Mold Level Shields

Operating Manual
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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

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

However, should questions arise which are not answered in this operating manual, please refer to Berthold.

IMPORTANT

For technical data, note the respective drawing and datasheet of the shield.

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 operating 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. Modification services are not performed 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, Pos. 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 (source)

1.9 Warning notes

Warning notes are designed as follows:

⚠ Signal Word

Source and consequence

Explanation, if required

- ▶ Prevention

In case of emergency…

- **Warning symbols:** (warning triangle) draws attention to the hazard.
- **Signal word:** Indicates the severity of danger.
- **Source:** Specifies the type or source of danger.
- **Consequence:** Describes the consequences of non-compliance.
- **Prevention:** Specifies how the hazard can be avoided.
- **In case of emergency:** Specifies which actions are required in the event of the occurrence of risk.

Symbols Used in the Operating Manual

In this manual, warning instructions before 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 mold level shield has been developed as shield/protective container for radioactive sources and may only be used for this purpose. If the mold level shield is used in a way not described in the present manual, dangerous situations may occur and the warranty claim becomes invalid.

Berthold only accepts liability for / warranties the correspondence of the mold level shield to its published specifications. The mold level shield may only be used in an undamaged condition. Any restructuring or modifications are inadmissible.

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:

- Applying conditions and requirements which do not conform to those stated in the technical documents, datasheets, operation and assembly instructions and other specific guidelines of the manufacturer.
- The usage after any repair carried out by employees who have not been authorised by Berthold correspondingly.
- Using the mold level shield 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 radiation beam outlet can no longer be locked).
- Operation without the safety precautions provided by the manufacturer, such as lifting eye nut during transportation, installation and dismounting.
- Any modification to design and function, except for any activities provided for and described in the present manual.
- Manipulation or avoidance of existing safety arrangements.
- Transportation and handling while the radiation beam outlet is open.
- If the mold level shield is used in a way which is not described in the present manual, the mold level shield protective effect is compromised and the warranty claim becomes invalid.
- Any non-compliance with the present operating manual for the mold level shield

NOTICE

Usually, the mold level 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.

2.2 Ambient Conditions during Operation and Storage

Mold level shield have been developed with the aim of resisting the rough ambient conditions of a continuous casting plant. The compliance with the operating conditions mentioned below contributes to warranty the permanent functionality of the mold level shield and the prevention of damage.

Mold level shield containing radioactive 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°C. Below this temperature, the sealing rings of the mold level shield may become brittle. In such case, the impermeability of the mold level shield can no longer be warranty.
- The **maximum admissible operating/storage temperature** is +100°C. Above this temperature, the sealing rings of the mold level shield may be destroyed. In such case, the impermeability of the mold level 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 chapt. 6) should be adjusted to the ambient conditions.
- **Highly combustible or explosive substances** must not be kept in the vicinity of mold level shield 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 mechanics 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 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. 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!

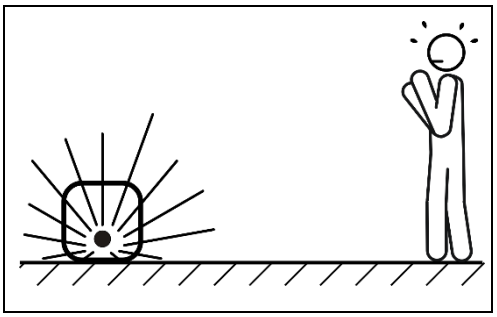
Radiation protection officers must have a special training with attendance of an officially recognized course and appropriate professional experience.

2.4 Radiation Protection

Basic Principles and Regulations

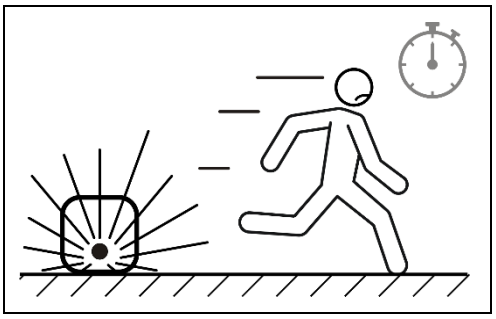
The amount of radiation absorbed by the body (exposure to radiation) is determined by three parameters from which the basic radiation protection regulations can be derived:

Distance



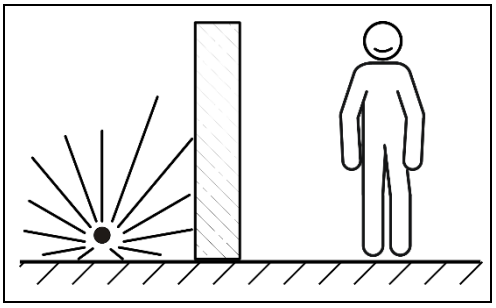
If work close to equipment containing radioactive substances is required, the largest distance possible is to be kept. In particular, this shall apply for employees which do not immediately participate in such work.

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 dismounting 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 dismounted 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 dismounted 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.

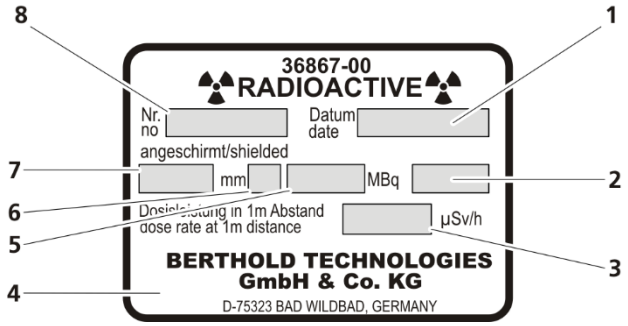
- In the case of fire, these measures limit the access to this area.
- Avoid the incorporation by keeping sufficient distance.
- Notify Berthold of the situation; you will promptly receive information on immediate measures.

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



1 Date of manufacture of the source
2 Isotope
3 Dose rate within 1 m distance [µSv/h]
4 Manufacturer of the source
5 Activity [MBq]
6 Shielding material
7 Effective shielding thickness
8 Source number

Fig. 1 Type plate of the sources

3 System Description

The mold level shield is used for shield the gamma radiation of the source, the shield guides the gamma radiation via the radiation beam outlet through the mold so that a detector is able to detect the radiation for mold level measurement.

By using the mold level shield, it is ensured that the useful beam is kept as small as possible in order to avoid an unnecessary exposure of employees to radiation.

Types of Mold Level Shields

There are three types of mold level shields:

- Operation shield
- Transfer shield
- Transport shield

Normally, the source is installed in an operation shield which has been designed according to the structure of the mold.

Some applications require the source to be integrated directly into the mold.

In such case, a transfer shield is used for the transport, storage and installation of the source.

If a source is delivered without an operation or transfer shield (e.g. a spare source for the replacement), a transport shield is used.

In each case, the diameter of the mold level shield and thus the shield effect for the respective source activity is adjusted in a way that the radiation protection requirements and any special requirements of the user can be complied with.

3.1 Operation Shield

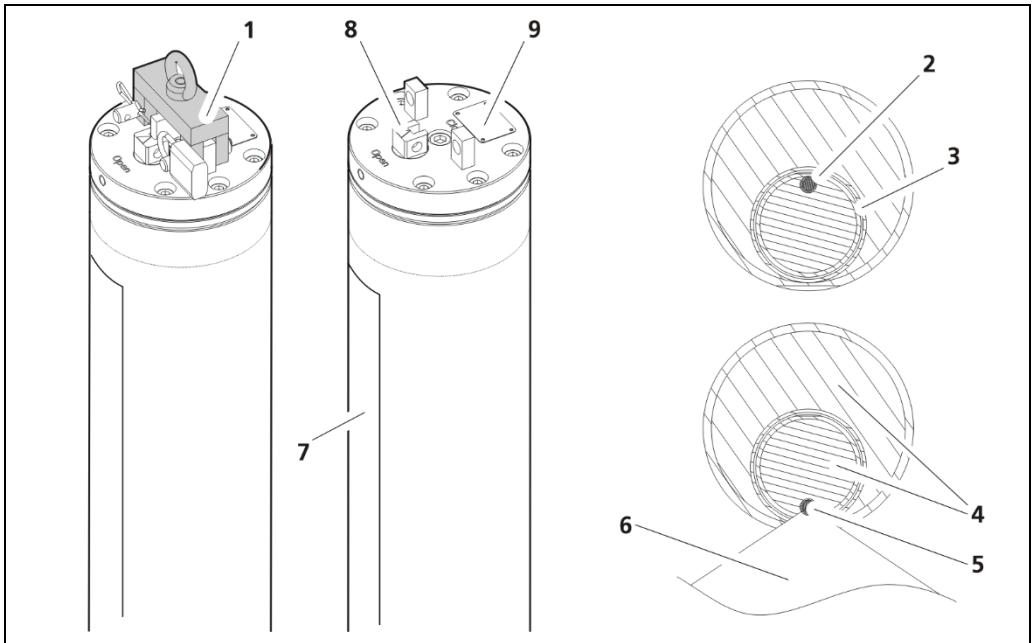
These shields are designed with different diameters and lengths as well as different adjustments to the mold structure, depending on the respective requirements and source types. However, the basic structure is the same.

The Shields consists of a steel cylinder in which the shield material is contained in a leak-proof way. Within this cylinder, another cylinder containing the source is positioned eccentrically and rotatable. By rotating it by 180°, the source is either positioned in the centre of the shield or in the outer area. In the centre of the operation shield, the source is shielded towards all sides with the same degree of protection. This corresponds to the **"CLOSED"** position.

By rotating it into the outer position, the source is not shielded into one direction. This corresponds to the "OPEN" position.

Both positions are limited by an arrestor and equipped with a detent position. For rotating, a square (Fig. 2, pos. 8) is provided on top of the operation shield on which a suitable key, hand wheel or another actuation mechanism can be fitted on-site.

During the transport or for mounting or dismounting the operation shield in the mold construction, the respective lifting eye nut (Fig. 2, pos.1) is to be attached to the Operation shield. This is only possible in the "CLOSED" position (pos.8); at the same time, the lock is arrested in this position. By doing so it can be ensured that handling the operation shield is only possible in the "CLOSED" position. The equipment is secured by means of a padlock.



