RITVERC™
isotope products

Safety and Handling Instructions for Radioactive Sources and Solutions

Saint-Petersburg
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ISO 9001

Safety and Handling Instructions for Radioactive Sources and Solutions.

Warnings

For reasons of safety and to ensure correct usage, read these instructions carefully before un-packing, using, storing, transporting or disposing of the radiation sources / solutions

These instructions must always accompany the radiation sources / solutions and be readily available to all persons using them.
You should be aware of the following:

- Radiation sources / solutions must only be used by qualified persons or by trained assistants working under their direct supervision.
- Radiation sources emit harmful radiation.
- Potentially dangerous radioactive material may be released if the radiation sources are damaged by misuse.
- The sources must not be used under operating conditions or for purposes outside those agreed in writing by **RITVERC JSC**.
- The sources must never be modified unless the modifications have been agreed in writing by **RITVERC JSC**.

In case of origination of unforeseen situations, it is necessary to address for the help to competent specialist for assistance.

Contents

1 Introduction

This document gives guidance information regarding the safe and proper use of Radiation Sources. It is most important that they are followed at all times. Where they exist, relevant local and national regulations and codes of practice and transport regulations must be adhered to.
Where applicable additionally to these recommendations the handling instructions / manuals of the manufacturer of appliances have to be considered.
The following statements concerning “radioactive sources” are also applicable to “radioactive solutions and gases”.

2 Regulations

Before ordering or using radiation sources or any other radioactive material customers must take whatever actions are necessary to ensure that they are complying with their national or state regulations governing the use of such materials.
In most countries regulations are closely related to the International Atomic Energy Agency (IAEA) regulations and codes of practice. If radiation sources have to be transported for use it is necessary to comply with the current IAEA Regulations for the Safe Transport of Radioactive Material (IAEA):
“Regulation for the safe transport of radioactive material”, Safety Standard Series no. TS-R-1 (ST 1, revised), 1996 edition.
Depending on the mode of transport, it is also necessary to comply with the regulations / requirements of:

- **ICAO**, the International Civil Aviation Organization and
- **IATA**, the International Air Transport Association or
- **IMO**, the International Maritime Organization or
- **ADR**, the European Road Regulations.

3 General Precautions

All radioactive products are dangerous if not handled, used, stored, transported or disposed of properly and in accordance with the appropriate regulations. To avoid danger it is essential that these instructions are strictly observed:

a) Sources must not in any way be modified or reworked, as this could be dangerous.
b) These sources must be unpacked or used only by persons who are fully trained and competent. Personnel unpacking or using sources must wear appropriate extremity and body dosimeters.
c) Sources emit harmful radiation and all personnel must be adequately protected from this radiation.
d) It is good practice to make regular checks for surface contamination in the area where sources are handled and on any equipment with which they come into contact.
e) Unless specifically requested, the sources are designed, manufactured and tested assuming that they are not to be used or stored in corrosive conditions, temperatures beyond 233 K to 343 K or acceleration > 20 $m \cdot s^{-2}$.
f) If in doubt about how to proceed contact your adviser on radiation protection or **RITVERC**

Additional precautions for solutions

g) All work with radioactive solutions should be performed in a ventilated fume cupboard or slit box having a flow rate through any opening of at least 0.5 m/s for nonvolatile radioactive compounds. A flow rate of 0.8 m/s is recommended for volatile compounds such as iodine or sulfur. Trays of sufficient capacity to contain the contents of the ampoule in the event of a spill should be used. The tray should be lined with absorbent paper. In the event of a spill, the paper lining the tray should be removed and disposed of according to your Local Rules.

The tray can then be wiped with swabs moistened with water or ethanol until no contamination the tray can be monitored directly.

Note: The same procedure should be followed if the solution is an alpha emitter but the swab should be allowed to dry before monitoring since the alpha particles would be absorbed by the water or ethanol and would not be detected by direct monitoring.

h) Certain products are classified as presenting a chemical hazard due to the characteristics of the chemical used in the carrier solutions is removed, then.

