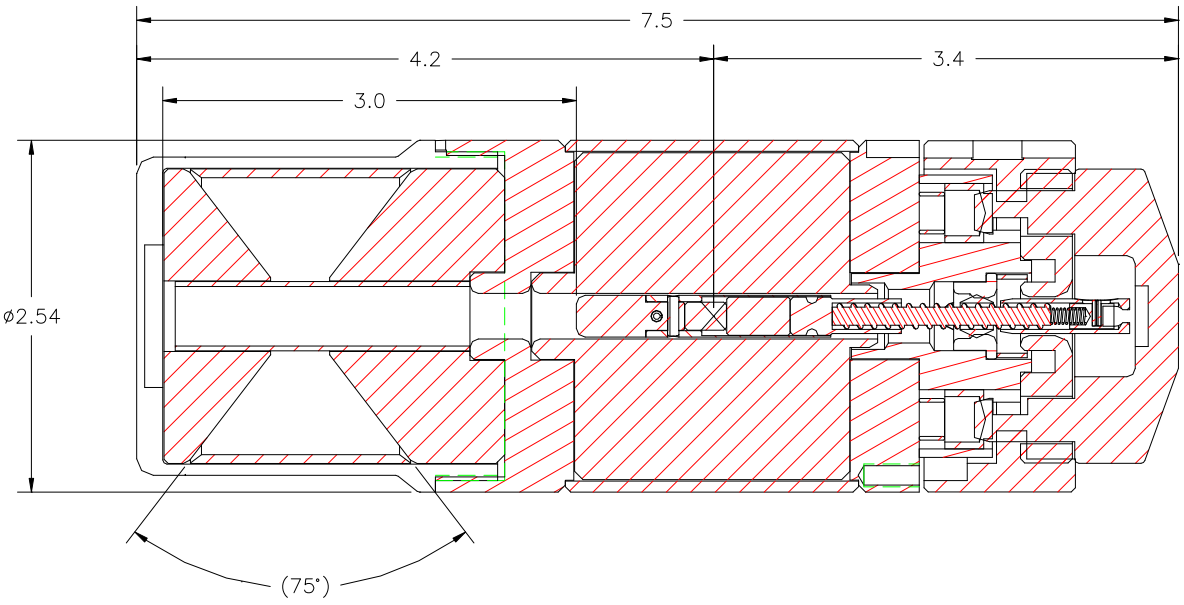
SENTINEL™

MODEL 979 RADIOGRAPHIC EXPOSURE DEVICE (FOR PIPELINE CRAWLERS) AND TYPE A TRANSPORT PACKAGE



OPERATION AND MAINTENANCE INSTRUCTION MANUAL

MAN-036
NOVEMBER 2004

AEA TECHNOLOGY QSA

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WARNING

Gamma radiography systems emit high levels of highly penetrating radiation during use.

An unshielded source at close range can cause serious ***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 hand under any circumstances.

Since gamma radiation cannot be detected by the normal human senses, strict procedures must be followed and proper use made of radiation detection instruments to avoid dangerous levels of exposure.

It is very important to prevent access by unauthorized persons to radiographic equipment and to areas where radiography is performed.

The systems must be operated only by properly trained and qualified radiographers, who have read and understand this Operating Manual, or by trained assistants working under their direct supervision.

During use of the radiographic exposure device, **never assume** the position of the radiation source. After each radiographic exposure, **always** conduct a thorough confirmatory survey using a calibrated and operable survey meter to confirm the location of the radiation source. Be reminded that a multitude of overexposure incidents which included injuries are directly attributed to a failure of the radiographer to perform or directly supervise an adequate confirmatory survey.

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

TIME:
Spend less time near the radiation source.

DISTANCE:
Increase the working distance in a direction away from the radiation source.

SHIELDING:
Use effective shielding between personnel and the radiation source.

MODEL 979

OPERATION AND MAINTENANCE

INSTRUCTION MANUAL

NOTICE

The Model 979 radiographic exposure device (gamma crawler head) is used in conjunction with a gamma radiography crawler. The Model 979 gamma crawler head, independent of the crawler device, is also part of a Type A shipping package for AEA Technology QSA, Inc. sealed sources. ***The user should become thoroughly familiar with this instruction manual before attempting operation of the equipment.***

Users of this equipment must comply with the regulatory requirements, licensing and transportation regulations as they apply in their respective countries.