1	Transport bracket (with lifting eye nut)	6	Radiation beam
2	"CLOSED" source position	7	Beam outlet
3	Closing cylinder	8	Locking square ("CLOSED" source position)
4	Shield material	9	Type plate
5	"OPEN" source position		

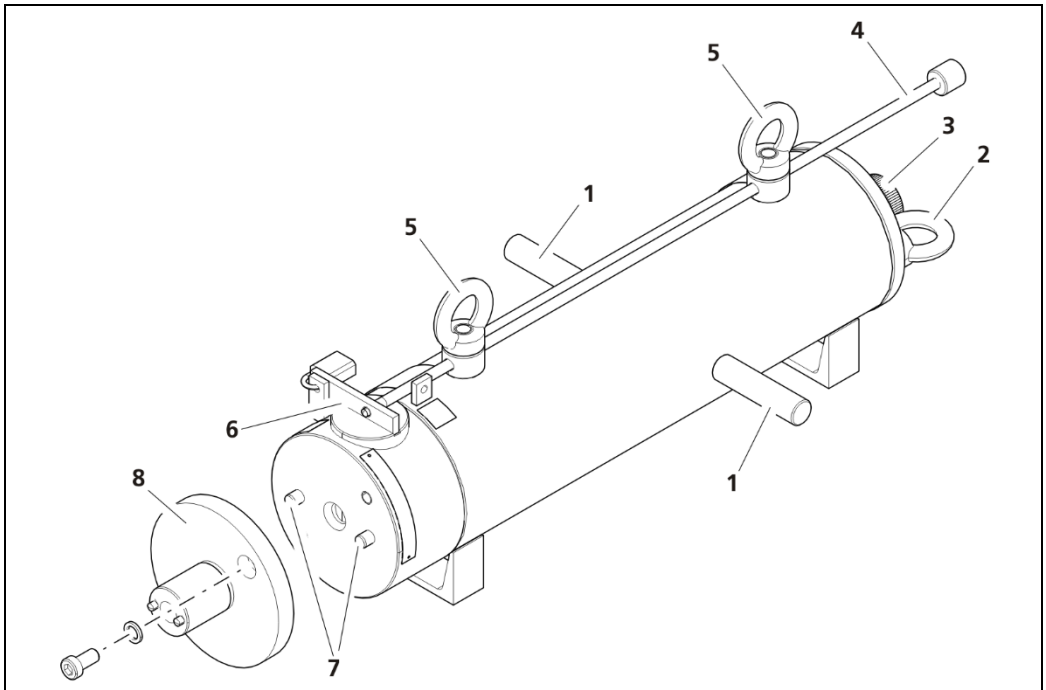
Fig. 2 Basic structure of operation shield

3.2 Transfer Shield

In the case of certain mold constructions, it is necessary that the source is installed in a protective tube within the water box or directly in the copper plates of the mold.

The benefit of this arrangement is the fact that the installation of a mold level measurement system is possible even if the space given is limited. Another benefit is the fact that the source activity required for this arrangement can be very low.

The storage of the source as well as its mounting in and dismounting from the mold is executed using a LB 7680 transfer shield. A shifting rod (Fig. 3, pos.4) is provided for the safe mounting and dismounting of the source. The locking mechanism (Fig. 3, pos.6) is located at the lower end of the transfer shield. Two positioning nipples are located at the bottom of the shield (Fig. 3, pos.7). The positioning nipples fit into the respective bore holes in the mold head (to be provided by the customer) and ensure the correct and accurate positioning of the transfer shield when mounting and/or dismounting the source.



1	Positioning handles	5	Lifting eye nut
2	Positioning eyelets	6	Locking mechanism
3	Screwed sealing plug	7	Positioning nipples
4	Shifting rod	8	Adapter plate

Fig. 3 Structure of a transfer shield

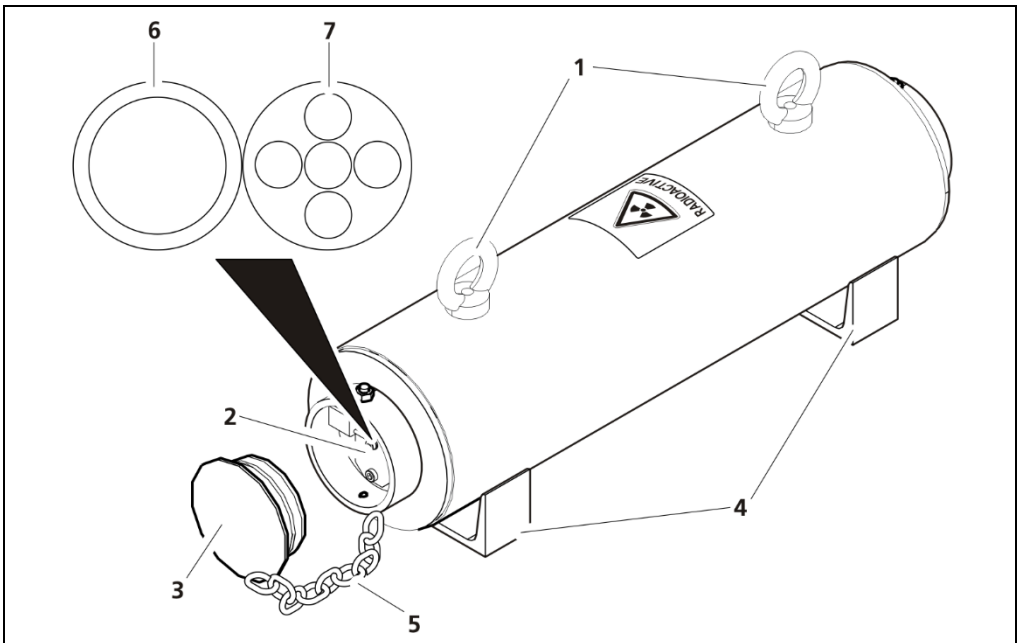
3.3 Transport Shield

A transport shield is used for shield the source during transportation and storage. The transport shield is only used if sources are delivered without work or transfer shield (e.g. spare source for the replacement).

IMPORTANT

The handling of the transport shield is described in a separate operating manual.

- ▶ Observe the operating manual of the transport shield.



1 Lifting eye nut
2 Closing plug
3 Cover
4 Base
5 Chain
6 Adapter
7 Magazine (optional)

Fig. 4 Basic structure of a transport shield

4 Transport

4.1 Safety Instructions

⚠ WARNING




Danger of injury by falling loads!

Shields have built-in lead components increased weight.

- Exclusively use the provided fixing possibilities (lifting eye nut) for attaching the sling gear.
- Only use tested sling gear components appropriate for the transport weight.
- Never stand underneath a lifted or suspended load, keep at a safe distance.
- 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.

The applicable national regulations of the country of use have to be observed. Observe the marking for the center of gravity on the outer packaging, if applicable.

NOTE

The device may only be transported by competent persons (see 2.3 Qualification of the Personnel).

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 Scope of Delivery

Depending on the order, the product is configured and delivered. Check the delivery for completeness (material parts) and integrity. In the case of damage, immediately notify the forwarding agent and the manufacturer.

Check delivery

Document any visible transport damage with photos on delivery. In case of damage contact the transport company and the manufacturer immediately.

4.5 Transport to Operation Site

The transportation may only be executed by construction site personnel experienced in handling heavy components. The construction site personnel is to be instructed by at least by one authorised person. If the mold level shields contains a radioactive source, the radiation protection officer is to be consulted, as well.

For lifting packages or mold level shields weighing more than 25 kg, suitable aids (e.g. forklift truck) are to be used. If mold level shields are lifted without transport packaging (wooden box or pallet), the provided fixing possibilities (lifting eye nut) are to be used exclusively for attaching the sling gear.

Please observe the radiation protection regulations for the transportation of radioactive substances.

5 Start-up

5.1 Safety Instructions

⚠ WARNING




Danger of injury by falling loads!

- Never stand underneath a lifted or suspended load, keep at a safe distance.
- Only use tested sling gear components appropriate for the transport weight.
- Exclusively use the provided fixing possibilities (lifting eye) for attaching the sling gear.
- 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!

- Loads of more than 25 kg are to be lifted with suitable lifting equipment.
- 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.
- Ensure that the locking mechanism is turned to the "CLOSED" position until the start-up of the measuring system.
- Check that the shipping braces included in the scope of delivery are mounted.

Problems during the installation of the rod source by damage or misaligned position of the protective tube.

- Immediately return the source into the mold level shields.
- Close the locking mechanism of the mold level shields.
- Secure the locking mechanism with the padlock provided.
- At the mold, look for causes of defect which may hinder the installation process.

5.2 Mounting the Operation Shield

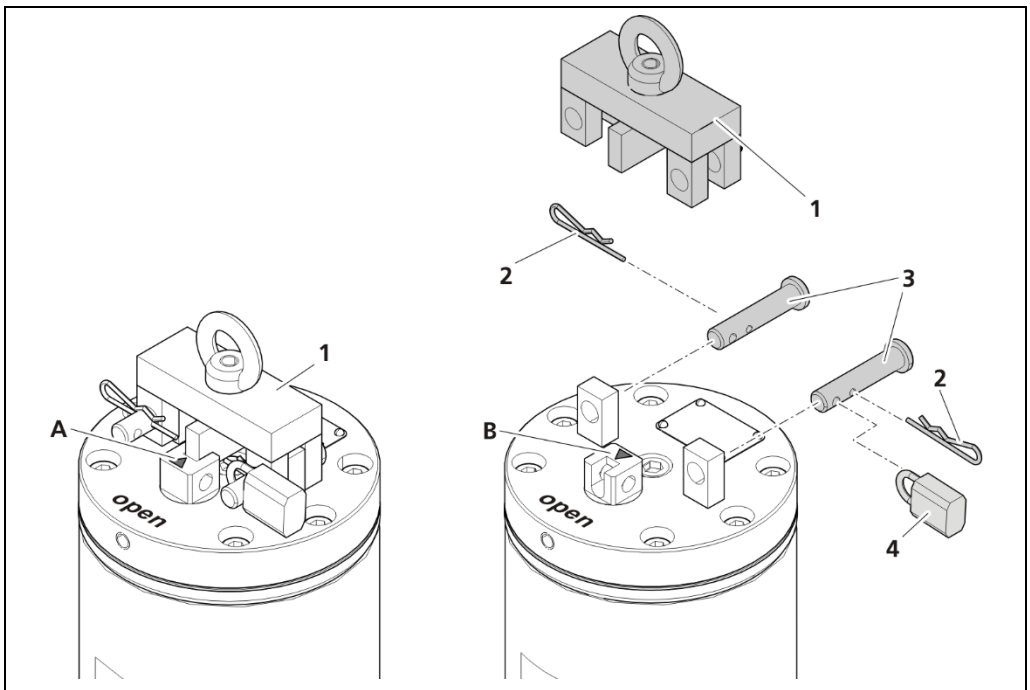
Depending on the mold design used, the start-up process differs. For example, the usage of a source without operation shield is possible, as well.

In order to avoid unnecessary exposure to radiation, the operation shield should be mounted as the last system component. The mounting is to be executed by employees with general knowledge and have been instructed by an authorized person. If the mold level shield contains a radioactive source, the radiation safety officers must be present during the planning and execution of the installation.

