

QSA GLOBAL.



OPERATIONS MANUAL. MAN-061 FEBRUARY 2019

MODEL NE4C.

SOURCE CHANGER & TRANSPORT CONTAINER OPERATIONS MANUAL

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DANGER – IMPORTANT WARNINGS

This transport container must only be used for radiography source assemblies that are approved for use with this container. Please refer to Table 1 for a listing of source assemblies that are authorized for use. The container must be operated only by trained and qualified radiographers who have read and understand this Operating Manual or by trained assistants working under their direct supervision.

WARNING

The use of this radiographic source changer by unqualified personnel or when safety procedures are not fully met, could result in life-threatening dangers.

Do not use this transport container for unauthorized, damaged or cropped source assemblies.

The radioactive source assemblies utilized in this transport container emit high levels of highly penetrating radiation during use.

An unshielded radiation source at close range can cause **injury, sickness or death** to anyone who is exposed to it even for a short period of time.

A radiation source **must not** be touched by the hands under any circumstances.

Since gamma radiation cannot be detected by the human senses, strict operating and emergency procedures must be followed. The proper use of calibrated and operable survey meters must be employed to avoid potentially dangerous levels of radiation exposure.

Proper dosimetry including film badges or thermoluminescent dosimeters, optically stimulated luminescence badges (OSL); direct reading pocket dosimeters and audible alarm ratemeters must be worn during all radiographic operations.

It is imperative that the users of this transport container perform adequate radiation surveys of the transport container and exposure devices. Surveys must be performed using a calibrated survey instrument before, during and after source exchanges and before transport to determine if the source assembly is properly shielded within the transport container. The failure to perform an adequate radiation survey can cause unnecessary exposure to personnel resulting in a reportable incident.

It is very important and required by national regulations to prevent access by unauthorized persons to radiographic equipment and to the area where radiography is performed.

Take advantage of the three basic radiation protection methods to minimize radiation exposure:

Time: Spend less time near the radiation source.

Distance: Increase your distance in a direction away from the radiation source.

Shielding: The use of effective shielding between you and the radiation source.

Do not perform any unauthorized modifications to the radiographic source changer or components of the radiography system.

It is important that trained and qualified radiographers perform or supervise a daily safety inspection of the radiography system for obvious defects prior to operation of the system.

Do not use any components that are not approved for use with the radiography system or after-market components that may compromise the safety designed into the system.

1. TECHNICAL SPECIFICATIONS.

1.1 General Requirements

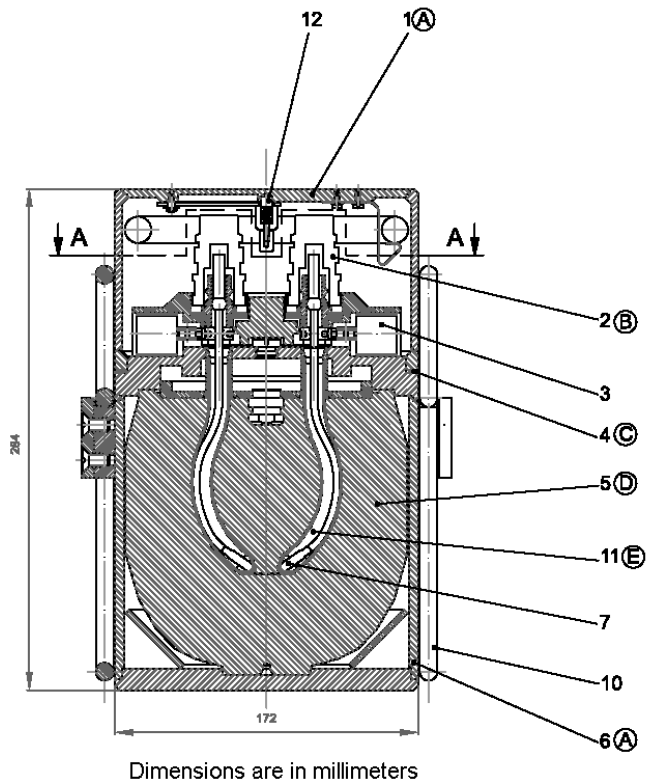
The Model NE4C is used as a source changer and transport package for Type B (U) quantities of radioactive material in authorized radiography source assemblies containing. A listing of authorized source assemblies are listed in Table 1.

For Type B transport,

- Maintain on file a copy of the Type B(U) transport certificate issued by the Czech Republic, including a copy of these operating instructions for the package.
- Users of this equipment outside of the Czech Republic must comply with the regulatory, licensing and transportation rules and regulations of their respective countries.
- Maintain on file a copy of the Competent Authority special form certificate for the special form source(s) transported in the source changer.
- Prepare this package for transport per the applicable Type B approval requirements and as described in these Operating Instructions.

1.2 Source Changer General Description

The Model NE4C source changer is a portable, depleted Uranium-238 shielded transport container used for transferring radiography source assemblies to and from industrial radiography exposure devices (see Figure 1). The source changer is a Type B(U) transport container that is designed to safely contain radiography source assemblies during shipment and storage. The source changer permits field exchanges of depleted and new radiography source assemblies without exposing the operator to unsafe radiation levels, provided proper procedures and radiation surveys are followed. The source changer is designed to contain up to a maximum of four (4) source assemblies during transport. Each source assembly is secured by an independent locking mechanism, a protective source cap and a security clip. Authorized source assemblies are listed in Table 1, or as otherwise approved in writing by a Regulatory Affairs representative of QSA Global, Inc. When transporting Type B quantities of Iridium-192 and/or Selenium-75, the maximum combined activity of all sources is 22 TBq (595 Ci). The maximum activity of any single Iridium-192 or Selenium-75 source loaded in the NE4C transport container is 5.5 TBq (148.6 Ci).



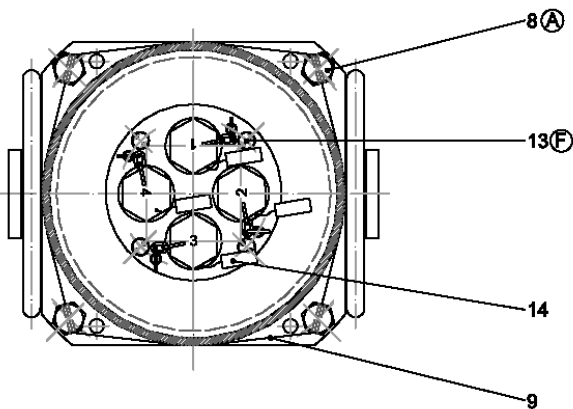
PARTS LIST / SEZNAM SOUČÁSTÍ:

1. COVER / VÍKO
2. CHANNEL END CAP / KRYCÍ VÍKO KANÁLU
3. LOCK / ZÁMEK
4. "O" RING / "O" KROUŽEK
5. DEPLETED URANIUM SHIELD / STÍNĚNÍ Z OCHUZENÉHO URANU
6. BASE / PODSTAVEC
7. SEALED SOURCE ASSEMBLY / DRŽÁK ZDROJE
8. M-10 SCREW / ŠROUB M10
9. WIRE SEAL / PLOMBA
10. HANDLE / DRŽADLO
11. CHANNEL / KANÁL
12. RECEPTACLE ASSEMBLY FOR KEY / SCHRÁNKA PRO ULOŽENÍ KLÍČKU
13. TAMPER PROOF SCREWS / BEZPEČNOSTNÍ ŠROUBY
14. SOURCE IDENTIFICATION TAG / IDENTIFIKAČNÍ ŠTÍTEK

