions are to be considered:

- ambient conditions (outdoors, rain, sunlight, wind)
- operating conditions (degree of utilisation of the plant, misuse)

### Performing the visual inspection:

1. Check the shield for obvious damage (dents, cracks, holes etc.) and corrosion.
2. Only before dispatch: Check if the shield is in closed position and if the padlock as well as the transport securing device are installed.

#### *Tip*



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If there is any doubt regarding the actual position of the locking mechanism: Check the dose rate at the shield using a dose rate measuring device. If the shield is closed, the dose rate in the direction of the beam may not be significantly higher than at other parts of the shield.

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3. If any defects are identified during visual inspection, inform the radiation safety officer who will initiate the measures required for repairing the defects.

For further information, please contact the manufacturer.

## 6.3 Leak Test

Depending on the supervisory authority responsible for the area where the source is used, regular leak tests must be carried out. These tests are to be carried out at the discretion of the competent supervisory authority either by an authorized expert or by the manufacturer. For this test, the corresponding source documentation must be made available.



### Required Documents

- Inventory list of the sources to be tested including indication of previous leak tests.
- Source certificate containing the following information: Nuclide, activity, procurement date, physical/chemical form, description of the enclosure and type of closing, resistance against mechanical and thermal influences or classification of the source design. The source certificate is provided together with the source.
- Information on the location, application as well as on the maximum customary mechanical and thermal strains.
- If the source is installed in a device, a drawing is to be provided. In the drawing, the position of the source and of all parts intended to protect the source against external influences must be clearly indicated. Recommendations regarding the most appropriate test method should be given, e.g. by indicating alternative test areas. If required, recommendations should be given on how the necessary test can be conducted without affecting the functionality of the system or device.

# 7 Decommissioning

## 7.1 Disposal of Radioactive Substances

### NOTICE



Should you have any questions regarding the transportation or disposal of radioactive substances, please contact the manufacturer.

Generally, each country has a depot where radioactive material is accepted and can be disposed of.

## 7.2 Shipment of Radioactive Substances

If you wish to dispatch radioactive material, you must observe the international regulations for the transport of dangerous goods and for radiation protection as well as any applicable national regulations. It is the full responsibility of the sender to comply with these regulations.

Please also note the following:

- Dose rate at the surface of the packaging must be lower than 2000  $\mu\text{Sv/h}$ .
- Dose rate at a distance of 1m from the surface of the packaging must be lower than 100  $\mu\text{Sv/h}$ .
- The packaging must be marked with a reference for dangerous goods in accordance with the applicable regulations with the UN number.
- Furthermore, transport documents with the correct description of the content as well as an accident procedures sheet according to the ADR regulations are required.
  - With regard to transport by air, the IATA DGR.
  - IAEA as the basis for all regulations.
- Packaging must comply with the current ADR regulations (for example European Agreement concerning the International Carriage of Dangerous Goods by Road).
- The cargo must be secured in the transport vehicle according to the applicable national and international regulations.
- Before dispatch, each shield containing a source must be subjected to a visual inspection by the user (chapter 6.2). The shields may only be dispatched if the test requirements are met.
- At the time of dispatch, a valid certificate concerning the leak proofness of the source must be available.

## Preconditions for returning shields to BERTHOLD TECHNOLOGIES GmbH & Co. KG

- Radioactive substances and their shields must not be damaged in any way and a respective, valid seal test certificate must be provided. The seal test certificate issued before the arrival of the radioactive substances in Germany may not be older than 6 months.
- If radioactive sources with isotope Am-241 or Cm-244 are returned, the special form certificate must be attached.
- At all times, any radioactive material sent to us must be sufficiently labelled with your name and address. If we have sent you a quotation in advance, our quotation number must be indicated, as well.
- Radioactive substances may only be returned after the respective approval by *Berthold*. We are pleased to send you a quotation regarding the costs.
- Radioactive substances must be sent to Bad Wildbad, Germany, carriage paid. *Berthold* will not assume any costs for customs clearance or transportation.
- *Berthold* is to be informed about any return transport in advance. *Berthold* will reject any radioactive substances sent to *Berthold* without prior notice. Any storage costs accrued in such case shall be borne by the sender.
- A copy of the enclosed notification form and leak test certificate must be affixed to each source. The original must be enclosed with the shipping documents. Beforehand, the documents must be sent to our source disposal and repair department.