Installation Preparations

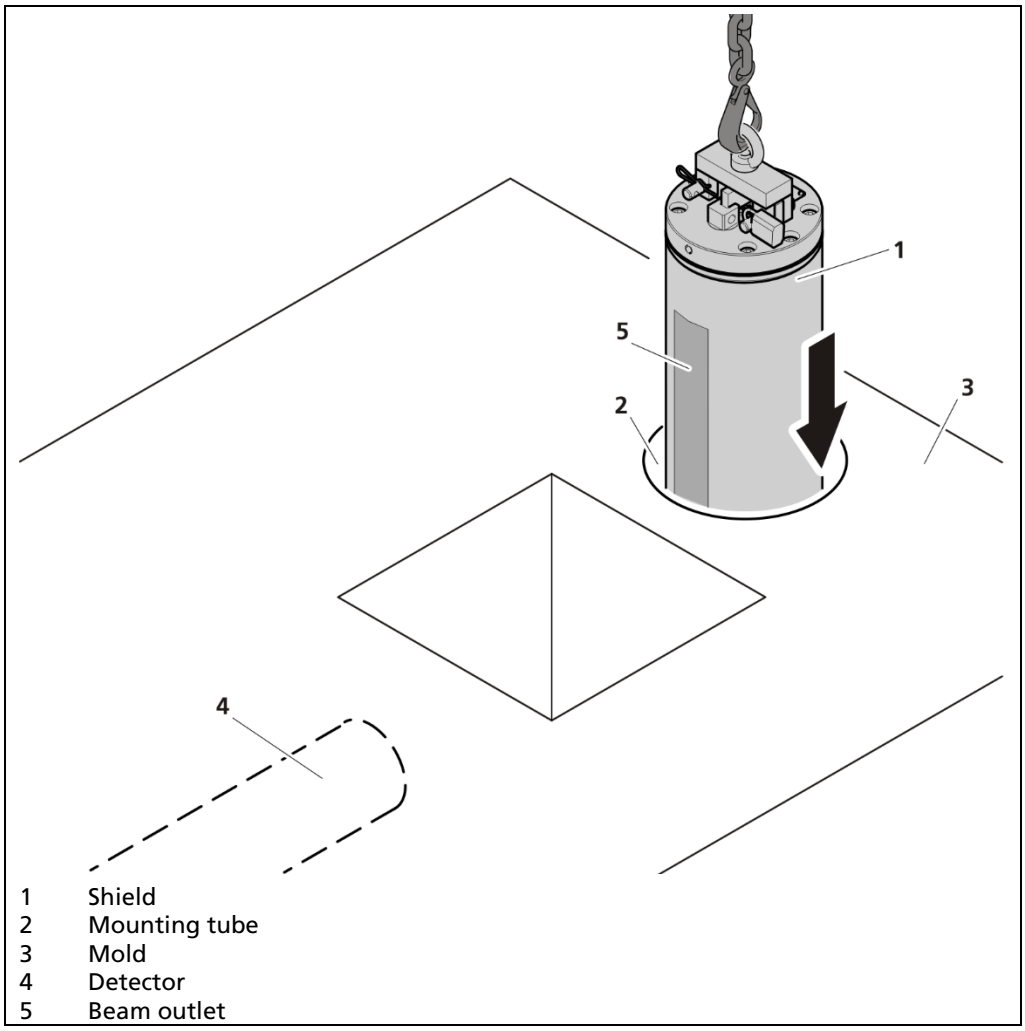
1. Carefully plan the installation process and assess the exposure to radiation.
2. Instruct the employees.
3. Clean the installation site in order to avoid slipping.
4. Provide lighting at the installation site.
5. Make sure the installation site is well lit.
6. Lay out the required tools.
7. Remove all obstacles which may hinder the installation work (e.g. mold cover).
8. Check whether the scope of delivery of the mold level shields is complete (e.g. shipping braces) and ensure that all components have been cleaned. If required, clean the components.

Installation and Usage of a Operation Shield



1	Transport bracket (with lifting eye nut)	A	Locking square ("OPEN" source position)
2	Spring cotter pin		
3	Bolt	B	Locking square ("CLOSED" source position
4	Padlock		

Fig. 5 Operation shield with transport bracket and source.
Position left: "CLOSED“, right: "OPEN“



1 Shield
2 Mounting tube
3 Mold
4 Detector
5 Beam outlet

Fig. 6 Installation of a operation shield

When mounting the operation shield, please observe the following:

⚠ WARNING

Danger of injury by falling loads!

Falling loads can endanger people.

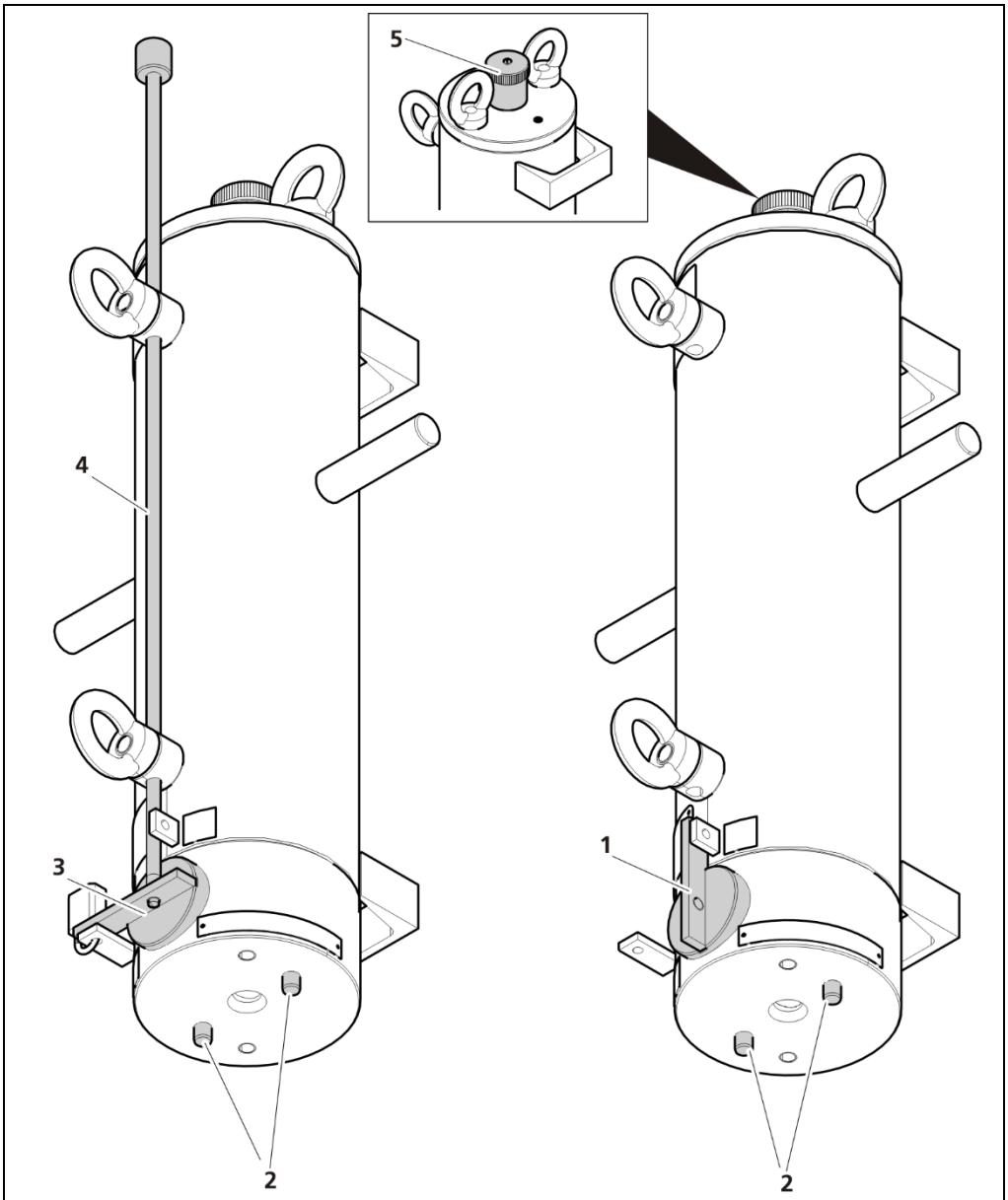
- Never step under suspended loads, keep safety distance.
- Adhere to the guidelines for safe handling at high weight.
- Ensure good stability and use the prepared mounting options.

1. Carefully prepare the mounting process.
2. Ensure that the operation shield has been closed and secured (the arrow on the locking square must be pointed to the "CLOSED" position (Fig. 5, A) and the transport bracket (Fig. 5, pos.1) must be mounted.
3. Attach the shield to the ring nut with adequately dimensioned and tested slings.
4. Lift shield vertically. Avoid diagonal pull!
5. Position the operation shield directly above the site of installation.
6. Position the operation shield in a way that the radiation beam outlet (Fig. 6, pos.5) is directed towards the detector (Fig. 6, pos.4).

7. Slowly lower the operation shield into the mounting tube (Fig. 6, pos.2) at the mold.
8. Secure the operation shield with the existing fixing equipment (the type and the design of the fixing equipment depends on the individual design of the mold level shields. Further details can be obtained from the design drawing.).
9. Remove the shipping braces (Fig. 5, pos.2, pos.3, pos.4) and the transport bracket (Fig. 5, pos. 1) and do not open the mold level shield until immediately before commissioning the measuring system.
10. In order to open it, turn the locking square into the "OPEN“ position (Fig. 5, B).
11. Reattach any covers of the mounting tube (depending on the mold construction).
    - The shield has been correctly installed and put into operation.

5.3 Insert a Source with a Transfer Shield

Normally, sources which are operated without operation shield in the mold are delivered in a transfer shield in order to ensure a secure transfer of the source to the mold.