NOTES / POZNÁMKY

1. MEETS ALL IAEA REQUIREMENTS FOR TYPE B(U) TRANSPORT PACKAGES / SPLŇUJE POŽADAVKY IAEA PRO PŘEPRAVNÍ OBALY TYPU B(U)
2. SEALED SOURCE MEETS IAEA REQUIREMENTS FOR SPECIAL FORM RADIOACTIVE MATERIAL / UZAVŘENÝ RADIONUKLIDOVÝ ZDROJ SPLŇUJE POŽADAVKY PRO RADIOAKTIVNÍ MATERIÁL ZVLÁŠTNÍ FORMY
3. TOTAL WEIGHT / CELKOVÁ HMOTNOST 68 kg (150 lb)
4. CONTAINS 48 kg (106 lb) OF DEPLETED URANIUM / OBSAHUJE 48 kg (106 lb) OCHUZENÉHO URANU

A - A



MATERIALS / MATERIÁLY

- A. STAINLESS STEEL / NEREZOVÁ OCEL 12xBH10T
- B. MODIFIED SNAP TILE BPHC-6 QUICK CONNECT (BRASS) / UPRAVENÝ KONEKTOR BPHC-6 (MOSAZ)
- C. RUBBER / PRYŽ
- D. DEPLETED URANIUM / OCHUZENÝ URAN
- E. TITANIUM ALLOY / SLITINA TITANU BT1-0
- F. STAINLESS STEEL / NEREZOVÁ OCEL 14x17H2

FIGURE 1 - NE4C COMPONENT DIAGRAM

TABLE 1: AUTHORIZED SOURCE ASSEMBLY INFORMATION

Source Assembly Manufacturer	Source Assembly Model	Isotope	Special Form Certificate	Maximum Source Activity
NTP Europe	C-337, C-337NE	Ir-192	B/012/S-96	148.6 Ci (5.5 TBq)
NTP Europe	C-990, C-990NE	Ir-192	B/012/S-96	148.6 Ci (5.5 TBq)
QSA Global Inc.	87703	Ir-192	USA/0335/S-96	148.6 Ci (5.5 TBq)
QSA Global Inc.	A424-9, A424-23	Ir-192	USA/0335/S-96	148.6 Ci (5.5 TBq)
QSA Global Inc.	A424-25, A424-25W	Se-75	USA/0502/S-96	148.6 Ci (5.5 TBq)
QSA Global Inc.	91805	Se-75	USA/0502/S-96	148.6 Ci (5.5 TBq)

*Sources transported in this package must also meet a minimum ISO 2912:2012(E) (or equivalent) Temperature classification of 4 and a Pressure classification of 3.

The sources are secured in place within one of four source locking mechanisms. Each source is secured by a key operated, plunger style lock that prevents the assembly from being removed from the source tube. In shipment the source is further secured in place and protected from damage by a source cap and a security clip. The security clip prevents disengagement of the quick connect system during transport/storage. When the security clip and source cap are removed and the plunger lock is disengaged, the source is in an “unsecured” position that will permit its removal from the source tube.

When the plunger lock is engaged to the “secure” position, it restricts the source assembly from being removed from the source tube.

A quick connect feature is also incorporated into the lock mechanism’s design. Source guide tubes (projection sheaths) are attached to a detachable threaded fitting that permits a quick connect or disconnect to the locking mechanism.

The locking system is protected from damage in transport/storage by a stainless steel cover. A flat rubber gasket is located between the cover and the container body and the cover is secured to the NE4C container base by four (4) M-10 screws.

The NE4C incorporates two (2) stainless steel handles to aid in lifting, movement and tie-down of the package.

1.3 Source Changer Specifications

Design Authority	QSA Global, Inc. 40 North Avenue Burlington, MA 01803
Device Model Number	NE4C
Size	11.2 (284 mm) high; 6.8” (172 mm) diameter
Shipping Weight	150 lbs. (68 kg) maximum
Weight of DU Shield	106 lbs. (48 kg)
Activity of DU Shield	17.6 mCi (651.2 MBq)
Certifications	Type B Transport Certification
Special Form Certifications & Source Assemblies	(See Table 1)
Operating Temperature Range	-40°F to 158°F (-40°C to +70°C)
Shipment Data	An envelope accompanies each shipment and contains: <ul style="list-style-type: none"> • Source decay chart and leak test certification. Keep for user’s records. • Source identification plate for attachment to user’s exposure device.

	<ul style="list-style-type: none"> • Return shipping labels. • Tamper indicator seals. • Operating Instructions.
<p>Safety Considerations</p>	<ul style="list-style-type: none"> • All operations must be monitored with an operable, currently calibrated survey meter capable of reading 2 mR/hr (20 µSv/hr) to 1,000 mR/hr (10 mSv/hr). • Personnel monitoring devices must be worn during all source changing operations. This should include a direct reading pocket dosimeter, alarming ratemeter if applicable, and either a film badge, thermoluminescent dosimeter or optically stimulated luminescence badges (OSL). These must be worn by any individual that enters a restricted area or is involved in a source changing operation. • Pocket dosimeters should be initially charged (zeroed) at the start of the day and should be checked periodically during the operation for accumulated exposure. In the event that an individual's pocket dosimeter goes off scale or if the alarm ratemeter alarms unexpectedly, stop work immediately, restrict and secure the area against unauthorized personnel and alert the Radiation Safety Officer. The individual's film badge, thermoluminescent dosimeter or optically stimulated luminescence badges (OSL) must be sent in for immediate processing. The individual must refrain from all work with radioactive material until the individual's exposure is determined to be below regulatory limits. <p>NOTE: All of the radiological precautions used during radiographic exposures must be followed during a source changing operation.</p>

1.4 Notice

This device is used as a radiography source changer and a Type B(U) shipping package for radioactive source assemblies. The purpose of this manual is to provide information, which will assist users in using the Model NE4C source changer. The user must be thoroughly familiar with this instruction manual, and the instruction manual for the radiography exposure device to be used in the source transfer, before attempting operation and use of this equipment.

It is the responsibility of users of this equipment to comply with all local, national and international regulatory, licensing and transportation rules and regulations as they apply in their respective countries.

1.5 Warranty and Limitation of Liability

In no event shall QSA Global, Inc. be liable for any incidental or consequential damages, whether or not such damages are alleged to have resulted from the use of such product in accordance with instructions given by or referred to by QSA Global, Inc.

QSA Global, Inc. assumes no liability or responsibility for the usage of any radioactive material or device generating penetrating radiation used in connection with this product. The use of such material or generators in

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any manner other than prescribed in applicable Country Regulations may constitute a violation of such license terms.

All other warranties, except those warranties expressly stated herein, including without limitation warranties of, merchantability and implied warranties of fitness, are expressly excluded.