### NOTICE



Observe the observance of the current regulations when taking them out of operation and disposal.

# 8 Appendices

## 8.1 Check Lists for Tests

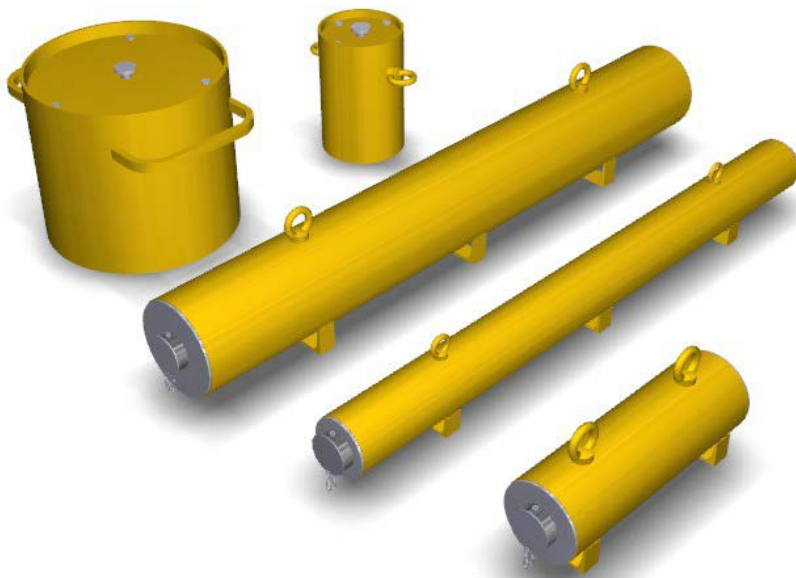
### Visual inspection

Requirement	met	not met
The shield must be free from damage.		
The type plates must be legible.		
If there is corrosion, it must not affect the function and stability of the shield.		
Only before dispatch: The beam path must be closed.		
Only before dispatch: The locking plate must be mounted and secured.		
Only before dispatch: The transport securing device(s) must be installed.		
Name of inspector:	Date:	Signature:

We reserve the right to further developments and technical modifications of our products.

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**BERTHOLD TECHNOLOGIES GmbH & Co. KG**



**Transport Shield**  
*Transportabschirmung*

**Technical Information**  
*Technische Information*

65107TI  
Rev. No.: 00, 01/2019

## Maximum Permissible Activities during Transport Zulässige Maximalaktivitäten für den Transport

### Rod sources Stabstrahler

The activity is determined in each case for the necessary load, nuclide, number, length, activity distribution in compliance with the limit of 2000  $\mu\text{Sv/h}$  at the surface of the packaging or lower values due to other provisions in advance.

Die Maximalaktivität wird jeweils für die notwendige Beladung, Nuklid, Anzahl, Länge, Aktivitätsverteilung unter Einhaltung des Grenzwertes 2000  $\mu\text{Sv/h}$  an der Oberfläche der Verpackung oder geringerer Werte aufgrund anderweitiger Bestimmungen im Vorfeld ermittelt.

### Point Sources Punktstrahler

Shield model <i>Abschirmungsmodell</i>	max. sources <i>max. strahler</i>	Maximum activity (Co-60) <i>Maximalaktivität (Co-60)</i>	Maximum activity (Cs-137) <i>Maximalaktivität (Cs-137)</i>
Variant B=107mm; ID: 81972 <i>Variante B=107mm; ID: 81972</i>	18	260 MBq	5550 MBq
Variant B=200mm; ID: 81749 <i>Variante B=200mm; ID: 81749</i>	35	5550 MBq	1*10 <sup>6</sup> MBq
Variant B=260 mm; ID: 81748 <i>Variante B=260 mm; ID: 81748</i>	35	74000 MBq	1,25*10 <sup>7</sup> MBq
		gerechnete Werte <i>calculated values</i>	