1 Locking mechanism in the "OPEN“ position
2 Positioning nipples
3 Locking mechanism in the "CLOSED“ position
4 Shifting rod
5 Sealing plug

Fig. 7 Left: Locking mechanism in the "CLOSED" position, secured by shifting rod, right: Locking mechanism in the "OPEN“ position

To insert the source into the operation shield, please observe the following:

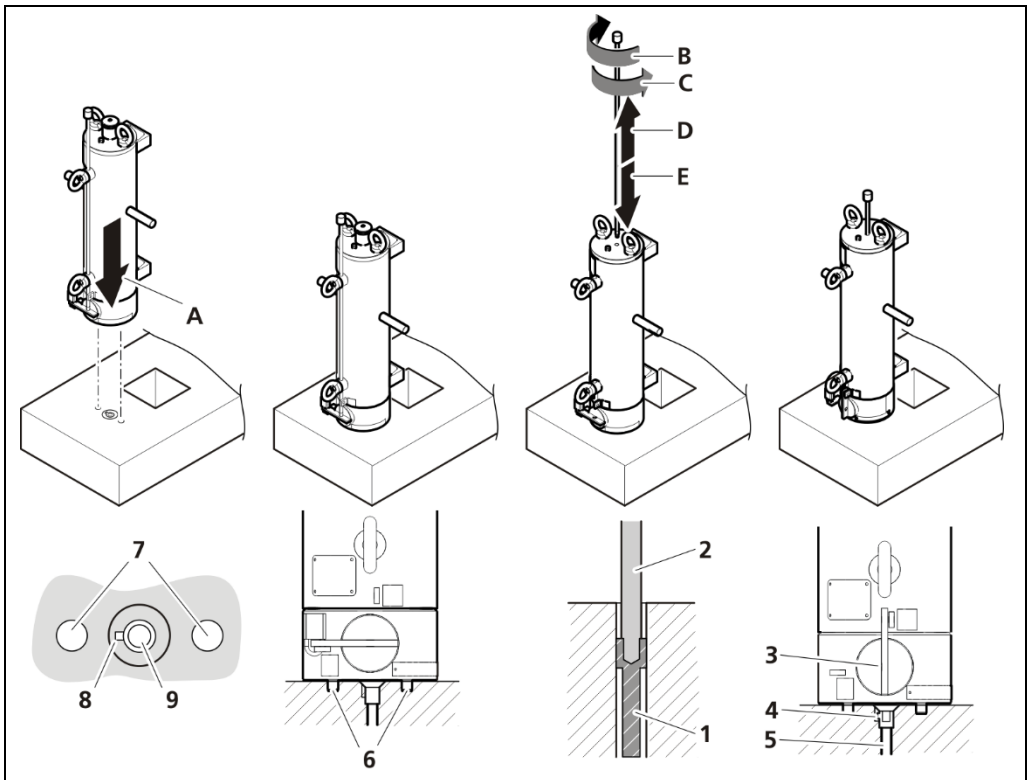
1. Carefully prepare the mounting process.
2. Ensure that the transfer shield has been closed and secured (the locking mechanism must be in the "CLOSED" position and be secured by means of the shifting rod). The screwed sealing plug located on top of the transfer shield must be mounted.

⚠ WARNING

Danger of injury by falling loads!
Danger of crushing by moving the transfer shield!

Due to the high weight of the shield, there is a risk of injury.

- Never step under suspended loads, keep safety distance.
- Do not grab between shield and mold construction.



1	Spacer / Source	8	Groove for twist protection
2	Shifting rod	9	Source mounting tube
3	Locking mechanism in the "OPEN“ position	A	Lowering
4	Twist protection	B	Tightening
5	Source in correct position	C	Untightening
6	Positioning nipple in correct position	D	Extracting
7	Positioning bore holes	E	Inserting

Fig. 8 Mounting the source

3. Open the mold head (e.g. by means of a screwed plug or cover plate).
4. Direct the transfer shield above the protective tube in a way that the positioning nipples (Fig. 8, pos.6) fit into the positioning bore holes (Fig. 8, pos.7) at the mold side.
5. Remove the screwed sealing plug (Fig. 7, pos.5) on top of the transfer shield.
6. Remove the shifting rod (Fig. 7, pos.4) from the bracket and, from above, screw it (Fig. 8, B) into the head of the source within the transfer shield.
7. Open the locking mechanism of the shield (Fig. 8, pos.3) and carefully insert the source (Fig. 8, pos.1) into the mounting tube within the mold by means of the shifting rod.
8. Ensure that the entire source is located within the protective tube (Fig. 8, pos.5) and that the pin of the twist protection at the head of the source latches into the respective groove (Fig. 8, pos.4).
9. Unscrew the shifting rod from the source (Fig. 8, C) and pull it upwards (Fig.

8, D), out of the transfer shield.

10. Carefully lift the transfer shield off the mold.
11. Ensure that the source is in the correct position.
12. Close the mold head (e.g. by means of a screwed plug or cover plate) so that the source is safe and secured in this position.
    - ▶ The source is inserted correctly.

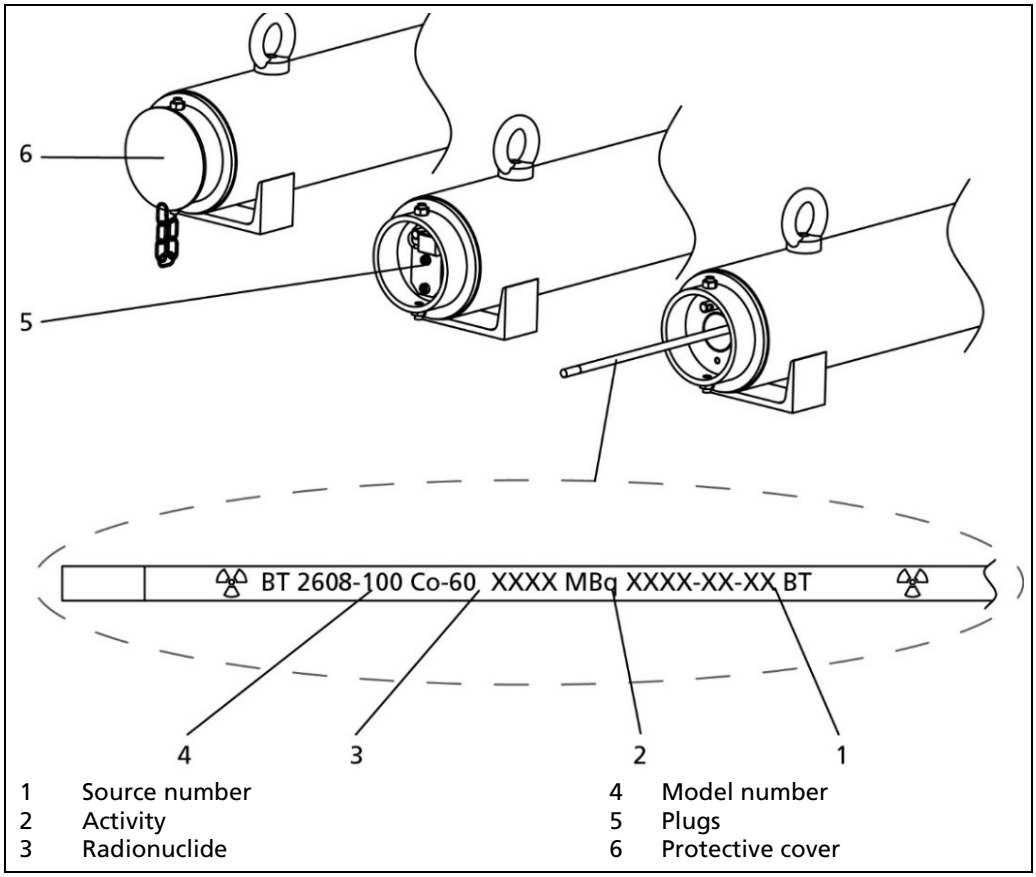
NOTICE

The dismounting process is executed in reverse order.

5.4 Usage of a Transport Shield

IMPORTANT

The handling of the transport shield is described in a separate operating manual.



1	Source number	4	Model number
2	Activity	5	Plugs
3	Radionuclide	6	Protective cover

Fig. 9 Usage of a transport shield

⚠ CAUTION

Danger caused by ionising radiation!

Never directly touch the source; the pliers are to be used exclusively for this purpose!

- Hold the source only with pliers.
- Keep the source far from the body.
- Ensure that no persons are in the field of radiation during the work.

1. Lay out pliers in order to be able to easily and securely grab the source.
2. Check the transport shield for visible damage. (If you detect any damage to the source, the removal process must not be continued).
3. Lay out the transport shield in direct vicinity of the respective site of usage of the source.
4. Remove the protective cover of the transport shield.
5. Remove the plug of the transport shield.

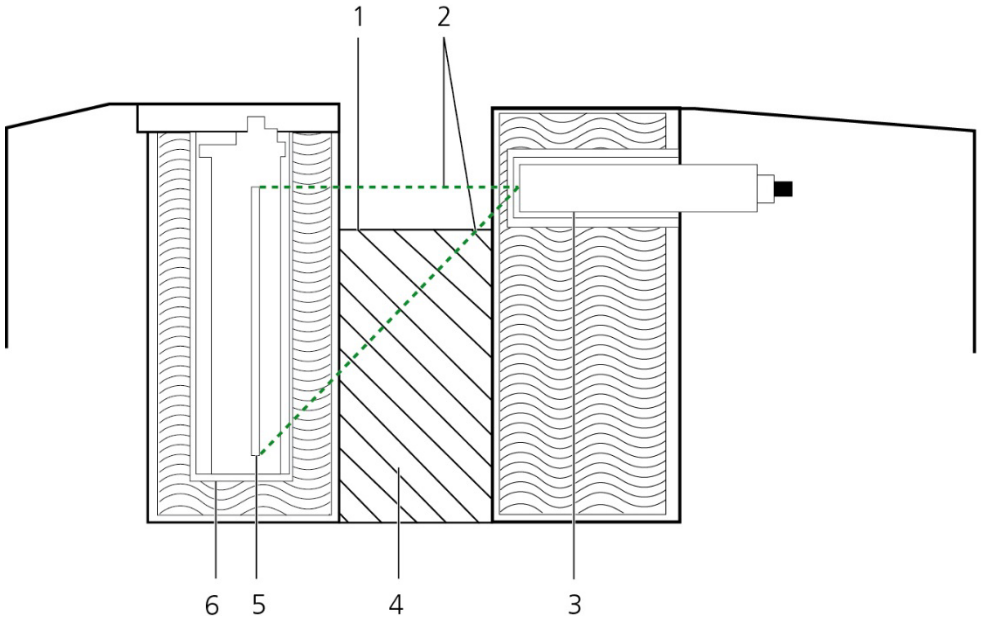
6. If the transport shield contains several sources, the correct source is to be identified before the removal. Use the loading schedule included in the scope of delivery in order to determine the magazine tube housing the required source.
7. If the transport shield is not equipped with a source magazine, the source number is to be obtained from the source itself. For this purpose, grip the source with pliers laid out and carefully extract the source from the transport shield until you are able to read the source.
8. Sources which are not required are to be returned into the transport shield immediately.
9. Once you have identified the source required, remove the source and mount it at its intended site of usage without undue delay.
10. Close the transport shield after removal.
    - The removal is completed.

5.5 Installation Options

Depending on the respective application, the operation shield containing the source is designed according to the respective mold design. The positioning of the operation shield within the mold is already determined during the planning stage.

If the mold itself has a sufficient shield effect, it is possible to directly mount the source without operation shield into the copper plate or the water box of the mold.