The warranty on this device is specifically limited to its use only with sealed sources, parts and accessories endorsed by QSA Global, Inc.

QSA Global, Inc. shall not be liable for any errors or omissions contained herein and the provision by QSA Global Inc. of the information set out in this manual does not in itself constitute acceptance of any liability on the part of QSA Global, Inc.

2. OPERATING INSTRUCTIONS.

2.1 General Requirements Before Use

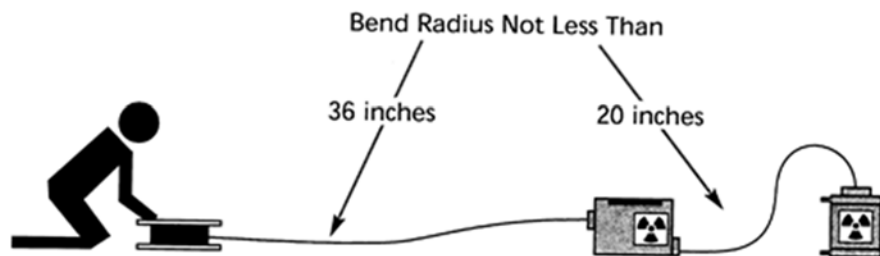
- 2.1.1 Upon receipt of a source changer, survey the source changer on all sides to assure that the source is in its proper storage position. Radiation levels should be less than 200 mR/hr (2 mSv/hr) at the surface of the container and less than 10 mR/hr (100 μ Sv/hr) at one meter from the surface of the container.

If either of these radiation levels are exceeded, place the source changer in a restricted area and notify the Radiation Safety Officer. The Radiation Safety Officer should notify the appropriate regulatory agency, the final delivering carrier and QSA Global, Inc. immediately.

Visually inspect the source changer for signs of damage and assure that the seal wire (tamper-indicator seal) has not been compromised or broken. Record any deficiencies of the visual inspection on the receiving report.

- 2.1.2 Locate the source changer and radiographic exposure device in a restricted area. Arrange them so the transfer tube provided with the NE4C source changer will fit between the exposure device and the changer without any sharp bends or kinks in the tube (see Figure 2).

FIGURE 2 - TYPICAL RADIOGRAPHY TRANSFER LAYOUT



The bend radius of the transfer tube during source exchanging operations should be greater than 20 inches (508 mm).



NOTE: THE NE4C SOURCE CHANGER MUST REMAIN UPRIGHT AT ALL TIMES. DO NOT LAY THE SOURCE CHANGER ON ITS SIDE.

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- 2.1.3 Locate the remote controls (wind-outs) as far away as possible from the exposure device and the source changer, preferably behind any available shielding.

2.2 Procedure for Engaging/Disengaging the Source Assembly Connector

2.2.1 Drive Cable Connection – To Engage Connector

 **WARNING** 

The NE4C lock plunger must be engaged in the “SECURE” and locked position at all times when connecting and disconnecting the drive cable to a source assembly in the source changer.

This procedure must be monitored with an operable, calibrated survey meter.

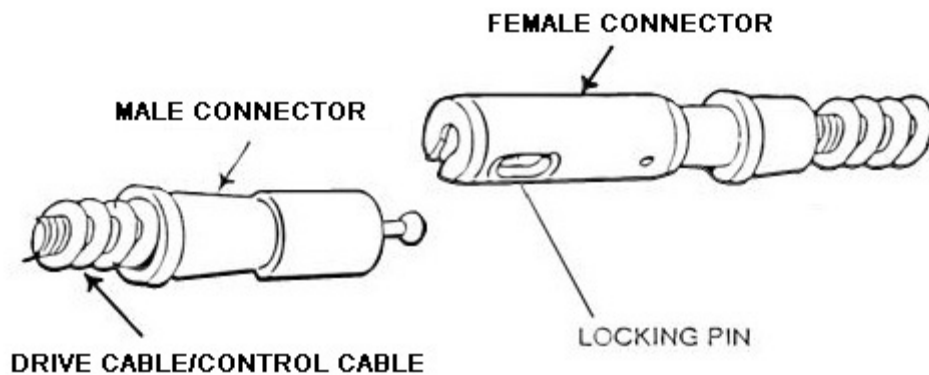


FIGURE 3 - SOURCE CONNECTION DETAILS

- a. Using a fingernail, move the connector pin downward (pressure on pin is toward the stored position of source). This moves the connector sleeve away from the keyway in the female connector.
 - b. Slide the drive cable connector into the female connector and release the pin. Assure that the connector sleeve has returned to the original position closing the keyway.
 - c. Test the connection by gently pulling between the source and the drive cable. (Note Warning above when performing this test).
- 2.2.2 Drive Cable Connection – To Disengage Connector
- a. Using a fingernail, move the connector pin downward (pressure on pin is toward the stored position of source). This moves the connector sleeve away from the keyway in the female connector.
 - b. Slide the drive cable connector out of the female connector and release the pin.

2.3 Operational Sequence to Transfer a Spent Source Assembly into the Model NE4C

- 2.3.1 Prepare the radiography exposure device for the source exchange according to the device manufacturer's instructions (e.g., operations manual).
- Connect the drive cable end of the device achieving a secure connection.
 - Attach the remote controls to the device.



WARNING



The exposure device **MUST NOT** be placed in the “OPERATE” mode until steps 2.3.2 through 2.3.8 have been completed.

- 2.3.2 Remove the four (4) M-10 screws from the NE4C lid and remove the lid from the container body. Remove the transfer tube from inside the lid for use in the source transfer.
- 2.3.3 Remove the security clip from the protective cap covering the empty source changer source tube by pulling on the metal cable. Remove the protective cap from the empty source tube.



WARNING



As the radiation level is higher at the exit of the source tubes than in the surrounding area, avoid passing over the source tubes in which the loaded source holders are stored.

- 2.3.4 At the empty NE4C tube, unlock the key-lock plunger. Remove the key.
- 2.3.5 For exposure devices with a shipping/storage plug, remove the device shipping/storage plug, then attach the threaded fitting of the transfer tube to the device exit port. For transfers from an 880 Style device, attach bayonet adaptor (part 88082) to the threaded end of the transfer tube, then attach that end of the transfer tube to the device in accordance with the instructions in the 880 operations manual. (Contact QSA Global, Inc. if you need a bayonet adaptor part 88082).
- 2.3.6 Connect the quick connect end of the transfer tube to the empty NE4C source channel.
- 2.3.7 Ensure the bend radius of the transfer tube between the exposure device and the NE4C changer is greater than 20 inches (508 mm) and that the NE4C is upright sitting on its base.
- 2.3.8 Set up the radiographic exposure device for an exposure. Ensure the “restricted” area is cleared of all personnel and all access points are secured. Position a survey meter close to the operation control point to allow continuous monitoring of the radiation intensity to which the operator is exposed.
- 2.3.9 At the exposure device's remote controls (wind-out), crank the source rapidly from the exposure device to the source changer. During movement of the source assembly, the radiation intensity will greatly increase as the source assembly exits the exposure device, decrease slightly as the source assembly is cranked from the exposure device towards the source changer and then drop down to background when the source assembly is shielded within the source changer.