4 General Instructions

4.1 Use

It is essential to check that the sources supplied are suitable for the intended application before they are used.
Sources are designed for specific uses described in our product catalogues or in some cases as agreed directly with the customers in writing.
Normal conditions relating to the use of radiation sources is assumed. Extreme or corrosive environments and cyclic thermal and mechanical conditions must be avoided.

4.2 Storage

Radioactive sources must be kept in a suitable receptacle in a store when not in use or being transported. The store must be adequately shielded, correctly labeled and fully secured against intrusion by any unauthorized persons.
Radioactive sources should be stored at room temperature. Care should be taken to ensure that sources are not trapped or bent when storage drawers are closed. It is recommended that sources are replaced in their storage container immediately after use.
Do not store beta radiation sources in contact with halogenated plastic materials as this may cause severe radiation damage to the plastic, followed by chemical attack on the active face of the source.

4.3 Damage and Loss

If the package or source is damaged or has been involved in an accident or exposed to adverse conditions then appropriate precautions must be taken according to your contingency plans.
RITVERC must be informed and further advice sought from the appropriate radiological protection service. In certain circumstances the national regulatory authority will need to be informed.
The radiation protection service should advise. In any case of doubt **RITVERC** or its authorized representative must be notified.
If the radioactive material is lost, the person responsible for radiation protection must immediately inform the local and national regulatory authorities. Records of any investigation taken to locate the lost material must be kept for an appropriate period.

4.4 Transfer and Disposal

a) Where radioactive material is resold or incorporated in other products or is transferred on in any way, it is the responsibility of the user to ensure that all subsequent users are made aware of the nature of the radioactive material and the specified use.
b) All users must be supplied with the original certificate (if necessary collect certificate), these instructions and any other relevant information that is required to ensure safe use, return and disposal of the radioactive material and any product into which the material is incorporated.
c) After use the radioactive material and all materials intimately associated with the use of the radioactive material (including any unused sources and its container) should be treated as potentially radioactive material. Where appropriate these materials should be decontaminated and checked before disposal. Any active or contaminated material, solid or liquid, should be disposed of in accordance with the conditions specified by the local competent authority and through an approved agency licensed to deal with.
d) When a radioactive source is no longer required and is to be disposed of, it must be properly packed and documented prior to being sent for disposal. Care should be taken to minimize radioactive waste. Advice on the safe disposal of radioactive material is available on request from the **RITVERC**.
e) It is important that equipment that contains radioactive material is clearly designated as such and the possibility of accidental contamination or radiation exposure to the public by scrap disposal activities is avoided. Equipment that has contained radioactive material must be thoroughly checked for such materials and contamination before disposal to radioactive waste.

5 Radiological Protection

a) Before any unpacking or radioactive material movement is attempted, a detailed plan of the actions contemplated must be prepared to assess any hazard that may arise. All radioactive material movements must be recorded and records maintained for an appropriate period as specified in your local rules. Contingency plans must be made for any foreseeable accidents.

b) All personnel must be adequately protected from alpha, beta, gamma and X-ray radiations as appropriate. Beta sources produce Bremsstrahlung (electromagnetic) radiation which results from the interaction of the beta particles with surrounding matter.

Details of radionuclide data of your source can be obtained from our catalogue, our homepage or from your adviser on radiation protection. Please note the following recommendations in any case. Care should be taken to avoid ingestion or contact with skin or clothing of radioactive material. It is recommended that protective clothing such as laboratory overalls, safety glasses and gloves be worn whenever radioactive sources are handled.

No smoking, drinking, or eating should be allowed in areas where radioactive materials are used. Frequent monitoring of working areas, hands and clothing is recommended

c) Minimize personnel exposure using: time, distance, shielding considerations.