This device is intended for use ONLY with the ELE025 actuator, or an actuator system which meets operational and safety requirement as outlined in this manual and as approved under a specific license. For additional information or assistance regarding use of the Model 979 gamma radiography crawler head, contact AEA Technology QSA, Inc at the addresses shown below:

AEA Technology QSA, Inc
40 North Avenue
Burlington, MA 01803

USA and International: (781) 272-2000

Or

AEA Technology QSA, Inc
6765 Langley Drive
Baton Rouge, LA 70809

USA: (800) 225-1383
International: (225) 751-5893

SECTION I
GENERAL INFORMATION

A. General description and application

The AEA Technology QSA, Inc. Model 979 gamma radiography crawler head is used in conjunction with a gamma radiography crawler (intra-tubular self-propelled vehicle) to perform panoramic radiography of circumferential welds and the adjacent heat effected areas on pipelines. During radiographic operations the Model 979 containing a Selenium-75 source with a maximum of 12.0 Curies (444 GBq) is attached to the crawler and is centered within the bore of the pipeline to be inspected. The Model 979 is designed to be used on crawlers that can be inserted into pipelines with an inner diameter of 3 inches (7.62cm) or greater. During radiographic operations the source assembly is exposed by an electro-mechanical actuator on the crawler which pushes the source assembly from a shielded position to a beam port within the Model 979 (see figure 1). The beam port is collimated to restrict the emergent beam to 360 degrees with a variable width of 5-90 degrees depending on the outer diameter of the pipe being inspected. The source assembly is retracted to the fully shielded position by the crawler's electro-mechanical actuator.

The Model 979 is specifically designed for use with gamma radiography crawlers only. It is not designed to be used or authorized for radiography using conventional remote controls commonly used on crank-out type radiography systems.

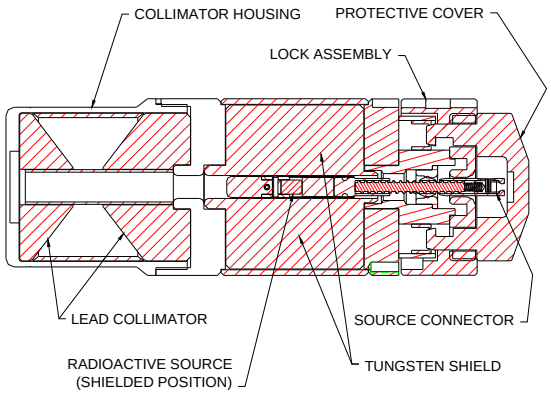
The basic radiography system consists of the Model 979 Radiography Crawler Gamma Head and either a ELE025 actuator or another customer provided (crawler specific) actuator, which meets all of the operational and safety requirements outlined in this manual. The Model 979 crawler head is supplied with a stainless steel, key-lockable storage cover (see figure 2). This storage cover in conjunction with a shipping container makes up the Type A Transport package.

The Model 979 crawler head is designed to be used with up to a maximum of 12.0 curies (444 GBq) of Selenium-75 to perform industrial radiography. Other radioisotopes cannot be used in the Model 979 gamma radiography head.

B. System Safety

The Model 979 in it's transport packaging is designed to comply with the requirements for Type A packaging in accordance with International Atomic Energy Agency Safety Standard Series No.TS-R-1 (1996 Edition Revised) and the US Regulations contained in the USNRC 10 CFR 71 and USDOT 49 CFR 173. The Model 979 was designed using the applicable specifications of ISO 3999, Part 2, Draft for Category X devices.

Figure 1



KEY ELEMENTS OF THE MODEL 979 CRAWLER HEAD

The Model 979 was designed using the applicable specifications of ISO 3999, Part 2, Draft for Category X devices. The Model 979 complies with ISO 3999:2000(E) requirements, except for the following:

- 5.4.1.2: Operation of the automatic securing mechanism
- 5.4.2: Secured Position Indicator
- 5.7.1: Remote Control Security - Control Cable Stop
- 5.7.3: Remote Control Security – Control Mechanism Movement Marking and Electromagnetic Compatibility
- 8: Source identification tag including activity in Ci's and Becquerels. (Curies are provided).

Partial compliance with the requirements in ISO 3999:2000(E) is allowed for this device since it is classified as Category X.