Approach the exposure device with a survey meter. Survey the exposure device, survey the entire length of transfer tube, and survey all sides of the source changer to assure that source assembly has been properly transferred and is in the fully shielded position. The maximum radiation level should be less than 200 mR/hr (2 mSv/hr) at the surface of the container and less than 10 mR/hr (100 µSv/hr) at one meter from the surface of the container.

If either of these radiation levels are exceeded, control access to the “restricted” area and notify the Radiation Safety Officer and QSA Global, Inc. immediately.

- 2.3.10 After confirming (by radiation survey) the transferred source assembly is in the fully shielded position, push the key cylinder of the lock inwards towards the center of the source changer. This will secure the source assembly in the lock mechanism.
- 2.3.11 Release the quick connect fitting of the transfer tube from the source channel fitting on the NE4C. Pull the transfer tube away from the fitting to expose the top of the source connector and the drive cable connection.
- 2.3.12 Disconnect the drive cable from the source connector.
- 2.3.13 Put the cap/plug on the source channel that has just been loaded and reinsert the safety clip on the cap/plug.
- 2.3.14 Remove the source identification tag for the transferred source from the exposure device and attach it to the NE4C channel cap.

2.4 Operational Sequence to Transfer a New Source Assembly from the Model NE4C into a Radiographic Exposure Device

- 2.4.1 Prepare the exposure device to receive the source according to the manufacturer’s instructions. Before making the transfer, check that:
 - The exposure device is empty,
 - The transfer tube is properly attached to the exposure device,
 - The remote control is connected to the other end of the exposure device,
 - The exposure device is in the “OPERATE” mode, and
 - The drive cable is exposed until the male connector of the drive cable is emerges from the end of the transfer tube.
- 2.4.2 Remove the safety clip locking the plug/cap of the source channel with the source to be transferred. Remove the plug/cap from the source channel to expose the top of the female connector of the source holder.
- 2.4.3 **Without unlocking the key operated plunger lock securing the source assembly**, attach the male connector of the remote control cable to the female connector of the source holder. Assure that a positive connection of the two connectors has been accomplished.
- 2.4.4 Connect the quick connect end of the transfer tube to the NE4C source channel. If necessary, rotate the crank arm of the remote control to retract the drive cable slightly to allow for easy attachment of the transfer tube to the open source changer channel.
- 2.4.5 Ensure the “restricted” area is cleared of all personnel and all access points are secured. Position the survey meter close to the operation point to allow continuous monitoring of the radiation intensity to which the operator is exposed.
- 2.4.6 Insert the key into the key-lock and rotate until the key-lock pops outwards. The source assembly is now able to pass freely through the lock mechanism.

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- 2.4.7 From the exposure device's remote controls (wind-out), crank the source assembly from the source changer to the exposure device as rapidly as possible. The radiation intensity will increase as the source assembly exits the source changer; then increase even higher as the source assembly travels in a direction towards the device; and then drop down to background when the source assembly is shielded within the exposure device.

For exposure device's equipped with an automatic securing mechanism (e.g., 880 Series etc.) from the exposure device, attempt to expose the source assembly from the exposure device to confirm if the source has been automatically secured.

- 2.4.8 Approach the exposure device with a survey meter, survey all sides of the exposure device, survey the entire length of transfer tube and survey all sides of the source changer to assure the source assembly has been properly transferred and is in the fully shielded position. The maximum radiation level from the exposure device should be less than 200 mR/hr (2 mSv/hr) on the surface and less than 10 mR/hr (100 µSv/hr) at one meter from the surface.

If either of these radiation levels are exceeded, control access to the "restricted" area and notify the Radiation Safety Officer and QSA Global, Inc. immediately.

- 2.4.9 Remove the transfer tube and remote controls while fully securing the source in the exposure device following the manufacturer's operating instructions for the device. If an 88082 bayonet adaptor was used on the transfer tube during the source exchange and no further transfers between 880 devices will be performed, then remove the 88082 adaptor from the transfer tube.
- 2.4.10 Affix the new source identification tag to the exposure device.
- 2.4.11 Release the transfer tube from the NE4C source changer by releasing the quick connector. Replace the cap/plug and security clip onto the source channel if no further source transfers will be made into that source channel.
- 2.4.12 Repeat sections 2.3 and 2.4.1 through 2.4.11 as applicable for any additional source transfers to be performed.
- 2.4.13 If no other source transfers are required, then install the transfer tube and the key inside the NE4C container lid and reattach the lid to the container using the four (4) M-10 screws.

3. SHIPPING / RECEIVING INSTRUCTIONS.

Shippers of radioactive materials in regulatory jurisdictions must ensure full compliance with all current and applicable transport regulations. Listed are the regulations that should be referenced for the legal transport of radioactive materials:

- International Atomic Energy Agency requirements No. SSR-6 (2012), 'Regulations for the Safe Transport of Radioactive Materials'.
- International Air Transport Association, 'Dangerous Goods Regulations'.
- International Civil Aviation Organization, 'Technical Instructions for the Safe Transport of Dangerous Goods by Air'.
- International Maritime Organization, 'International Maritime Dangerous Goods Code'.
- Refer to additional regulations applicable to the shipper's country.

3.1 Pre-Shipment Inspection

As a shipper of radioactive material, you must have in your possession a copy of:

- the competent authority Type B(U) certificate that applies to the package,
- the special form certificate(s) that apply to any radioactive sources to be shipped,
- this operating instruction manual covering the proper closing requirements for the NE4C package and other preparations for shipment before making any shipment under the approval certificates for the package and its sources.

The shipper must also perform a pre-shipment inspection to verify conformance to the package approval requirements for each individual shipment of radioactive material. This verification assures the package integrity is not compromised in a way such that there is a reduction of safety while in the transportation system.

Visually inspect the transport package:

- Ensure all markings are legible and labels are securely fastened to the container. These markings must include the Type B(U) identification mark, the package serial number, the words "TYPE B(U)" and the radiation trefoil symbol (see Figure 4).

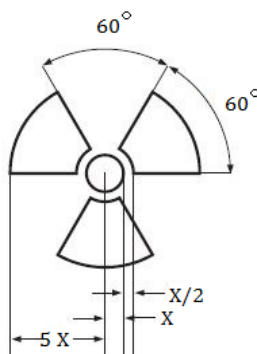


FIGURE 4- Basic trefoil symbol with proportions based on a central circle of radius X. The minimum allowable size of X shall be 4 mm.

- Inspect the container for signs of significant degradation. Ensure that the housing integrity is secure and does not have any significant dents, cracks or any significant rust on the cover (lid).
- Visually assure all welded areas are not cracked. If there is any evidence of cracked welds, contact QSA Global, Inc. prior to shipment.
- Examine the cover lid, container body, and handles to ensure they are intact, oriented properly and have no severe deformation.
- Assure all hardware is present and secured.
- Assure that the transfer tube with bayonet adaptor and the plunger lock key are installed inside the NE4C cover.
- Assure the key operated lock plunger assemblies allow free movement when performing an operational test and that the plunger lock engages and is functional. Assure the source tube caps/plugs install and secure over the source tubes and that the security clips are present and attach securely onto the caps/plugs.
- Assure threaded holes used to secure the protective lid to the container body do not have damaged threads and engage the shipping cover bolts.
- Wipe test the transport package over an area of 300 cm² and assure the level of removable contamination is less than 0.4 Bq/cm² (0.00001 μCi/cm²).