Time

- Minimize time spent by personnel near to the source of radiation.
- The total dose received in working with radioactive material is directly proportional to the time taken to carry out the work. Good planning helps to reduce exposure time to a minimum.

Distance

- Maximize the distance between personnel and the source of radiation.
- Exposure to gamma radiation is greatly affected by distance in accordance with the inverse square law. For example, if the distance is doubled the dose rate is reduced to one quarter of its original value, but if the distance is halved the dose rate will increase fourfold.

Dose rate at 1 mm is 10,000 times greater than it is at 100 mm!

Beta radiation is absorbed by air so its intensity declines with distance much more rapidly than inverse square law calculations would indicate. Low energy beta sources may give very high dose rates at the active surface so it is important that these sources do not touch the skin. So always wear protective gloves (e. g. surgical gloves).

Use rubber capped, shaped metal forceps to handle the sources and keep the active side pointing away from the operator.

Shielding

- Use shielding between personnel and the source of radiation. The shielding required will depend on the radionuclide and the activity of the radiation source, but in general, low atomic number materials such as plastic (~ 10 mm thick) are preferred as a primary shield to absorb beta particles while dense, high atomic number materials such as lead and concrete are preferred to reduce gamma.

Note: Radioactive sources containing beta particle emitters also produce bremsstrahlung radiation. If the resulting bremsstrahlung radiation is high, it can be reduced by placing a lead shield between the primary plastic shield and the operator.

- The wearing of eye protection is recommended when using beta sources.
- When sources are not in use, keep them in their storage containers and place in your radioactive material store and X-ray radiations.
- Your adviser on radiation protection should be able to advise on shielding requirements as necessary.
- A suitable calibrated dose rate meter must be used to check actual dose rates to personnel in the vicinity. Check the working area, hands and protective clothing for contamination after each operation using an appropriate calibrated monitor. If radioactive contamination is found react according to your local contingency plans.
- Always wash your hands and monitor yourself and your clothes before leaving the controlled area.

6 Receipt of a Package with Radioactive Sources

a) The package must be inspected on arrival and if any damage is observed which could have resulted in damage to the product then the package must not be opened. If there are any anomalies please notify **RITVERC** or its representatives as soon as possible. Notify the local health physicist or other authorized competent person that the package has arrived.

b) If the package is undamaged, check that the documentation and label description agrees with the order acknowledgement. If there are differences do not open the package, place it in a secure area

and notify **RITVERC** or its authorized representative as soon as possible.

c) Notify the person responsible for radiation protection that the package has arrived. Update the official accountancy record for radioactive substances noting the identification, activity and date.
d) If the package is not to be opened immediately, a suitable, secure store must be provided.
e) The shielding provided by transport containers is adequate to comply with the maximum dose rate as specified in the IAEA Transport Regulations. However, these levels may not be appropriate for storage of the package in places of work without additional shielding. Transport containers may be placed in a controlled area provided that the area is physically demarcated and access restricted.

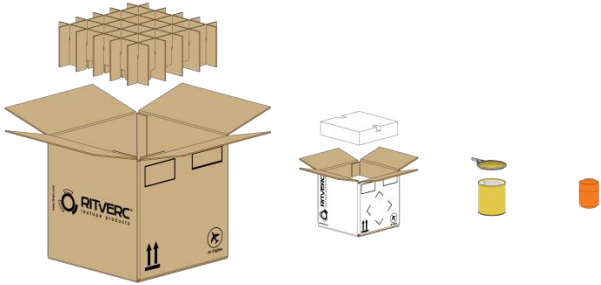
7 Unpacking and Inspection

a) Radioactive sources must only be unpacked in a specially designated area by trained, competent and authorized personnel. Especially chapters 6 to 8 of these instructions should be read carefully and preparations made for using the source or transferring it to a storage facility before unpacking.

Radiation levels should be checked using a dose rate meter at each stage of unpacking. The dose rate at the outer surface of the package may be as high as 2 mSv/h (200 mR/h) and dose levels at each stage of unpacking will get progressively higher.