C. Model 979 crawler head, stainless steel storage cover and shipping container.

1. Model 979 Radiographic Exposure Device

The Crawler Head in its key-lockable storage cover (see Figure 2) and a shipping container (Pelican case) serves as the storage and transport packaging for the radioactive source. The Crawler Head consists of a stainless steel housing which contains a tungsten shield. When the source is in it's proper shielded storage position in the exposure device, the shielding properties of the tungsten reduce radiation intensities on the surface of the Model 979 to measurable radiation levels within the regulatory limits. The key-lockable storage cover containing the Model 979 crawler head is placed in the shipping container (a lockable Pelican case). The three items constitutes the Type A transport package.

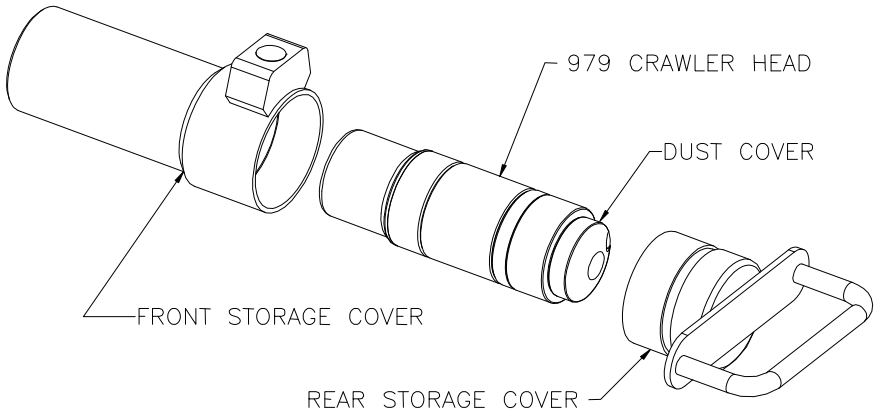


Figure 2

Crawler Head with stainless steel storage cover.
("Pelican Case" shipping container is not shown)

The radioactive source assembly attaches to the actuator at the rear of device. Once the selector ring on the crawler head is rotated into "operate" position, the crawler's electro-mechanical actuator can expose the source assembly forward (approximately 3.0 inches, 7.6 mm) into the beam port position within the Model 979 crawler head. In the exposed position, the emergent beam will be restricted to the collimation as manufactured.

The Model 979 is approved to be used with a variety of lead collimator configurations. The lead collimation must be installed by AEA Technology QSA, Inc. or one of it's authorized service centers. A Model 979 with a 360 degree X 75 degree collimated beam port is shown below as a reference (figure 3).

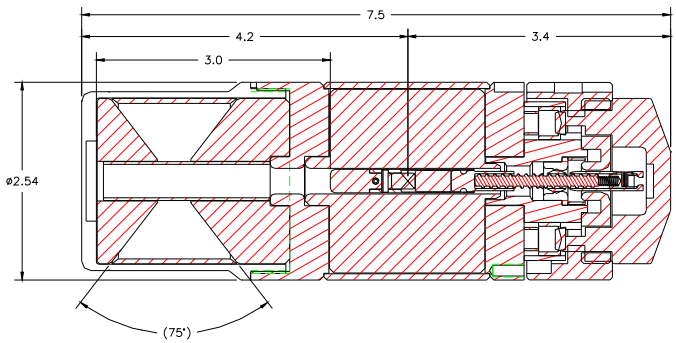


Figure 3

Cross-sectional view of the Crawler Head, with source assembly in the stored position.

2. Model 979 Crawler Head Actuator requirements

If the ELE025 actuator is not used with the Model 979, then the end user of this product will be responsible for providing an appropriate actuator for this device and obtaining applicable approval from State or USNRC regulators under their license. Figure 4 shows an example of an actuator, which can be used with the Model 979 crawler head. The actuator used must be designed and tested with the following safety features:

1. Safety connector assembly must meet AEA Technology QSA, Inc. dimensional and material requirements. The information is considered proprietary and will only be released to companies that apply to Regulatory Authorities to use gamma crawlers.

2. The actuator's safety connector assembly must be designed so that it's components are within AEA Technology, QSA, Inc.'s design specifications to prevent attachment to the Model 979 lock mechanism unless a secure connection is accomplished between the drive cable extension (or rod) connector and the source assembly connector.

3. The actuator can be mechanical or electrical/automated. In case of electrical/automated actuator, the radioactive source assembly must default into the fully shielded position if the device loses power or an operational signal.

4. The electrical/automated actuator must have self-contained energy storage/back-up system to return it into safe position. Such a backup can be mechanical (i.e. spring) or electrical (i.e. batteries).