## Technical Data *Technische Daten*

### **IMPORTANT / WICHTIG**

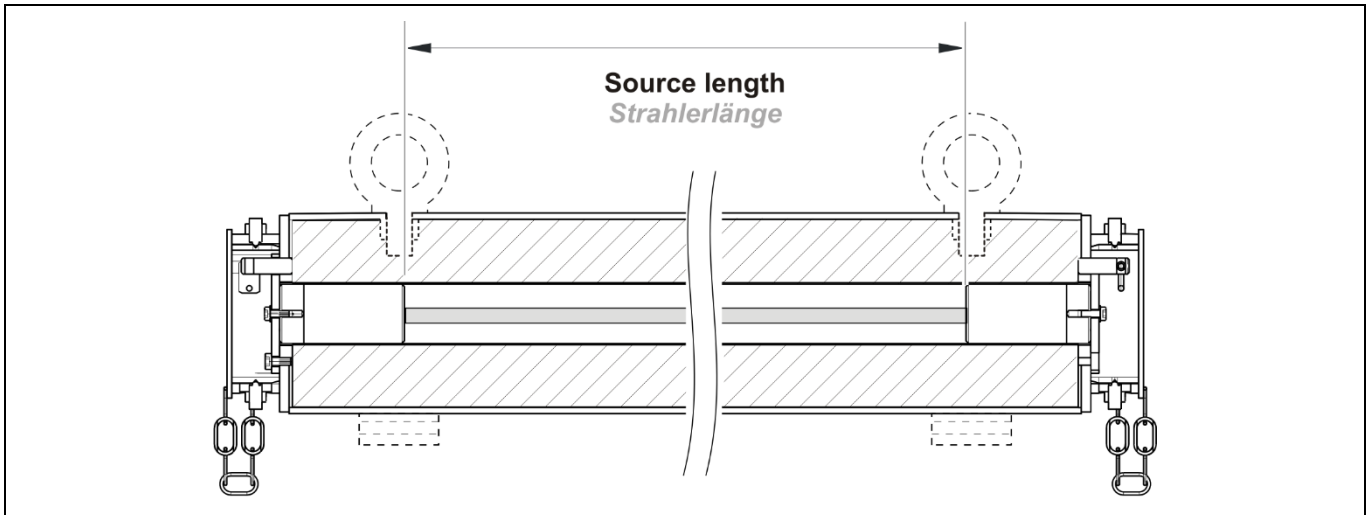


Maximal load (pieces) of rod sources in the transport shield with and without adapter:

- with adapter (inner  $\varnothing = 22$  mm) up to 5 rod sources or 3 rod sources connected with joint.
- without adapter (inner  $\varnothing = 38$  mm) up to 18 rod sources or 13 rod sources connected with joint.

*Maximalladung (Stückzahl) der Stabstrahler in der Transportabschirmung mit und ohne Adapter:*

- *mit Adapter (Innen- $\varnothing = 22$  mm) bis zu 5 Stabstrahler bzw. 3 Stabstrahler mit Gelenk verbunden.*
- *ohne Adapter (Innen- $\varnothing = 38$  mm) bis zu 18 Stabstrahler bzw. 13 Stabstrahler mit Gelenk verbunden.*





**Variant 100**  
*Variant 100*

Variant <i>Variante</i>	Source length <i>Strahlerlänge</i>	Weight <i>Gewicht</i>	Magazine for 5 rod sources (book separately) <i>Magazon für 5 Strahler (gesondert bestellen)</i>	Adapter for inner Ø 22 + 10 mm lead (book separately) <i>Adapter für innen Ø 22 + 10 mm Blei (separat bestellen)</i>
ID: 65107-01	353 mm	44 kg	ID: 42885	ID: 60197
ID: 65107-02	603 mm	65 kg	ID: 38155	ID: 60735
ID: 65107-03	903 mm	89 kg	ID: 38156	ID: 60204
ID: 65107-04	1253 mm	118 kg	ID: 38157	ID: 60737
ID: 65107-05	1553 mm	142 kg	ID: 48940	ID: 61391

**Variant 130**  
*Variant 130*

Variant <i>Variante</i>	Source length <i>Strahlerlänge</i>	Weight <i>Gewicht</i>	Magazine for 5 rod sources (book separately) <i>Magazon für 5 Strahler (gesondert bestellen)</i>	Adapter for inner Ø 22 + 10 mm lead (book separately) <i>Adapter für innen Ø 22 + 10 mm Blei (separat bestellen)</i>
ID: 65108-01	353 mm	69 kg	ID: 42885	ID: 60197
ID: 65108-02	603 mm	100 kg	ID: 38155	ID: 60735
ID: 65108-03	903 mm	137 kg	ID: 38156	ID: 60204
ID: 65108-04	1253 mm	181 kg	ID: 38157	ID: 60737
ID: 65108-05	1553 mm	219 kg	ID: 48940	ID: 61391