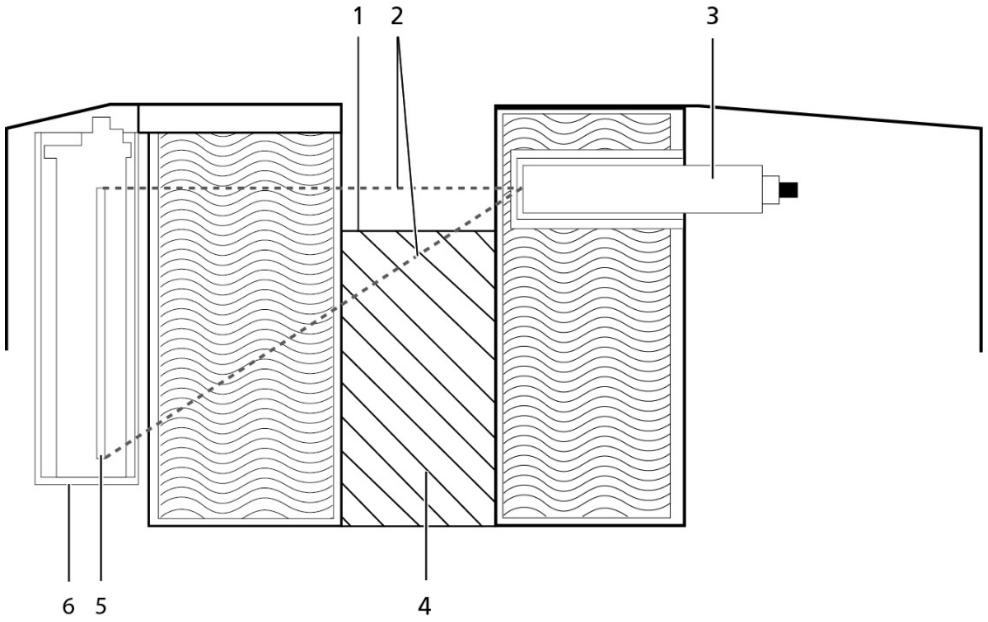
Within the Water Box of the Mold



1 Filling level
2 Beam path
3 GAMMAcast detector
4 Liquid steel
5 Source
6 Operation shield

Fig. 10 Operation shield within the water box of the mold

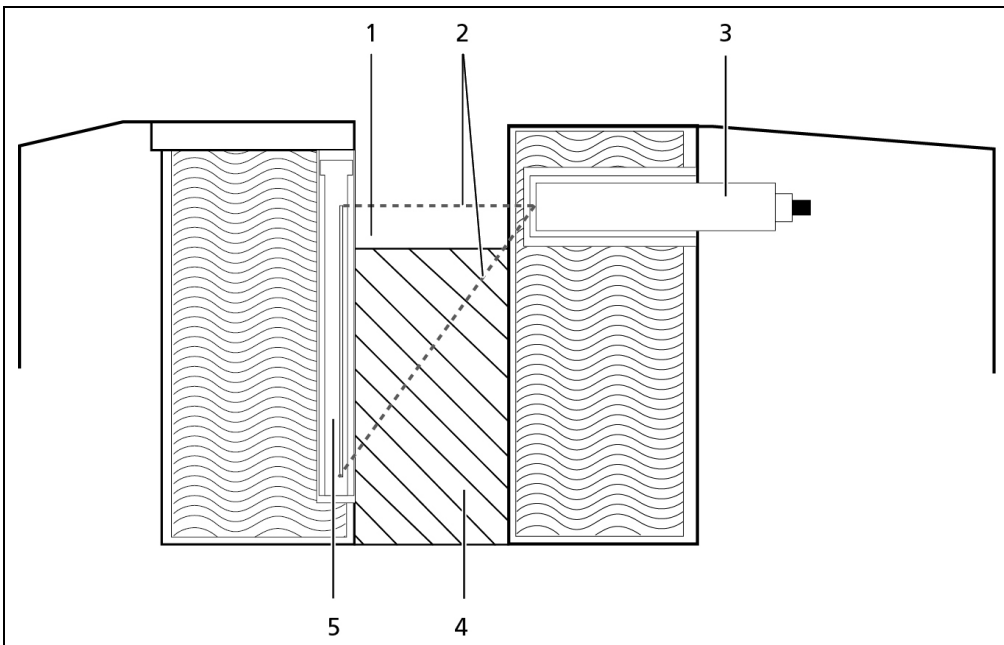
Outside of the Water Box of the Mold



1 Filling level
2 Beam path
3 GAMMAcast detector
4 Liquid steel
5 Source

Fig. 11 Outside of the water box of the mold

Without Operation Shielding within the Water Box of the Mold



1 Filling level
2 Beam path
3 GAMMAcast detector
4 Liquid steel
5 Source

Fig. 12 Source without operation shielding within the water Box of the mold

6 Maintenance and Repair

The mold level shields are neither equipped with wear parts nor with mechanically moved components which would require maintenance services under normal operating conditions. For safety reasons, it must be possible at all times to close the useful beam.

For this reason, a functional test is to be executed in appropriate intervals, at least every 6 months. If, during these tests, defects of a shield (e.g. at the sealings) or a stiff locking mechanism are identified, this is to be reported to the radiation safety officer immediately

6.1 Safety Instructions

⚠ CAUTION

Danger caused by ionising radiation!

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

- Ensure that the locking mechanism is turned to the "CLOSED" position.
- Consult the radiation safety officer responsible for your company.
- In order to keep the exposure to radiation as low as possible, the work is to be planned in detail and, if required, trained with the employees.
- While testing the locking mechanisms, it is to be ensured that no persons are lingering in the beam path of the open mold level shields.
- Longer repair and maintenance work on mold level shields must not be carried out with the sources remaining installed. If a removal of the source is impossible, please contact the Berthold service department.

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

A visual inspection of the mold level shields is to be executed regularly, as a minimum requirement every six months. Check the mold level shields for obvious damages (dents, cracks, holes etc.) and corrosion.

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

When determining the testing 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)

Tip

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.

A visual inspection is to be carried out before the initial start-up and with every repair that may be required.

All work carried out in the vicinity of radioactive sources are to be arranged in co-operation with the radiation safety officer. Any work directly affecting radioactive sources and their mold level shields are subject to the express authorisation and the supervision of the radiation safety officer.

For further information, please contact Berthold.

6.3 Inspection and Cleaning the Locking Mechanism at Operation Shields

The locking mechanism is to be inspected every six months as a minimum requirement in order to warranty a secure locking of the source in the operation level shields.

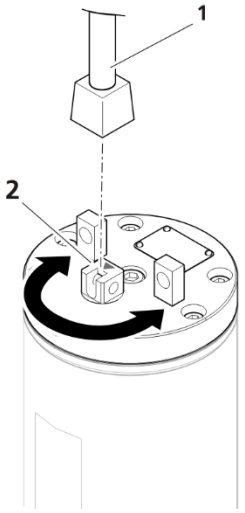
Such maintenance work may only be carried out by employees who have been authorised respectively.

NOTICE

The locking mechanism may be inspected with the source remaining installed.

- The cleaning may only be executed with the source being removed.

Inspection of the Locking Mechanism



1 Square box spanner
2 Locking square

Fig. 13 Open and close the locking mechanism

When inspecting the locking mechanism, please proceed as follows:

⚠ CAUTION

Danger caused by ionising radiation!

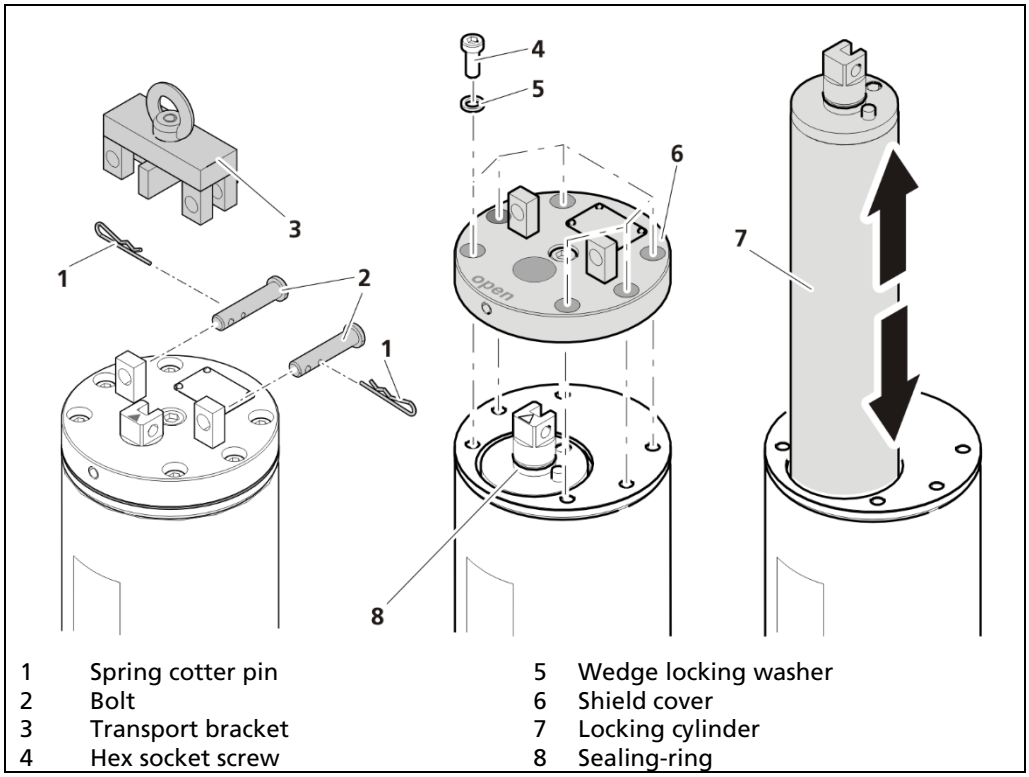
- While testing the locking mechanisms, it is to be ensured that no persons are lingering in the beam path of the open operation shield.

1. Ensure that no persons are present in the direction of the radiation beam outlet since, when opening the locking mechanism, they would be exposed to radiation.
2. Attach the square box spanner (Fig. 13, pos.1) at the locking square (Fig. 13, pos.2).
3. Open and close the locking mechanism several times.
   - The locking mechanism must be able to move in both directions to the respective end position.
4. Return the locking mechanism to the starting position.

5. Immediately report any malfunctions or stiffness of the locking mechanism to the radiation safety officer, and clean the locking mechanism.
   - The inspection was carried out.

Cleaning of the Locking Mechanism at Operation Shields

For cleaning the locking mechanism, the locking cylinder must be removed. During this maintenance work, no radioactive source must be present in the operation shield.