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- Assure a tamper indicating seal is attached to the container which can be used to indicate if unauthorized access to the sources may have occurred during transport. The tamper seal is typically accomplished by attaching a seal wire between two of the four M-10 cover screws after attachment of the cover.
- If the container fails any of these inspections, contact QSA Global, Inc. before making a Type B(U) radioactive material shipment.

3.2 Receipt of Radioactive Material

- 3.2.1 A radioactive material package must be accepted from the carrier at the time it is delivered
- 3.2.2 If a radioactive material package is to be held at the carrier's terminal for pickup, arrangements must be made to receive notification from the carrier of the arrival of the package at the time of arrival. The package must be picked up expeditiously upon receipt of notification (within three hours if practicable).
- 3.2.3 Package radiation survey monitoring must be performed as soon as practicable but at least within three hours if received during normal working hours or within three hours of the next work day if received after normal working hours.
 - a. Upon receipt of a radioactive material package, it shall be placed in a restricted area. Assure appropriate personnel are notified.
 - b. Survey the exterior surfaces of the package at the time of receipt and assure that the maximum radiation level does not exceed 200 mRem/hr (2 mSv/hr). Survey at 1 m from the exterior surfaces of the package and assure that the maximum radiation level does not exceed 10 mRem/hr (0.1 mSv/hr).

NOTE: If either of these limits are exceeded, notify the Radiation Safety Officer immediately. The Radiation Safety Officer may be required to immediately notify the applicable governing agency and the final delivering carrier.

- c. Record the maximum radiation levels measured at the package surface and at 1 m from the package surface on the Receiving Report.
- 3.2.4 If it is evident that the package is damaged or leaking, or if it is suspected that the package may have been damaged or leaked, access to the package must be restricted and qualified persons shall, as soon as possible, assess the extent of contamination, and the resultant radiation levels of the package. The assessment must include the package, the transport conveyance, the adjacent loading and unloading areas and, if necessary, all other material that has been carried in the conveyance. When necessary, additional steps for the protection of persons, property and the environment, in accordance with provisions established by the relevant licensing authority, shall be taken to overcome and minimize the consequences of such leakage or damage.

NOTE: Packages that are damaged or leaking radioactive contents in excess of allowable limits may be removed to an acceptable interim location under supervision, but shall not be forwarded until repaired or reconditioned and decontaminated as applicable.

- 3.2.5 Record the results of the package inspection on the receiving report. Also record on the Receiving Report the date, source model number, source serial number, radionuclide, activity, the individuals name making the record, transport package model number and serial number, exposure device model number and serial number, and the mass or activity of depleted uranium.
- 3.2.6 Assure that the package is locked or place the package into an outer locked container. Secure the package in accordance with your license requirements.
- 3.2.7 Keep a copy of the Operations Manual for the NE4C and the Type B(U) certificate for the package on file to assure you have the proper opening and handling instructions. Assure that the instructions are followed and any noted special precautions are performed.

3.3 Shipment of Radioactive Material

3.3.1 Pre-shipment training requirements. Prior to shipping hazardous materials, personnel should be trained in accordance with applicable regulatory requirements. Contact your government officials for further guidance. Typically, this training includes:

- General awareness/familiarization training.
- Function specific training.
- Safety training, providing:
- Emergency response information.
- Measures to protect employees from potential hazards associated with hazardous material to which employees may be exposed in the workplace, both radioactive and chemical hazards.
- Employer safety measures implemented to protect employees.
- Methods and procedures for accident avoidance, i.e. proper procedures for handling hazardous materials packages.

Documentation of hazardous materials training should be kept available for review by regulators when required.

3.3.2 Prior to shipment assure the package and its contents meet the following requirements.

- The contents are authorized for use in the package.
- The package is in good physical condition for transport.
- All locks or required shipping covers are properly installed and secured where required.
- All conditions of the Type B(U) approval are met.
- Maintain copies of the most current Type B(U) certification and special form certification on file.

3.3.3 Assure that the source is secured in the proper shielded position package as described in this operation's manual and the package is assembled as described in the approval certification. Perform a pre-shipment inspection.

3.3.4 Attach a security seal as specified in Section 3.1 to serve as a tamper indicator.

3.3.5 If the shipping package is to be packaged inside a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transport and must not reduce the safety of the package. The shipping package must be placed within the outer package with sufficient blocking to prevent shifting during transportation. Mark the outside of the package with the Type B(U) number and the words 'Type B(U)' for a Type B shipment.

3.3.6 Survey the exterior surfaces of the package and assure that the maximum radiation level does not exceed 200 mRem/hr (2 mSv/hr). Survey 1 m from the package surfaces and assure that the maximum radiation level does not exceed 10 mRem/hr (0.1 mSv/hr). Determine the proper shipping labels to be applied to the package using the criteria in Table 2.




	Maximum Radiation Level at Surface	Maximum Radiation Level at 1 Meter
Radioactive White I 	0.5 mRem/hr (0.005 mSv/hr)	None
Radioactive Yellow II 	50 mRem/hr (0.5 mSv/hr)	1.0 mRem/hr (0.01 mSv/hr)
Radioactive Yellow III 	200 mRem/hr (2 mSv/hr)	10 mRem/hr (0.1 mSv/hr)

Table 2

For a package, both the transport index (TI) and the surface radiation level conditions shall be taken into account in determining which is the appropriate category of radioactive material label. Where the TI satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package shall be assigned to the higher category of the two. For this purpose, category White-I shall be regarded as the lowest category.

The TI is the maximum radiation level measured in mRem/hr at a distance of 1 m from the external surface of the package. When recording the TI, the dose rate units of the mRem/hr are not listed, for example a reading of 2 mRem/hr (20 μ Sv/hr) would indicate a TI = 2.0. (Note that the TI is rounded to the nearest tenth value.)

NOTE: If an overpack is used for shipment of the Model NE4C, surveys and contamination wipes must first be performed on the external surface of the NE4C and then on the surface of the overpack.

- 3.3.7 Ensure the package is legibly and durably marked on the outside with an identification of either the consignor or consignee, or both. Each overpack shall be legibly and durably marked on the outside of the overpack with an identification of either the consignor or consignee, or both, unless these markings of all the packages within the overpack are clearly visible.
- 3.3.8 When an overpack is used, each overpack shall be legibly and durably marked with the word "OVERPACK" and the applicable UN marking, unless all the markings of the packages within the overpack are clearly visible.
- 3.3.9 Properly complete two shipping labels indicating the radionuclide source contents (e.g., Iridium-192, Selenium-75), the activity of the source(s) (in Becquerels or multiples of Becquerels, e.g.,

GigaBecquerels (GBq)) and the transport index. The transport index is used only on Yellow II or Yellow III labels and is defined as the maximum radiation level in mRem/hr at 1 m from the package surface (See Table 2).