Various packing combinations are used depending on the type, the radionuclide and total activity of the source or sources supplied. Sources are dispatched in non-returnable packaging consisting of an inner container (e. g. Lead pot, plastic bag with sealed sources, glass vial in stainless steel container) inside a sealed metal can or another sort of container.

b) Open the outer cardboard carton, pull out the documents. The documents include a scheme for further unpacking this type of package.
c) Follow the instructions in the unpacking scheme. In general, the unpacking scheme is presented below.



d) The radioactive source should be inspected immediately taking care to restrict personnel dose levels by the use of suitable shielding, remote handling and viewing using magnifying glass.
e) Check that the source serial number agrees with the accompanying paperwork including the Certificate of Calibration (if presents). If there are differences do not use, repack the source and place it in a secure area and notify **RITVERC** or its authorized representative immediately.

8 Cleaning

To clean carefully any foreign matter from the outside of the source for most of sources use a cotton wool lightly moistened with water or ethanol.

9 Testing and Feedback

a) Capsule designs are assessed for their suitability for typical applications in accordance with the requirements of the ISO standards which must be observed. The ISO classification for sources is stated in a quality certificate provided with the source. Please obtain advice from **RITVERC** if in doubt as to the suitability of a source for a particular application.
b) Sources are tested in accordance with ISO standards. Results of tests performed are quoted in a certificate provided with the source.

c) Adverse environments may affect the integrity of a source. It is the user's responsibility to inspect and test the source regularly in order to assess its suitability for continued service. Sources should be inspected before and after use to ensure that there are no obvious signs of damage.
d) Leak tests must be carried out regularly and at the intervals required by local regulations. These tests should be performed in accordance with the appropriate standards. Records of inspection and testing must be maintained for an appropriate period.
e) **RITVERC** would be pleased to receive any information regarding the performance of their sources in use and to give advice on Recommended Working Lives and also to consider requests for.

Where sources are resold, incorporated into other products or transferred in any other way, it is the responsibility of **RITVERC** customer to ensure that all subsequent users are made aware of the nature of the radiation source and its specified use, and he must include appropriate warnings in the literature he sends out or include copies of these Handling Instructions with the final package advice on source.

10 Recommended Working Life

The Recommended Working Life (RWL) is the maximum period within which **RITVERC** expects the source to meet its design requirements under proper conditions of environment and usage.

A source should be replaced within the Recommended Working Life or a proper assessment should be made to verify its suitability for continued use.

RITVERC makes no warranties, expressed or implied, or guarantees as to how long any source can actually be safely used. Adverse environments, conditions, improper usage or materials combination in usage could affect the appearance and integrity of the source and it is the user's responsibility to carry out routine inspection and testing to determine when it should be replaced.

According to the requirements of the authorities the expiry of the RWL (details see approval) may result in the loss of the approval as special form source disposal.

11 Recommendations for Sources with “Special Form Approval”

Sources with “Special Form Approval”, as a rule, have a high activity and, accordingly, a large external radiation dose. So pay attention to notices before transporting “Special Form Sources”:

- Identification of the source by comparison with the relevant certificates / documents.
- Visual inspection of the source or the source holder- if the source is mounted in any - for mechanical or corrosive damage which may influence the integrity of the source.
- Used sources have to pass a test for leakage (e. g. wipe test) before they can be transported. Sources which are mounted in a holder have to be tested at a proper alternative test area. The test methods have with ISO 9978. The date of test for leakage is not allowed to be older than 6 months before the transport starts, national regulations must be complied with to comply.

Please contact the manufacturer if you have any queries.

12 Additional Information for Special Products

12.1 General

Please observe this additional information for the following sources. The necessary product information (“source type” or “drawing”) for assignment of your product can be found on the certificate.