1	Spring cotter pin	5	Wedge locking washer
2	Bolt	6	Shield cover
3	Transport bracket	7	Locking cylinder
4	Hex socket screw	8	Sealing-ring

Fig. 14 Dismounting and mounting the locking cylinder of a operation shield

When dismounting and cleaning the locking mechanism, please proceed as follows:

⚠ CAUTION

Danger caused by ionising radiation!

- There must not be any radioactive sources in the shield.
- Follow the instructions to safely remove the source in chapter 6.5.

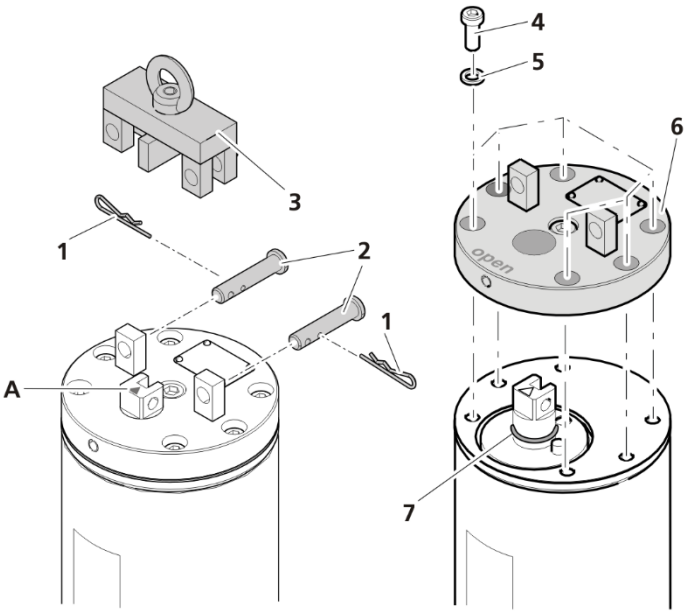
1. Remove the spring cotter pins (Fig. 14, pos.1) and the bolts (Fig. 14, pos.2)
2. Remove and transport bracket (Fig. 14, pos.3).
3. Untighten the hex socket screws (Fig. 14, pos.4) of the shield cover and remove the shield cover (Fig. 14, pos.6).
4. Pull the locking cylinder (Fig. 14, pos.7) upwards, out of its reception tube.
5. Clean the locking cylinder (Fig. 14, pos.7) and the reception tube thoroughly.
6. Regrease the locking cylinder and insert it into the reception tube.
7. Check the sealing-ring (Fig. 14, pos.8) for damages and wear, and follow the instruction in the next chapter 6.4.
8. Remount the shield cover (Fig. 14, pos.6) and the transport bracket (Fig. 14, pos.3).

- The cleaning is completed.

6.4 Inspection and Replacement of Sealing Ring of Operation Shields

An inspection or replacement of sealing rings (o-ring gaskets) is required if an overheating of these parts cannot be excluded.

Such maintenance work may be carried out with the source being mounted provided that it has been ensured that the locking cylinder remains in the operation shield during the entire time. Such maintenance work may only be carried out by employees who have been authorised respectively.



A	Locking mechanism in “CLOSED” position	4	Hex socket screw
1	Spring cotter pin	5	Wedge locking washer
2	Bolt	6	Shield cover
3	Transport bracket	7	Sealing-ring

Fig. 15 Inspection and replacement of the sealing ring

When inspecting the sealings of the operation shields, please proceed as follows:

⚠ CAUTION

Danger caused by ionising radiation!

- The locking mechanism must turned to the “CLOSED” position.

1. Remove the spring cotter pins (Fig. 15, pos.1) and the bolts (Fig. 15, pos.2)
2. Remove the transportation bracket (Fig. 15, pos.1) and ensure that the locking mechanism is turned to the "CLOSED" (Fig. 15, A) position.
3. Untighten the hex socket screws (Fig. 15, pos.4) of the shield cover and remove the shield cover (Fig. 15, pos.6).
4. Check the sealing ring (Fig. 15, pos.7) for damages and wear and replace it, if required.
5. Remount the shielding cover (Fig. 15, pos.6) and the transportation bracket

(Fig. 15, pos.3).

- The inspection / replacement is completed.

6.5 Replacement of a Source

Generally, the radioactive source used enables a service life between 5 and 10 years. A replacement of the source is only required if the statistical fluctuations of the output signal are inadmissibly large and compensation by increasing the time constant is no longer possible (e.g. for regulation-technical reasons).

If a renewal of the source is required, when reordering the source, the manufacturer's number of the source used must be indicated. The length, activity and activity distribution of the new source must correspond to the original version. You can obtain the manufacturer's number from the type plate at the top of the mold level shields.

The replacement of the source requires the direct handling of the unshielded source. Please clarify with the responsible supervisory authority in advance whether your license for handling radioactive substances comprises handling unshielded sources. In any case, the replacement of the source may only be carried out by authorised persons. The radiation safety officer must be consulted in such case, as well.

Tools needed for replacement

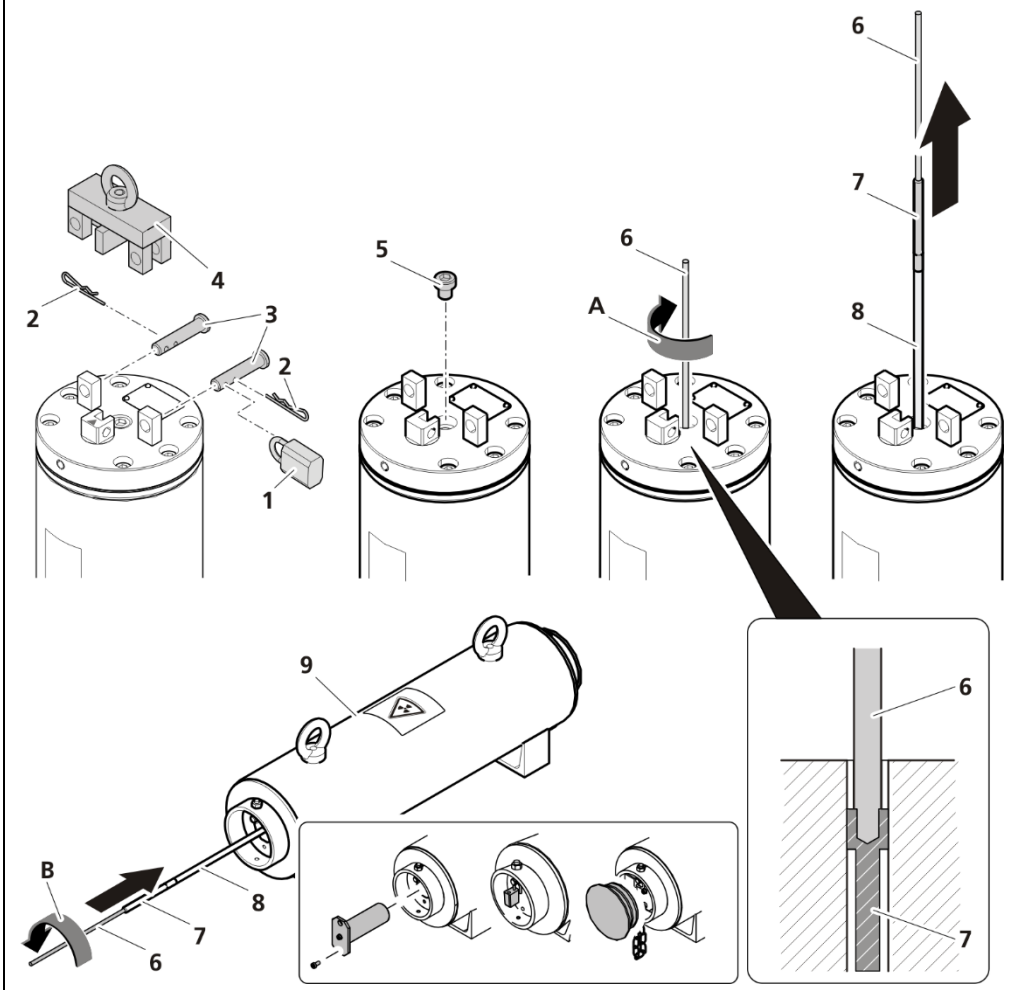
- Two pliers (with which you can easily and safely grip the source).
- One set of hexagon spanners
- One set of allen keys
- Teflon sealing tape
- M3 threaded rod (approx. 50 mm long)
- 4 grooved pins
- Type plate of the new source.

NOTICE

In order to keep the exposure to radiation during the replacement of the source as low as possible, all persons involved should familiarise themselves with the exact procedure in advance.

- Only replace the source in areas with closed floor. Any apertures which are larger than the external diameter of the source (7 mm) are to be covered before commencing any work.

Remove Source



1	Padlock	6	M3 threaded rod
2	Spring cotter pin	7	Spacer
3	Bolt	8	Source
4	Transport bracket	9	Transport shield
5	Sealing plug (Hex socket screw)	A	Tightening
		B	Untightening

Fig. 16 Remove source

1. Lay out the transport shield (Fig. 16, pos.9) and open the transport shield, so that the old source can insert as quickly as possible.
2. Remove the transport bracket (Fig. 16, pos.4) of the operation shield and ensure that the locking mechanism is in the "CLOSED" position.
3. Remove the screwed sealing plug (Fig. 16, pos.5) of the operating source by means of an allen spanner.

4. Screw (Fig. 16, A) the M3 threaded rod (Fig. 16, pos.6) into the upper part of the source spacer (Fig. 16, pos.7) of the old source, and carefully extract the source from the operation shield.