- 3.3.10 Assure that any old shipping labels have been removed from the package. Apply two properly completed labels to two opposite sides of the package (excluding the bottom surface).
- 3.3.11 Mark the outside of the package with the proper shipping name and identification number (i.e. Radioactive Material, Type B(U) Package, Class 7, UN2916 for Type B(U) shipments) if not already marked.
- 3.3.12 Assure that the levels of removable contamination on the outside surface of the outer package do not exceed 0.4 Bq/cm^2 ($0.00001 \text{ } \mu\text{Ci/cm}^2$)

NOTE: If an overpack is used for shipment of the Model NE4C, surveys and contamination wipes must first be performed on the external surface of the NE4C and then on the surface of the overpack.

- 3.3.13 Mark the outside of the package with the permissible gross weight in kilograms.
- 3.3.14 Properly complete the shipping papers indicating:
 - a. Physical and chemical form (i.e. special form).
 - b. Activity of the source in Becquerels or multiples of Becquerels.
Note: Number of Curies X 37 = number of Gigabecquerels (GBq).
 - e. Category of label applied (i.e. Radioactive Yellow II).
 - f. Transport index.
 - g. Type B identification number based on Type B certificate.
 - h. A signed and dated Shipper's certification: **'I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport in accordance with the applicable international and national governmental regulations.'**
[IAEA SSR-6 §547 & 549].
 - i. For air shipments, the shipping papers must meet the requirements specified in IATA for a Shipper's Declaration for Dangerous Goods
- 3.3.15 Provide in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned and must include the following as applicable:
 - a. Supplementary requirements for loading, stowage, carriage, handling and unloading of the package, or overpack, including any special stowage provisions for the safe dissipation of heat. If these are not applicable, there must be a statement that no such requirements are necessary.
 - b. Restrictions on the mode of transport or conveyance and any necessary routing instructions.
 - c. Emergency arrangements appropriate to the consignment.
- 3.3.16 Retain a copy of each of the transport documents containing the information required under IAEA SSR-6 (or applicable local regulatory requirements) for a minimum period of three months. (NOTE: This time period may be longer depending on the requirements of the shipper's competent authority for radioactive material transport.)
- 3.3.17 Copies of applicable competent authority certificates (e.g., Type B(U), Special Form, etc.) must be made available to the carrier(s) before loading and unloading of the package.

3.4 Shipment of Empty Uranium Shielded Containers

- 3.4.1 Assure that the package does not contain a radioactive source.
- 3.4.2 Ensure the package is legibly and durably marked on the outside with an identification of either the consignor or consignee, or both. Each overpack shall be legibly and durably marked on the outside of the overpack with an identification of either the consignor or consignee, or both, unless these markings of all the packages within the overpack are clearly visible.
- 3.4.3 If the shipping package is to be placed inside a crate or other outer packaging which is not part of the Type B(U) container, the outer packaging must be strong enough to withstand the normal conditions of transport and must not reduce the safety of the package. The shipping package must be placed within the outer package with sufficient blocking to prevent shifting during transportation.
- 3.4.4 When an overpack is used, each overpack shall be legibly and durably marked with the word "OVERPACK" and the applicable UN marking, unless all the markings of the packages within the overpack are clearly visible.
- 3.4.5 Assure that the levels of removable contamination on the outside surface of the outer package do not exceed 0.0001 microcuries per cm².
- 3.4.6 Survey the package at the surface and at 1 m from the surface to determine the proper shipping labels to be applied to the package.

Note: If the surface radiation level does not exceed 0.5 mRem/hr (5 µSv/hr) and there is no measurable radiation level at 1 m from the surface, continue with the instructions in Section 3.4.5 and skip Section 3.4.6. If either of these levels are exceeded, skip Section 3.4.5 and continue with the instructions in Section 3.4.6.

Since the Model NE4C is a depleted uranium shielded container which can produce dose rates at the surface of 1-2 mRem/hr (10-20 µSv/hr), the NE4C would need to be overpacked inside a crate or other outer packaging in order to meet the 0.5 mRem/hr (5 µSv/hr) surface dose rate limit and ship as an excepted package under Section 3.4.5. Otherwise skip to Section 3.4.6.

- 3.4.7 If the surface radiation level does not exceed 0.5 mRem/hr (5 µSv/hr) and there is no measurable radiation level at 1 m from the surface, no label is required.
 - a. The outside of the inner packaging or, in there is no inner packaging, the outside of the packaging itself bears the marking 'Radioactive.'
 - b. The outside of the package must be marked with 'UN2909'.
 - c. When shipping by Air, excepted packages are exempt from the requirement for the use of Dangerous Goods Declaration
- 3.4.8 If the surface radiation level exceeds 0.5 mRem/hr (5 µSv/hr), or if there is a measurable radiation level at 1 m from the surface, use the criteria of Table 2 to determine the proper shipping labels to be applied to the package.
 - a. Mark the outside of the outer shipping package with the proper shipping name and identification number (**Radioactive Material, Low Specific Activity (LSA-1), UN2912**). If the container is packaged inside a crate or other outer packaging, mark the outer package with the statement 'Overpack.'
 - b. Properly complete the shipping papers indicating:
 - i. Proper shipping name and identification number (i.e. **Radioactive Material, Low Specific Activity (LSA-1), UN2912, Class 7**).

- ii. Name of the radionuclide (i.e. LSA-I).
 - iii. Physical and chemical form (i.e. Solid metal).
 - iv. Activity of the uranium in Becquerels or other appropriate multiples of Becquerels (i.e. 649 MBq).
 - v. Category of label applied (i.e. Radioactive Yellow II).
 - vi. Transport Index
 - vii. A signed and dated Shipper's certification: **'I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport in accordance with the applicable international and national governmental regulations.'**
 - viii. The weight of the package including the unit of measure of the hazardous material covered by the description (e.g., 68 kg). For air shipments the weight must be in multiples of kilograms.
 - ix. For air shipments, the shipping papers must meet the requirements specified in IATA for a Shipper's Declaration for Dangerous Goods.
- 3.4.9 Provide in the transport documents a statement regarding actions, if any, that are required to be taken by the carrier. The statement shall be in the languages deemed necessary by the carrier or the authorities concerned and must include the following as applicable:
- a. Supplementary requirements for loading, stowage, carriage, handling and unloading of the package, or overpack, including any special stowage provisions for the safe dissipation of heat. If these are not applicable, there must be a statement that no such requirements are necessary.
 - b. Restrictions on the mode of transport or conveyance and any necessary routing instructions.
 - c. Emergency arrangements appropriate to the consignment
- 3.4.10 Retain a copy of each of the transport documents containing the information required under IAEA SSR-6 (or applicable local regulatory requirements) for a minimum period of three months. (NOTE: This time period may be longer depending on the requirements of the shipper's competent authority for radioactive material transport.)
- 3.4.11 Copies of applicable competent authority certificates (e.g., Type B(U), Special Form, etc.) must be made available to the carrier(s) before loading and unloading of the package.