**Variant 160**  
*Variant 160*

Variant <i>Variante</i>	Source length <i>Strahlerlänge</i>	Weight <i>Gewicht</i>	Magazine for 5 rod sources (book separately) <i>Magazon für 5 Strahler (gesondert bestellen)</i>	Adapter for inner Ø 22 + 10 mm lead (book separately) <i>Adapter für innen Ø 22 + 10 mm Blei (separat bestellen)</i>
ID: 65109-01	353 mm	120 kg	ID: 42885	ID: 60197
ID: 65109-02	603 mm	170 kg	ID: 38155	ID: 60735
ID: 65109-03	903 mm	232 kg	ID: 38156	ID: 60204
ID: 65109-04	1253 mm	304 kg	ID: 38157	ID: 60737
ID: 65109-05	1553 mm	365 kg	ID: 48940	ID: 61391

**Variant 200**  
*Variant 200*

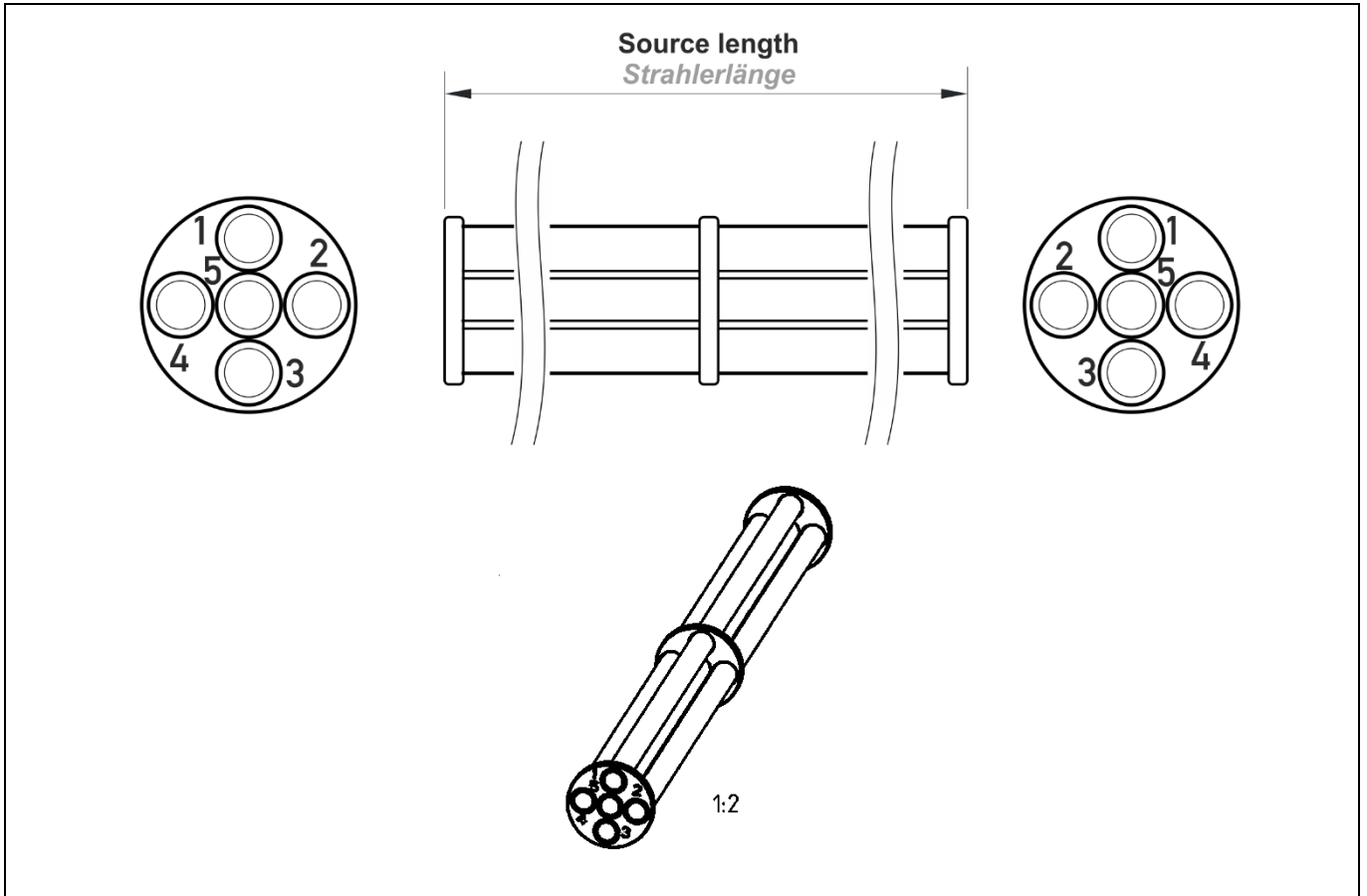
Variant <i>Variante</i>	Source length <i>Strahlerlänge</i>	Weight <i>Gewicht</i>	Magazine for 5 rod sources (book separately) <i>Magazon für 5 Strahler (gesondert bestellen)</i>	Adapter for inner Ø 22 + 10 mm lead (book separately) <i>Adapter für innen Ø 22 + 10 mm Blei (separat bestellen)</i>
ID: 65110-01	353 mm	218 kg	ID: 42885	ID: 60197
ID: 65110-02	603 mm	303 kg	ID: 38155	ID: 60735
ID: 65110-03	903 mm	405 kg	ID: 38156	ID: 60204
ID: 65110-04	1253 mm	525 kg	ID: 38157	ID: 60737
ID: 65110-05	1553 mm	627 kg	ID: 48940	ID: 61391