⚠ CAUTION

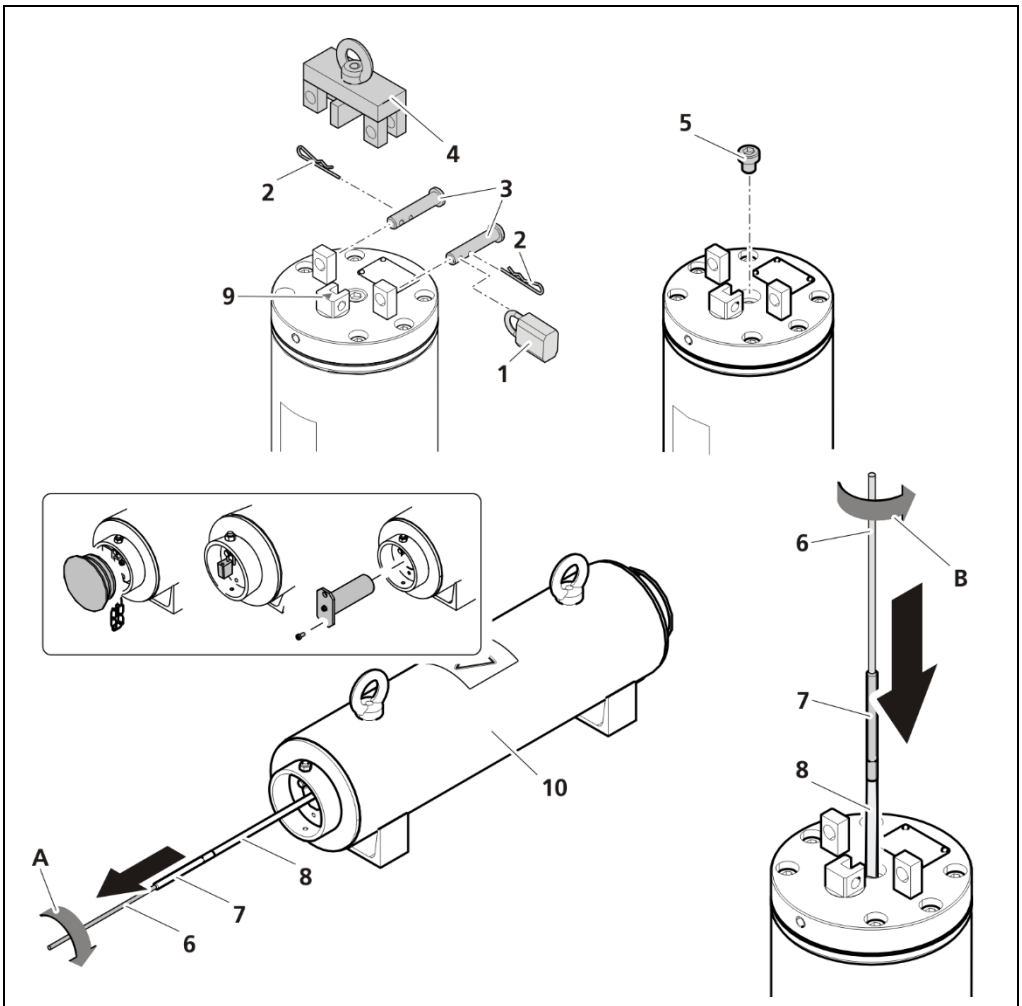
Danger caused by ionising radiation!

Never directly touch the source; the pliers and the M3 threaded rod are to be used exclusively for this purpose!

- Hold the source only with pliers.
- Keep the source far from the body.
- Ensure that no persons are in the field of radiation during the work.

5. Without undue delay, insert the old source into the transport shield (Fig. 16, pos.9) so that only the spacer and a small part of the actual source protrude.
6. Grip the source with one pliers and, with the other pliers, unscrew (Fig. 16, B) the spacer (Fig. 16, pos.7).
   - The spacer is reused when inserting a new source.
7. Close and secure the transport shield (see chapter 5.4).
   - The removal of the source is completed.
8. Close and secure (Fig. 16, Pos.4, Pos.5) the operation shield or insert a new source (see next page).

Insert new Source



1	Padlock	7	Spacer
2	Spring cotter pin	8	Source
3	Bolt	9	Locking square ("CLOSED" position)
4	Transport bracket	10	Transport shield
5	Sealing plug (Hex socket screw)	A	Tightening
6	M3 threaded rod	B	Untightening

Fig. 17 Installation of the source into a operation shield

1. Make sure that the operation shield is opened (removing parts Fig. 17, pos.1 to pos.5), so that the new source can be inserted quickly as possible.
2. Check the source reception tube of the operation shield and make sure that the old source is removed.
3. Check the operation shield for damages and wear.
   - If any defects are identified during the visual inspection, no source may be used. Inform the radiation safety officer who will initiate the measures required for repairing the defects.

⚠ CAUTION

Danger caused by ionising radiation!

Never directly touch the source, the pliers and the M3 threaded rod are to be used exclusively for this purpose!

- Hold the source only with pliers.
- Keep the source far from the body.
- Ensure that no persons are in the field of radiation during the work.

4. Open the transport shield (Fig. 17, pos.10).
5. Grip the new source (Fig. 17, pos.8) with one pliers and, with the other pliers, screw the spacer (Fig. 17, pos.7) which has unscrewed from the old source (see sub chapter “Remove source”), onto the new source.
6. Remove the new source with the pliers and insert the plug into the transport shield in order to shield the sources as long as they are not required.
7. Insert the new source without delay into the operation shield so that only the spacer (Fig. 17, pos.7) protrudes.
8. Unscrew the M3 threaded rod (Fig. 17, pos.6) from the spacer (Fig. 17, B).
9. Attach new Teflon sealing tape to the screwed sealing plug (Fig. 17, pos.5).
10. Close the source reception tube of the mold level shield by means of the screwed sealing plug.
11. Remove the nameplate (Fig. 1) of the old source from the mold level shield.
12. Attach the nameplate of the new source with four groved pins.
13. Close and secure (Fig. 17, Pos.4, Pos.5) the operation shield.
14. If no further sources have to be inserted, close and secure the transport shield (Fig. 17, Pos.10).
    - The insertion of the new source into the operation shield is complete.

6.6 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 sealing, 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.

Alternative test areas

Alternative test areas are areas of a shield which will most likely be contaminated if a source is leaking. The area marked in gray (Fig. 18) visualizes the test area of the mold level shield.

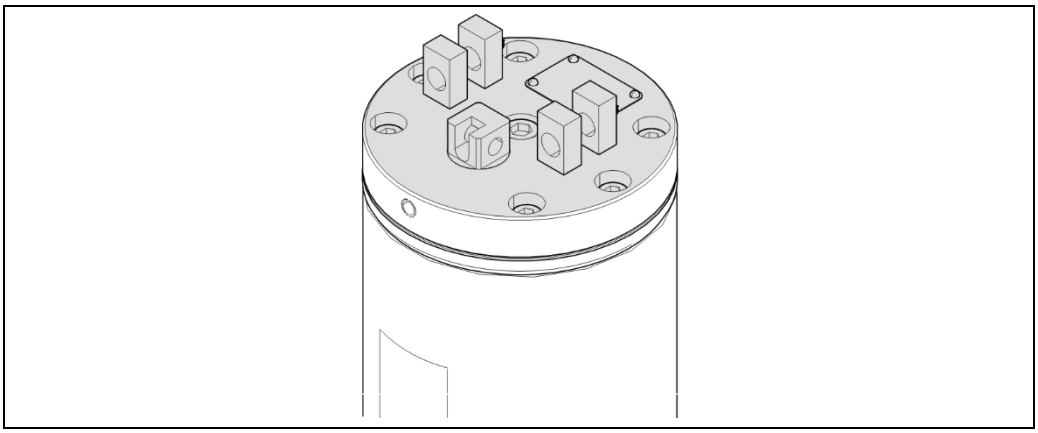


Fig. 18 Alternative test area at an operation shield

1. Remove the padlock and the transport bracket.
2. Perform the contamination measurement on the replacement test area.
   - The contamination measurement may only be carried out by radiation protection officers. If contamination is detected, appropriate decontamination measures must be taken.
   - The leak test is completed.

7 Decommissioning

⚠ CAUTION

Danger caused by ionising radiation! Exposure to radiation!

For decommissioning, a direct contact with the mould level shield is required.

- Carefully plan the decommissioning process.
- Ensure that the locking mechanism is turned to the "CLOSED" position.
- If the locking mechanism is in the "OPEN" position, do not enter the beam path.
- Ensure that there are no persons in the beam path.

When decommissioning the operation shield, please proceed as follows:

1. Note all information in chapter 5.1 and 5.2.
2. Turn the locking mechanism of the operation shield to the "CLOSED" position.
3. At operation shields, mount the transportation bracket and secure it by means of the shipping braces (see Fig. 5).
4. Remove the operation shield from the mold construction
5. Store the mould level shields containing the source in the dedicated storage room exclusively until its reuse, handing over to the manufacturer or disposal. The storage room must comply with the national requirements regarding the storage of radioactive substances.

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 µSv/h.
- Dose rate at a distance of 1m from the surface of the packaging must be lower than 100 µSv/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 Maintenance and Repair). 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

- 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 Technical Data

Lead Shields

Description	Lead [mm]	Steel [mm]	Brass [mm]	Max. length possible [mm]	Max. source length [mm]	Typical weight [kg]
Type 60	18	4	1	650	500	13
Type 80	26	6.,7	1	650	500	27
Type 100	37	6.6	1	650	500	36
Type 115	40	6	1	650	500	47
Type 120	43	7	1	650	500	52
Type 127	47	8.6	1	650	500	57
Type 140	48	4.1	1	650	500	70
Type 159	61	10.4	1	650	500	90
Type 203	81	9.5	1	650	500	147

Tungsten Shields

Description	Tungsten [mm]	Steel [mm]	Brass [mm]	Max. length possible [mm]	Max. source length [mm]	Typical weight [kg]
Type 60	17	3	1	650	500	19
Type 80	32	3	1	650	500	34
Type 100	41.5	3.6	1	650	500	63
Type 115	47	2.5	1	650	500	72
Type 127	53	2	1	650	500	86
Type 140	58	2	1	650	500	105
Type 159	69	1.5	1	650	500	135

Transfer Shields

Description	Lead [mm]	Steel [mm]	Max. length possible [mm]	Max. source length [mm]	Typical weight [kg]
Type 80	32	2.5	853	500	38
Type 80	33	2.5	548	350	45
Type 105	42	2.5	698	500	60
Type 105	42	2.5	548	350	65
Type 127	52	4	650	420	75
Type 127	52	4	698	500	85
Type 127	52	4	548	350	95

8.2 Spare Parts

Replacement parts and repair kits are available for the mold level shields. Contact Berthold Service for more information.