3.5 Carriage of Radioactive Material

- 3.5.1 Assure the vehicle used is in good condition and carries the normal complement of safety equipment including Radiation Area signs, a length of rope, spare tire, fire extinguisher, a set of vehicle tools and a set of flares. Assure that the glove compartment contains the vehicle registration certification and an operating flashlight. Additionally, assure that the operator has a calibrated and operable survey meter and assure that all individuals traveling in the vehicle are wearing both a film badge and a direct reading pocket dosimeter.
- 3.5.2 Assure that the transport package is properly packaged, marked and labeled and assure that the proper shipping papers are completed in accordance with the instructions for shipping radioactive material. The shipping papers must be accessible from the driver's seat.
- 3.5.3 Place the transport package in the vehicle. Properly brace and secure the package against movement in the vehicle.
- 3.5.4 Survey the driver's compartment to assure that the radiation level does not exceed 2 mRem/hr (0.02 mSv/hr). Note that this requirement is only mandatory for exclusive use shipments by a common carrier.

- 3.5.5 If the vehicle is transporting a package bearing a Radioactive Yellow III label, the vehicle must be placarded on all four sides with a Radioactive placard.
- 3.5.6 It is recommended to complete the Suggested Radioactive Material Transport Checklist (see attached example). Forward a completed copy to the Radiation Safety Officer upon completion of the carriage.
- 3.5.7 If the vehicle becomes disabled on the road, do not leave the vehicle unguarded when going for help. A message for help may be sent by a passing motorist or the police may be enlisted to guard the vehicle.
- 3.5.8 Should any kind of accident occur, make an immediate radiation survey to determine if any radiation levels are unusually high. If unusual radiation levels exist, establish the boundary Notify the Radiation Safety Officer as soon as possible, but do not leave the scene without assuring that the police or some other responsible party will keep people out of the area of the restricted area. Keep all persons out of this area and get police assistance, if possible.
- 3.5.9 Collect information pertinent to the accident, such as names of witnesses, names of people involved, names of police, license numbers and circumstances of the accident. Call the Radiation Safety Officer promptly and give him as much information as possible.
- 3.5.10 If a source should escape from the packaging, the vehicle operator should make no attempt to restore the source by himself. He should wait for assistance from the Radiation Safety Officer.
- 3.5.11 If the vehicle is going to be used for storage of radioactive material at a temporary job site:
- The vehicle's storage access entrance must be posted with 'Caution Radioactive Material' signs.
 - The vehicle must be secured/locked so that there is no unauthorized access.
 - Radiation levels must be below 2 mR/hr outside the vehicle to meet unrestricted area requirements.
- 3.5.12 A vehicle and equipment used regularly for the transport of radioactive material is required to be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is transported. [IAEA SSR-6 §512 & 513].

NOTE: Any conveyance/vehicle, or equipment or part thereof that has become contaminated above the allowable limits in IAEA SSR-6 §508 in the course of the transport of radioactive material, or that shows a radiation level in excess of 5 μ Sv/hr (0.5 mrem/hr) at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be reused unless the following conditions are met:

- **The non-fixed contamination does not exceed the limits specified in SSR-6 §508.**
- **The radiation level resulting from fixed contamination does not exceed 5 μ Sv/hr (0.5 mrem/hr) at the surface.**

The Model NE4C source changer contains depleted uranium shielding which will produce radiation levels at the surface of the container from 10-20 μ Sv/hr (1-2 mrem/hr), therefore, fixed contamination of 5 μ Sv/hr (0.5 mrem/hr) will not be distinguishable on the Model NE4C container.

- 3.5.13 In the event of a transport emergency or accident involving this package, follow the guidance contained in "2016 Emergency Response Guidebook: A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident", or equivalent guidance Documentation.

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Suggested Radioactive Material Transport Checklist:

Date _____ Operator _____

Destination _____

Transport container model _____ Serial number _____

Radionuclide _____ Activity _____

Type of label applied _____ Transport index _____

Survey meter model _____ Serial number _____

Calibration date _____ Film badge _____

Dosimeter serial number _____ Initial reading _____

Final reading _____

Radiation area signs _____ Packing list _____

Rope _____ Bill of lading _____

Radioactive material sign _____ Emergency equipment _____

Radiation survey _____ Driver's compartment _____ mRem/hr or μ Sv/hr

(Record highest reading) Vehicle (45.72 cm or 18 in from surface) _____ mRem/hr or μ Sv/hr

Packages properly marked and labeled (including transport index) _____

Packages secured in vehicle _____ Vehicle placarded _____

Shipping papers properly completed _____

Remarks: _____

Operator's signature _____

4. DEFINITIONS & TERMS.

Area alarm

An area radiation level monitor that provides a highly visual warning when the radiation level exceeds a pre-set threshold. Commonly referred to as Gammalarms, use is required by most jurisdictions in permanent radiographic installations and they are often used in conjunction with door interlocks and audible alarms. Portable area alarms are required by some jurisdictions for radiography performed at temporary job-sites.

Alarm ratemeter

An alarm worn by radiography personnel that provides a continuous audible warning when the alarm ratemeter detects a radiation level in excess of a pre-set threshold of 500mR/hr (5mSv/hr). This redundant safety alarm is required by regulation for temporary job-site radiography within the USA.

Apparatus for industrial gamma radiography

Apparatus including an exposure device, a source assembly as applicable, a remote control, a projection sheath, an exposure head and accessories designed to enable radiation emitted by a sealed radioactive source to be used for industrial gamma radiography purposes. Also known as: isotope radiography system, isotope radiography kit.

Automatic securing mechanism

An automatically activated mechanism located on the radiographic exposure device designed to restrict the source assembly in the secured position.

Carrier

Carrier means any person, organization or government undertaking the carriage of radioactive material by any means of transport. The term includes both carriers for hire or reward (known as common or contract carriers in some countries) and carriers on own account (known as private carriers in some countries).

Consignee

Consignee means any person, organization or government that is entitled to take delivery of a consignment.

Consignment

Consignment means any package or packages, or load of radioactive material, presented by a consignor for transport.

Consignor

Consignor means any person, organization or government that prepares a consignment for transport.

Exposure device (container)

Radiographic exposure devices are used to remotely project the radiation source to a predetermined exposure position when required and to securely maintain it and shield it when it is not in use. Current equipment requirements require devices be designed and tested to ISO/ANSI standards and pertinent transportation regulations for transport containers. Also known as: projector, gamma ray projector (G.R.P.), camera, pill-box, source-box, exposure container.

Locked position

Describes the condition when the lock on a radiographic exposure device or transport container is fully engaged to lock the source assembly in place and the key is removed from the lock. This condition prevents unauthorized personnel access to the sealed source assembly locked within the device.

Maximum rating

The maximum activity expressed in Becquerels and curies that cannot be exceeded, of a sealed source specified by radionuclide by the manufacturer when contained within a radiographic exposure device or a transport container.

Plunger lock

A mechanical device with a key used to lock or unlock the radiographic exposure device or transport container.

Remote control

The mechanical device that enables movement of the source assembly to and from a working position by operation from a distance away from the radiographic exposure device. The remote control includes the control mechanism and the control hose for connection between the control mechanism and the exposure device.

Sealed source

Radioactive source sealed in a capsule or having a bonded cover, the capsule or cover being strong enough to prevent contact with and dispersion of the radioactive material under the conditions of use and wear for which it was designed. Commonly referred to as: the 'source' or the 'pill'.