## Variant 270

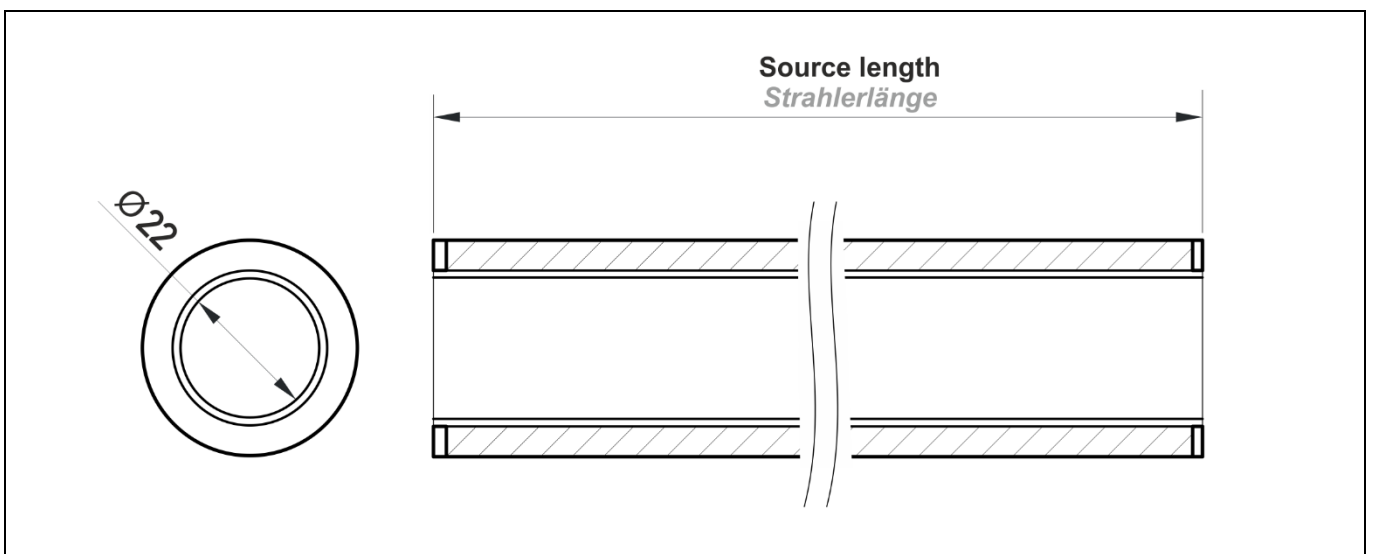
### Variant 270

Variant <i>Variante</i>	Source length <i>Strahlerlänge</i>	Weight <i>Gewicht</i>	Magazine for 5 rod sources (book separately) <i>Magazon für 5 Strahler (gesondert bestellen)</i>	Adapter for inner Ø 22 + 10 mm lead (book separately) <i>Adapter für innen Ø 22 + 10 mm Blei (separat bestellen)</i>
ID: 65111-01	353 mm	436 kg	ID: 38155	ID: 60197
ID: 65111-02	603 mm	587 kg	ID: 38155	ID: 60735
ID: 65111-03	903 mm	769 kg	ID: 38156	ID: 60204
ID: 65111-04	1253 mm	980 kg	ID: 38157	ID: 60737