8.3 Drawings

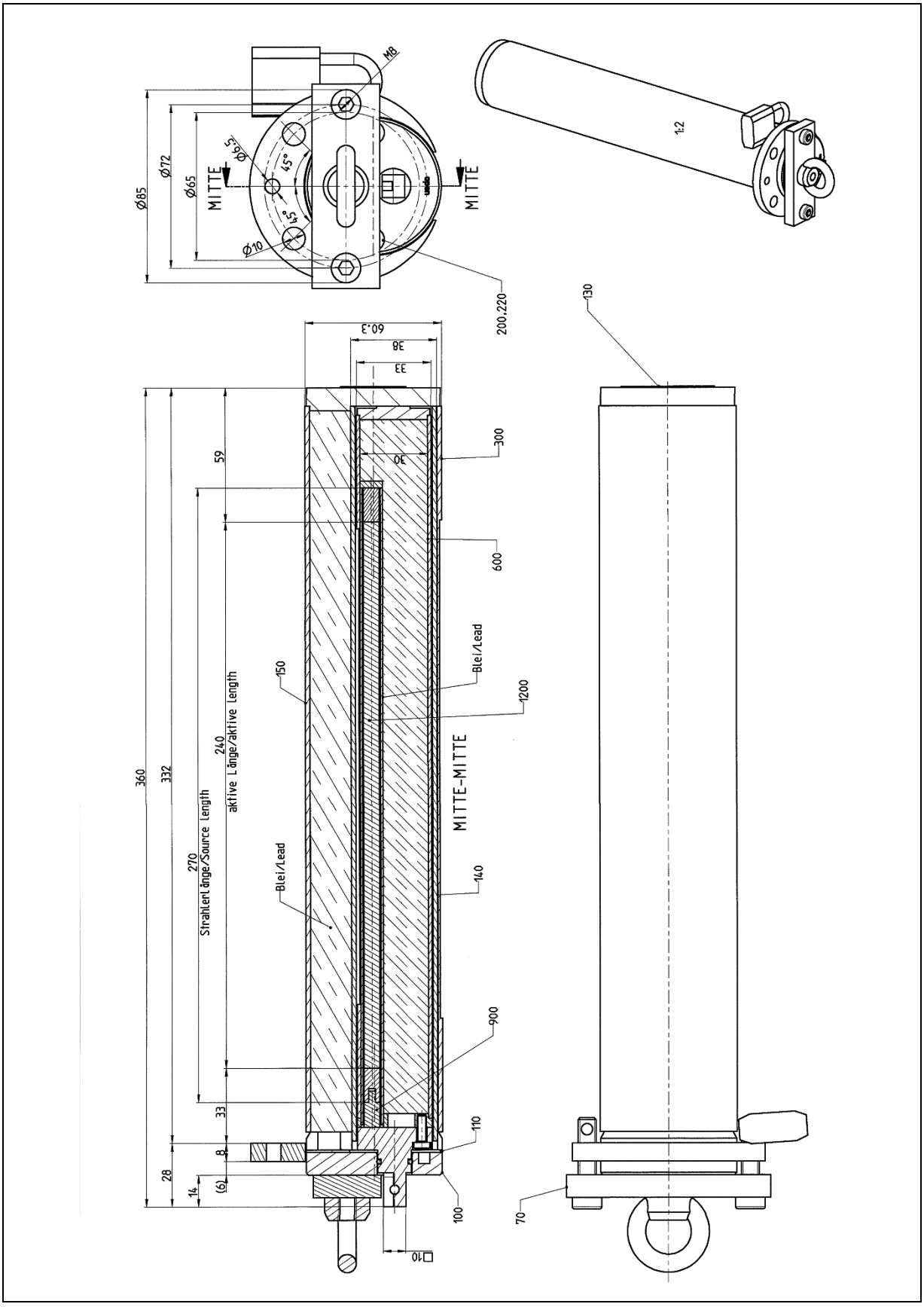


Fig. 19 Example Drawing Mold Level Shield

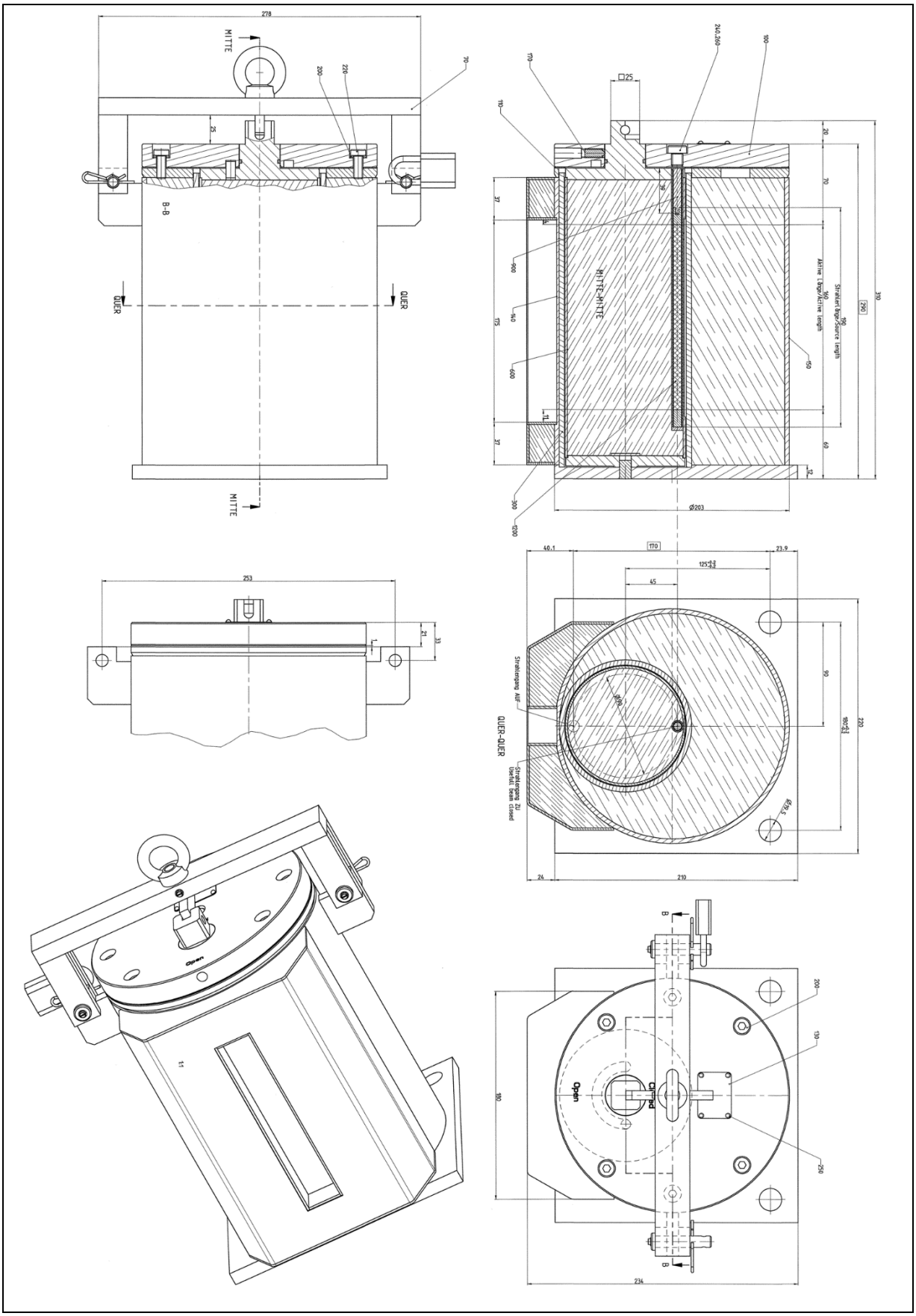


Fig. 20 Example Drawing Mold Level Shield with Collimator

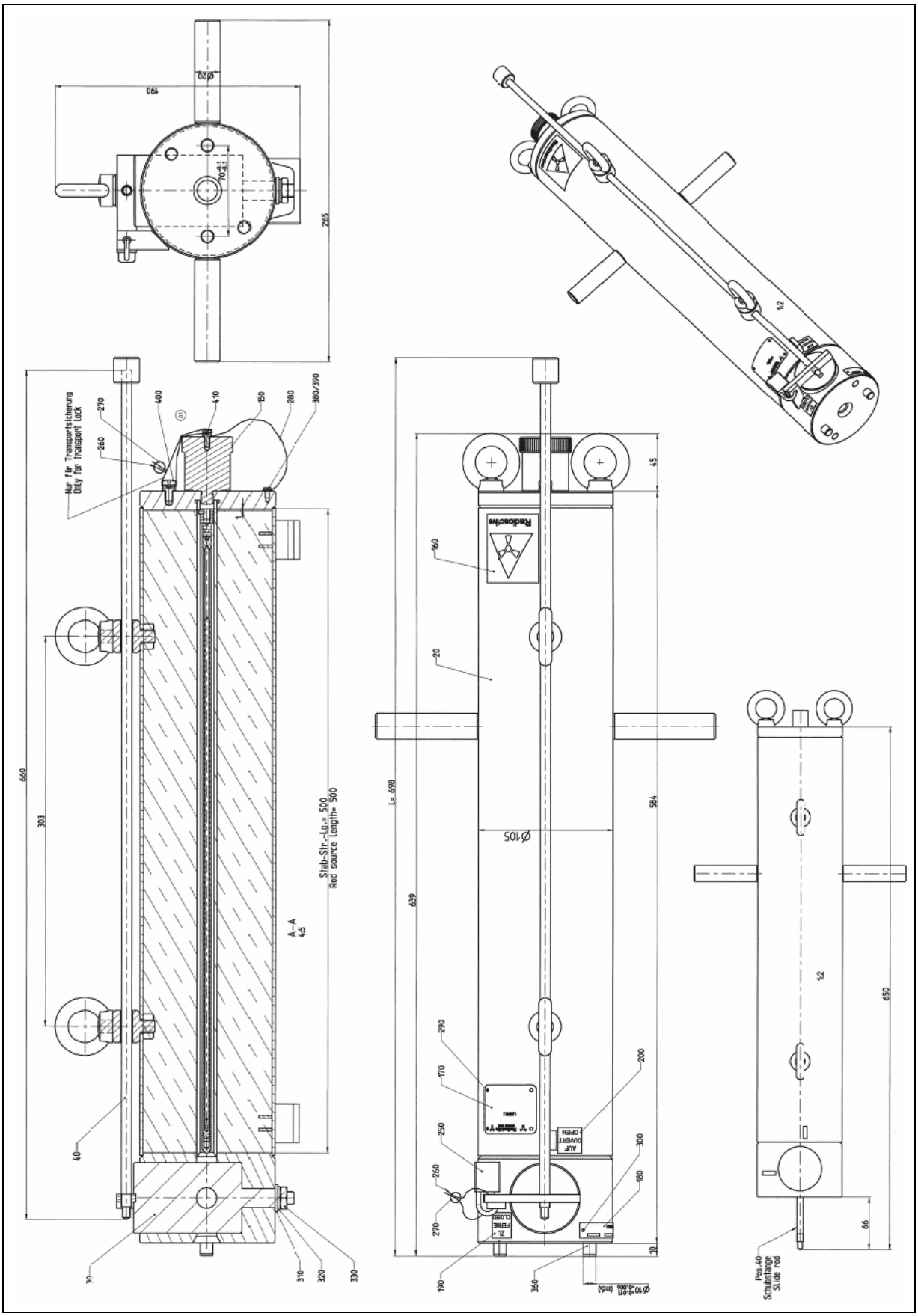


Fig. 21 Example Drawing Transfer Shield

8.4 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 sealing plug must be screwed and secured by the transport bracket		
Name of inspector:	Date:	Signature:

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

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