5. The actuator must have a visible, external indicator that the source is in the fully shielded position.

6. The actuator must have a provision for a manual return of the source into a fully shielded position in the case where the primary and backup provisions do not retract the source into the shielded position.

7. The actuator must allow for the drive cable (or rod) to extend (approximately 1.5-2.0 in, outside of actuator) in order to connect to the source assembly. This extension can be accomplished by a mechanical or electrical means.

8. The actuator must provide at least 3 inches of travel.

9. The actuator must be able to achieve a minimal force of at least 0.22 lbs (3 times the weight of the source assembly) and a maximum force of no more than 100 lbs.

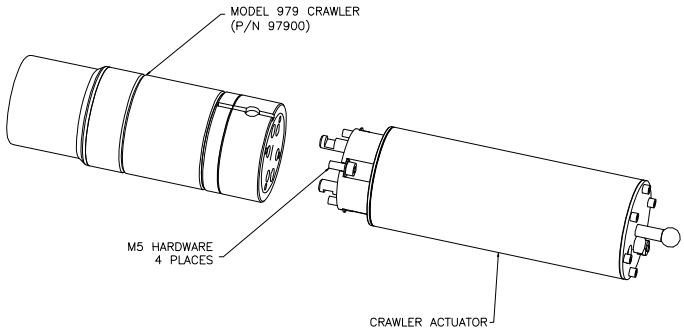


Figure 4

Crawler Head and Sample Actuator assembly

3. Radioactive Source Assembly

The Model 979 Exposure Device is used in conjunction with AEA Technology QSA, Inc. Model 97941 Source Assembly. This source assembly contains an AEA Technology QSA, Inc. X540/1 source capsule. The Se-75 source capsule and the source assembly are specifically designed for the Model 979 exposure device and may only be reloaded by AEA Technology QSA, Inc. or it's authorized service centers.

The Model 97941 Source Assembly is designed to be re-usable. To accomplish this task, it is held together by two, non-reusable, roll-pins oriented 90 degrees to each other (See figure 5).

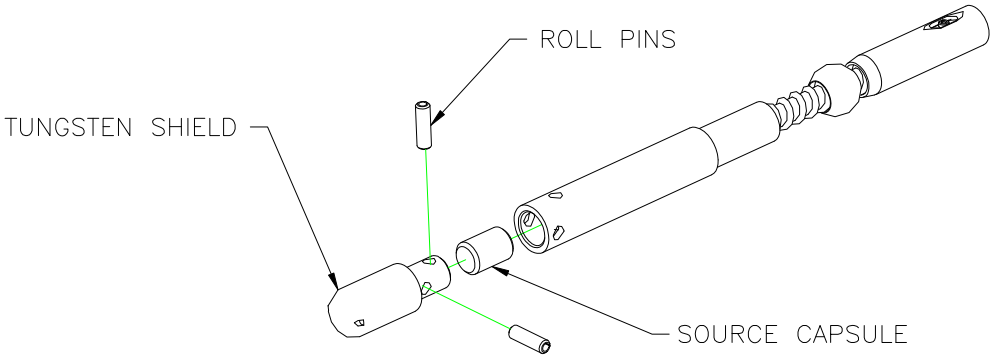


Figure 5

Each source capsule is seal welded and meets the requirements of Special Form radioactive material in accordance with IAEA Safety Series TS-R- 1 (1996 Edition Revised)

Additionally, the sealed sources have been designed and tested to comply with the requirements of International Standard ISO 2919 (1980) and American National Standard N542 (1977) and have achieved an ANSI/ISO classification of C63344. The source assembly meets the design and testing requirements of ISO3999-2000(E) and ANSI N432-1980.

The Model 979 must only be used with an AEA Technology QSA, Inc Model 97941 source assembly containing a Model X540/1 with a maximum of 12.0 Curies (444 GBq) of Selenium-75. Selenium-75 sources of lesser activity are available.

The source assembly and sealed source capsule in the Model 979 may only be changed by AEA Technology QSA, Inc. or one of it's authorized service centers. Source changing of this device requires the use of a shielded cell and specially designed tools. Therefore, all devices must be returned to AEA Technology QSA, Inc. or one of it's authorized service centers for source replacement and/or for source disposition. While empty, annual servicing and changes to the lead collimation can be performed on the Model 979 crawler head.

D. Model 979 exposure device specifications

Device manufacturer:
AEA Technology QSA, Inc.
40 North Avenue
Burlington, Massachusetts 01803

Primary application:
Industrial gamma radiography in conjunction with intra-tubular self-propelled crawlers.