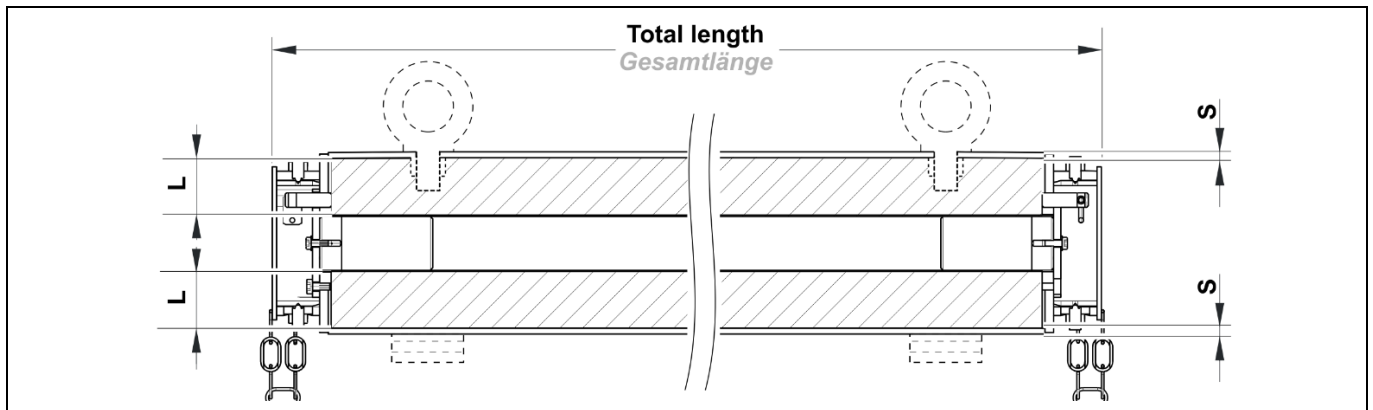
## Dimensions Magazine Abmessungen Magazin