12.2 Beta Source

a) ^{85}Kr or ^{90}Sr / ^{90}Y

^{90}Sr sources emit high energy beta particles. It is important to screen this beta emission with thick absorbers of low atomic number. For example 15 mm “Perspex” shield (PMMA) will absorb nearly all beta radiation below 4 MeV and minimize the formation of penetrating bremsstrahlung radiation. ^{85}Kr sources have beta energies between 0.2 and 0.7 MeV; beta particles of this energy are effectively absorbed in tissue. Particular care must therefore be taken to minimize dose to tissue. ^{85}Kr sources also emit gamma radiation at 0.514 MeV, the dose rate from high activity sources may be significant but this can be reduced by using lead shielding as necessary.

Note: Although ^{85}Kr is a gas it can be absorbed into grease. ^{85}Kr sources have a thin window; if this window is damaged or punctured the radioactive gas will be released into the air. In this instance, the room must be ventilated and entry restricted until the gas has dispersed. The person responsible for supervising work with ionizing radiation should be informed.

Cleaning

It may be appropriate to rub the source on a swab that has been placed in a tray or dish rather than rubbing the source with a swab. Forceps must be used to hold the source or swab. Care should be taken to avoid scratching the source window. Do not use abrasive cleaners immediately.

Description of wipe test

A filter paper moistened with alcohol / water is held in the forceps so that the filter paper protrudes beyond the longer silicon tube by approximately 2 mm. The window of the source is wiped at an angle from above. Care should be taken to ensure all edges of the window are wiped. The source itself is held from behind during this procedure. This should be done with appropriate tools. Although the soft silicon tube assures that not too much pressure is applied to the titanium window, the wipe should be carried out with great care.

General precautions

Never put your bare hand into the radiation field above the source window (**very high dose rate!**). We recommend wearing a finger ring dosimeter and eye protection glasses during this procedure.
The source window should always point away from the body.
Gloves should be worn when performing the wipe test.

b) ^{63}Ni

Dosimetry

Since the beta radiation from ^{63}Ni will not penetrate the outer layers of the skin it does not present a significant risk from external radiation. If ^{63}Ni compounds are ingested, the majority of the activity will be excreted, in the faeces, within 24 hours.
In the case of inhalation, the fate of the material will depend on its chemical and physical form but about half would usually be excreted in

the faeces within 24 hours and the majority of the remainder will be excreted in the urine within a few days.

Safety warnings and precautions

Suitable radiation and contamination monitoring instruments must be used when unpacking or using a source as an aid to minimizing exposure to radiation. Thin end-window Geiger counters are suitable monitoring instruments for use with ^{63}Ni.

^{63}Ni sources are normally packed in a crimped glass vial. ^{63}Ni sources should be handled with care to avoid damage of the inert layer on the active face.

^{63}Ni sources will gradually tarnish under normal atmospheric conditions due to the exposure to air, aggravation by moisture, and, in confined space, by the effect of beta radiation on air. It is recommended that ^{63}Ni sources should be stored under an inert atmosphere such as dry argon when not in use.

12.3 Gamma sources

Unpacking

Sources are dispatched in lead pots. Disc and annual sources are packed with the radiation emitting window facing down but when the lid is lifted the sources will be unshielded so the dose rate may be high.

Use tweezers and scissors to remove any plastic packing.

Use suitable handling device (e. g. tweezers) to remove the source, taking care not to scratch or damage the active face.

13 Additional Information

If radiation sources have to be mounted or inserted into devices (e. g. using additional source holders) the operating instructions of the device manufacturer must be followed.

In some sources (e. g. reference sources) the radioactive material may be sealed by a very thin inactive surface. The sources therefore must always be handled carefully to prevent surface damage and subsequent loss of radioactive material.

There is always a risk of contamination when using unsealed radioactive material / sources. It is important that the material is only handled in an approved enclosure and in a designated area material.

Please obtain information of the most important parameters of uses nuclides, performed surveys and quality securing proceedings from product catalogues or from our homepage www.ritverc.com.

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