Model number:
Model 979 exposure device (crawler head)

Length:
7.5 inches (19.5cms) without storage cover and shipping container
Diameter:
2.54 inches (6.5cm) without storage cover and shipping container
Mass:
9.6 to 13.9 pounds (4.4 to 5.9 kg) depending on lead collimation in beam port.
Shielding:
5.8 pounds (2.6 kg) of tungsten (plus 3.8 to 8.1 pounds (1.7 to 3.7 kg) of lead for the collimator).

Construction:
Tungsten shielding is encased in a welded tubular stainless steel shell. The beam port contains lead to shape the emergent primary beam when the source assembly is in the exposure mode. The shell is partially sealed to prevent the ingress of mud, sand, moisture and liquids during use. The exposure device should not be submerged in liquids during use.

Maximum capacity of exposure device:
12.0 Curies (444 GBq) of Selenium-75 as special form.

Source assembly Model number:
Designed for AEA Technology, QSA, Inc. Model 97941

Sealed source capsule:
Designed for X540/1 only

Certifications:
Special form: USA/0502/S
Device in storage cover and overpack meets requires for a Type A transport packages under IAEA TS-R-1(1996), USNRC 10CFR71, USDOT 49CFR173 and was designed to meet the applicable specifications of ISO 3999, Part 2 Draft for Category X devices.

Inspection requirements:
A daily inspection of the device for obvious defects is required. Complete annual servicing is available during source reloading at the manufacturer.

Operating temperature range:
-40 degrees F to 300 degrees F (-40 C to 149 degrees C)

Actuator for Model 979:
The Model 979 crawler head is compatible for use with the ELE025 actuator or other compatible and approved mechanical or electro-mechanical actuators. The actuators are gamma crawler specific and are specified by the end user.

SECTION II
PERSONNEL MONITORING

Pursuant to Radiation Safety regulations, all personnel who enter a restricted area or are present during radiographic operations are required to wear a direct reading pocket dosimeter with a range of 0 to 2 mSv (0-200 mRem) and either a film badge or thermoluminescent dosimeter (TLD). Additional dosimetry and or alarming rate meters may be required under specific regulations. Check with the applicable Regulatory Authority to ensure all required personnel monitoring are used during radiographic operations.

In the event that a person's pocket dosimeter is found to be off scale, that person must stop all work with radiation immediately. His/her film badge (or TLD) must be sent in immediately for processing, and he/she must not re-enter a restricted area until it has been determined that he/she received less than the maximum allowed occupational exposure as defined in the local regulations.

Radiography personnel should also have a calibrated and operable radiation survey meter capable of measuring from .02 mSv/hr to at least 10 mSv/hr (2 mR/hr to 1 R/hr) to determine radiation levels when performing radiographic operations. (In Canada, the survey meter must be capable of measuring from 0.02 mSv/hr to at least 100 mSv/hr (2 mR/hr to 10 R/hr).

SECTION III
ACCESS TO CONTROLLED AREAS

A "Controlled Area" will be required where instantaneous dose rates could exceed 7.5 µSv/hr. (0.75 mR/hr). A particular room or building may be designed, or an area marked out. Entry to the "Controlled Area" must be restricted to classified persons, unless under a written scheme of work. The boundary of this area must be suitably labeled. Signs must be used to the standard of the Safety Signs Regulations, 1980, BS3510 and BS5378. Boundary dose rates must be noted and records kept for three years. In Canada, requirements for controlling access to areas surrounding radiographic exposure operations are described in Part VI, Section 18 of the Atomic Energy Control Regulations. In the USA, boundaries for the High Radiation area and Restricted area must be identified and secured according to the regulations of 10CFR20 and 10CFR34 or Agreement State regulations.

A. Receiving Radioactive Material

The consignee of a package of radioactive material must make arrangements to receive the package when it is delivered. If the package is to be picked up at the carrier's terminal, this should be done expeditiously upon notification of its arrival.

Upon receipt of the Model 979, inspect the package for signs of external damage and confirm that the tamper-indicating seal has not been broken. If damage is evident, the carrier's agent should be present while unpacking. Survey the package and ensure radiation levels at the surface do not exceed 2 mSv/hr (200 mR/hr) or 100 μSv/hr (10 mR/hr) at 1 meter (40 in) from the surface. If the radiation levels exceed either of these two limits, the package should be secured in a Restricted Area and the appropriate personnel notified.