## Dimensions Adapter Abmessungen Adapter

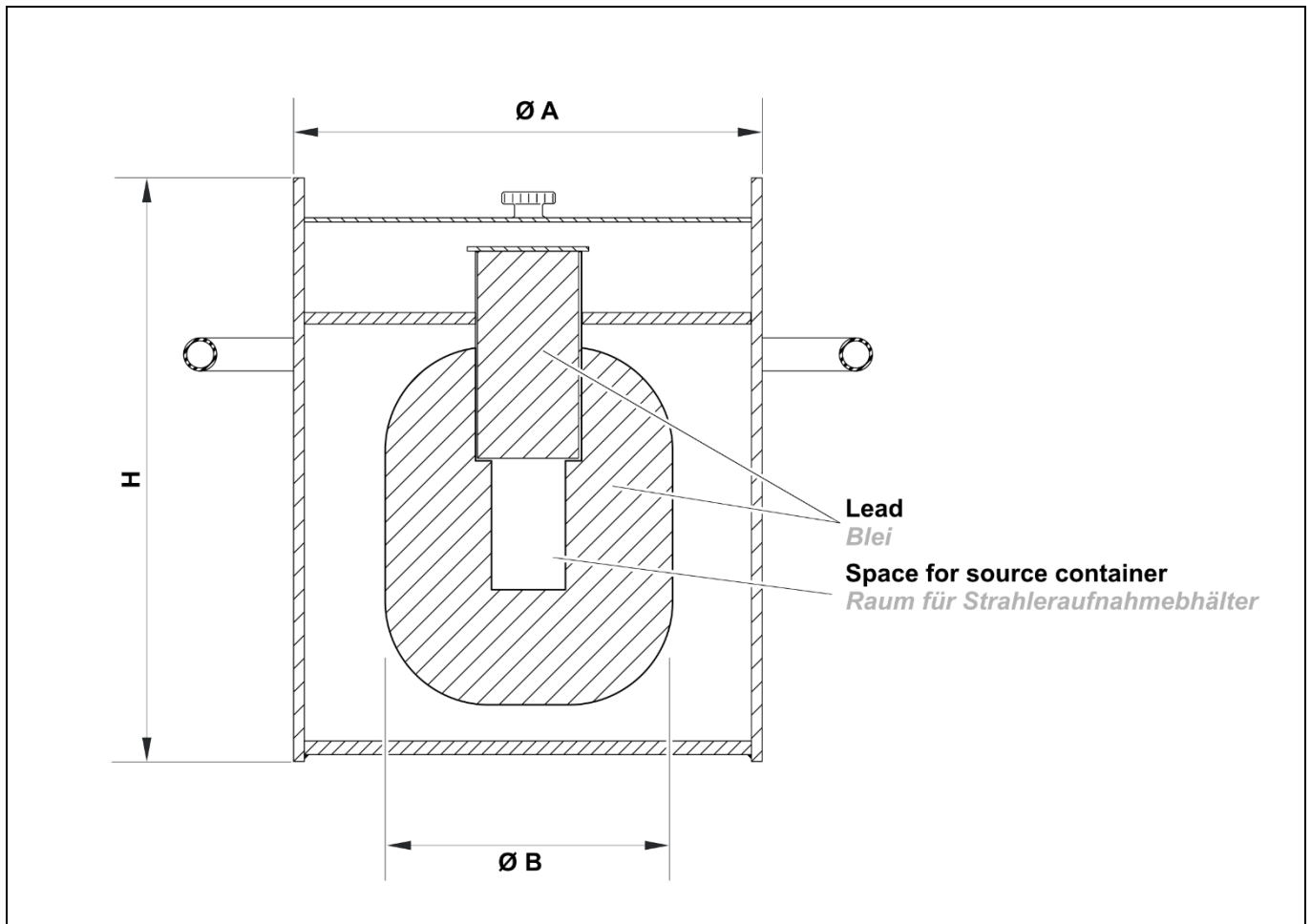


## Dimensions Abmessungen



Variant Variante	ID	Total length Gesamtlänge	L (Lead) L (Blei)	S (Steel) S (Stahl)
100	65107-01	546 mm	30 mm	3.5 mm
	65107-02	796 mm	30 mm	3.5 mm
	65107-03	1096 mm	30 mm	3.5 mm
	65107-04	1446 mm	30 mm	3.5 mm
	65107-05	1746 mm	30 mm	3.5 mm
130	65108-01	579 mm	39 mm	5 mm
	65108-02	826 mm	39 mm	5 mm
	65108-03	1126 mm	39 mm	5 mm
	65108-04	1476 mm	39 mm	5 mm
	65108-05	1776 mm	39 mm	5 mm
160	65109-01	626 mm	55 mm	6 mm
	65109-02	876 mm	55 mm	6 mm
	65109-03	1176 mm	55 mm	6 mm
	65109-04	1526 mm	55 mm	6 mm
	65109-05	1826 mm	55 mm	6 mm
200	65110-01	686 mm	75 mm	7 mm
	65110-02	936 mm	75 mm	7 mm
	65110-03	1236 mm	75 mm	7 mm
	65110-04	1586 mm	75 mm	7 mm
	65110-05	1886 mm	75 mm	7 mm
270	65111-01	776 mm	107 mm	7 mm
	65111-02	1026 mm	107 mm	7 mm
	65111-03	1326 mm	107 mm	7 mm
	65111-04	1676 mm	107 mm	7 mm

## Transport Shield for Point Sources Transportabschirmung für Punktstrahler



ID	H <i>H</i>	Ø A <i>Ø A</i>	Ø B (Lead) <i>Ø B (Blei)</i>	Total weight <i>Gesamtgewicht</i>
81972	310 mm	159 mm	107 mm	40 kg
81749	400 mm	324 mm	200 mm	112 kg
81748	465 mm	406 mm	260 mm	210 kg



We reserve the right to further developments and technical modifications of our products.

*Weiterentwicklungen unserer Produkte und technische Änderungen vorbehalten.*