Secured position (shielded position)

Condition of the radiographic exposure device and source assembly, when the sealed source is fully shielded and restricted to this position within the radiographic exposure device. Note: When in the secured position during radiographic operations, the radiographic exposure device may be unlocked.

Simulated source

A sealed source whose structure is such as that of the sealed radioactive source, but not containing any radioactive material. Also known as: mock source, dummy source, phantom source, dummy pill.

Source assembly

A source holder with a sealed source attached or included. In cases where the sealed source is directly attached to the control cable without the use of a source holder, the source assembly is the control cable with the sealed source attached. In cases where the sealed source is not attached to the control cable nor included within the source holder, the sealed source is the source assembly.

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Rigid or chain link type source assemblies are also known as: source rods, source pencils, source trains, source chains.

Source holder

A holder or attachment device, by means of which a sealed source or simulated source can be:

- directly included in the radiographic exposure device (category I apparatus - an exposure device in which the source assembly is not removed for exposure).
- fitted at the end of the control cable (category II apparatus - an exposure device from which the source assembly is projected out through a projection sheath to the exposure head for exposure. The exposure is remotely operated.)
- Source holders may be an integral part of the source assembly or may be capable of being dismantled for sealed source replacement.

Source changers

A lockable Type A or Type B transport container used to transport new sealed source assemblies, exchange them and return depleted sealed source assemblies to the manufacturer. Source changers are also utilized for storage of sealed source assemblies. Also known as: source exchangers, storage containers.

Working position

Condition of the exposure container and source assembly when in the position intended for the performance of industrial gamma radiography.

5. EMERGENCIES & PERSONNEL SAFETY.

5.1 Emergencies

After returning the sealed source into the stored position in the source changer, radiographers are required to perform a confirmatory survey of the source changer. Performing a confirmatory survey after a radiography source transfer is required by regulation and is the only method that the radiographer should rely on to determine if a source assembly is in the fully shielded position within the source changer. If the radiographer measures any radiation level that indicates the sealed source is not fully shielded while performing the confirmatory survey, the radiographer must first recognize that a problem exists and then follow his company's emergency procedures. Emergency conditions are those problems in which the source assembly cannot be returned to the shielded position by normal means, specifically by movement of the drive cable in the crank assembly (wind-out). The important safety points for radiographers to follow are:

- Always perform a confirmatory survey after each source transfer.
- If higher than expected radiation levels are measured, recognize that an emergency exists. (Stop and Think!).
- Follow emergency procedures.
- Do not attempt to retrieve the sealed source. Secure the area and notify the Radiation Safety Officer.

The radiography crew is limited to the following basic steps and must be adhered to under regulation:

1. Immediately leave the area and maintain continuous surveillance of high radiation area.
2. Adjust the restricted area boundary to ensure the measured dose/rate is $< 20 \mu\text{Sv/hr}$ (2 mR/hr). Do not allow anyone into the area.
3. Immediately notify the Radiation Safety Officer.
4. Do not leave the area unattended under any circumstances. Maintain security of the area until the Radiation Safety Officer arrives at the site.

Do not under any circumstances attempt to retrieve the source. Performing source retrieval is a licensed activity that allows only specially trained RSOs to respond to an emergency. This regulatory requirement is the result of overexposures to radiographers attempting to handle emergency retrievals by themselves.



WARNING



An unshielded source must not be picked up or handled at close range under any circumstances. An unshielded source at close range can cause serious injury or death to anyone who is exposed to it, even for a short duration of time.

5.2 Fires & Spills

Should the Model NE4C be involved in a fire, perform the following:

- Survey the area surrounding the source changer and set up a restricted area (or controlled area) boundary if necessary around the source changer location to limit radiation exposure to personnel.
- Immediately contact your Radiation Safety Officer, QSA Global, Inc. and your applicable regulatory agency to advise of the situation and determine what additional steps to take in response to the handling and assessing the Model NE4C source changer and radiation source.

The radioactive source used in the Model NE4C is a special form capsule that has been tested up to 800°C. The radioactive material within the source capsule is a solid and will not leak from the container similar to a liquid radioactive material spill. Performance of the semi-annual source leak test confirms the integrity of the sealed source containment.

5.3 Training

Formal classroom training in radiation safety, supervised hands-on training and certification by an independent certifying organization of radiographers are essential components for radiological safety in isotope radiography.

5.4 Access to Restricted Areas

The site where radiography and/or source changing is performed must be separated from other work areas by as much distance as possible. If applicable, check for occupation of the areas above and below the radiography site. Clearly defined boundaries must be set up and warning signs displayed to provide warning and prevent access to the radiography site by unauthorized personnel before any exposure/transfer begins.

No one should enter the boundary marking a 'Restricted Area' or 'Controlled Area' without a film badge, TLD or OSL, direct reading pocket dosimeter (or electronic pocket dosimeter) and alarm ratemeter (if required). A pocket 'chirper' alarm is required in some countries to provide radiography personnel with an immediate audible warning of high radiation intensity.

5.5 EU Regulations

A 'Controlled Area' must be marked with a barrier at a distance where the radiation intensity will not exceed 0.75 mR/hr (7.5 μ Sv/hr). The boundary dose rates must be noted and the record kept for 2 years. During radiographic operations, only classified radiation workers are allowed inside this area.

A 'Supervised Area' is defined as the area where the boundary dose rate limit must not exceed 0.25 mR/hr (2.5 μ Sv/hr). No barriers or notices are required here, but the radiographer must be vigilant to ensure that personnel in this area do not enter the 'Controlled Area'.

5.6 Personnel Monitoring

All personnel who enter a 'Restricted' or 'Controlled' area or are present during radiographic operations are required to wear the appropriate personnel monitoring devices as required by the regulatory jurisdiction. These devices can include; film badges; thermoluminescent dosimeters (TLD); optically stimulated luminescence badges (OSL); direct reading pocket dosimeters; electronic pocket dosimeters; alarm ratemeters; and audible alarms. Calibrated and operable survey meters must be used to determine radiation levels when conducting radiographic operations.

6. DISPOSITIONS & DISPOSAL.

By international regulations, radioactive materials that are no longer required must be transferred to a licensed recipient for final disposition. Iridium-192 or Selenium-75 source assemblies that have depleted beyond their useful working life may be returned to authorized recipients using a source changer authorized for the specific model source assembly.

Authorized recipients will provide any specific conditions to the shipper as required by regulatory authorities. As a minimum, sources that are transferred for a final disposition must be within a current leak test and properly secured within an authorized package before shipment.

Damaged, cropped, modified or contaminated source assemblies may require special handling and special transport containers. Notify the authorized recipient for specific instructions in these circumstances.

Depleted Uranium (DU) shielded source changers that are removed from service due to severe damage or for decommissioning reasons must be sent to a licensed recipient for final disposition. If the Type B(U) transport status of a damaged source changer is impaired, the source changer must be transported without radioactive source assemblies. DU shielded exposure devices sent for final disposition must be properly packaged, surveyed, marked and labeled before placement into the transportation system. Contact QSA Global Inc. for assistance in the transfer of DU shielded source changers for final disposition.

7. CONTACT INFORMATION.

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