Document radioactive material receipts in accordance with the applicable Regulatory Authority's requirements and/or your radioactive materials license.

B. Shipment of Radioactive Material

The Model 979 device in the lockable storage cover and "Pelican" shipping case meets the requirements for a Type A shipping package under the regulations of the U.S. Nuclear Regulatory Commission, the U.S. Department of Transportation and the International Atomic Energy Agency.

1. Shipment of Radioactive Source

1.1 Prior to shipment verify that the package and its contents meet the following requirements:

a. The contents are authorized for use in the package.

b. The package is in good physical condition for transport.

c. All locks are properly engaged and seal wired where required.

d. All conditions of the Type A documentation are met.

1.2 Verify that the source is locked into place in its proper storage position. Perform a survey, then verify the selector ring is in the "lock" position with the protective cover (dust cap) installed. The device is then loaded into the storage cover. Ensure the key operated lock is engaged and the key is removed. Place the Model 979 securely in the shipping/storage case. Attach a tamper indicating seal with an identification mark to the shipping case.

1.3 If the shipping case is to be packaged in a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transport. The device should be put in the outer package with sufficient blocking to prevent shifting during transportation.

1.4 Perform a radioactive contamination wipe test of the outer shipping package. This consists of rubbing filter paper or other absorbent material, using heavy finger pressure, over an area of 300 cm^2 (46 in^2) of the package surface. The activity should not exceed 0.4 Bq/cm^2 (0.0001 $\mu Ci/cm^2$) of removable contamination. If the activity exceeds this amount, contact AEA Technology QSA, Inc for guidance on shipment of the package.

1.5 Survey the exterior surface of the shipping case with a survey meter and assure that the maximum radiation level does not exceed 2 mSv/hr (200 mR/hr) at the surface or 100 µSv/hr (10 mR/hr) at 1 meter (40 inches) from the surface to determine the proper radioactive shipping labels to be applied to the package. If radiation levels above 2 mSv/hr (200 mR/hr) at the surface or 100 µSv/hr (10 mR/hr) at 1 meter (40 inches) from the surface are measured, the package must not be shipped. Contact AEA Technology QSA, Inc for guidance on shipment of the package.

1.6 Complete shipment of the package according to proper procedures for transporting radioactive material as established in IAEA regulations and/or other applicable regulations.

2. Shipment of an Empty Package

2.1 Perform a radioactive contamination wipe test of the outer shipping package. This consists of rubbing filter paper or other absorbent material, using heavy finger pressure, over an area of 300 cm^2 (46 in^2) of the package surface. The activity should not exceed 0.4 Bq/cm^2 (0.0001 $\mu Ci/cm^2$) of removable contamination. If the activity exceeds this amount, contact AEA Technology QSA, Inc for guidance on shipment of the package.

2.2 Survey the exterior surface of the package with a survey meter and assure that the maximum radiation level does not exceed 2 mSv/hr (200 mR/hr) at the surface or 100 µSv/hr (10 mR/hr) at 1 meter (40 inches) from the surface to determine the proper radioactive shipping labels to be applied to the package as required by IAEA regulations and/or other applicable regulations. If radiation levels above 2 mSv/hr (200 mR/hr) at the surface or 100 µSv/hr at (10 mR/hr) at 1 meter (40 inches) from the surface are measured, the package must not be shipped. Contact AEA Technology QSA, Inc for guidance on shipment of the package.

2.3 Complete shipment of the package according to proper procedures for transporting radioactive material as established in IAEA regulations and/or other applicable regulations.

C. Carrying Radioactive Material

Any vehicle that is to be used to transport radioactive material should be in good operating condition and carry a normal complement of safety equipment such as Radiation Area signs, rope, spare tire, fire extinguisher, vehicle tools and flares. Before placing the package in the vehicle and securing it against movement, the operator should ensure that the transport package is properly packaged, marked, and labeled and that the proper shipping papers are completed. The operator should survey the driver's compartment to ensure that radiation levels are below 20 µSv/hr (2 mR/hr).

D. Hand Carrying

In order to minimize radiation exposure, it is recommended that care be taken when hand carrying the unit. A direct reading pocket dosimeter and film badge or TLD should be worn on the side of the body closest to the exposure device. If more than one person is present, it is good practice to alternate the hand carrying between them to minimize radiation doses to any one individual. Likewise, no person should be permitted to sit on or lounge against the exposure device.

E. Storage

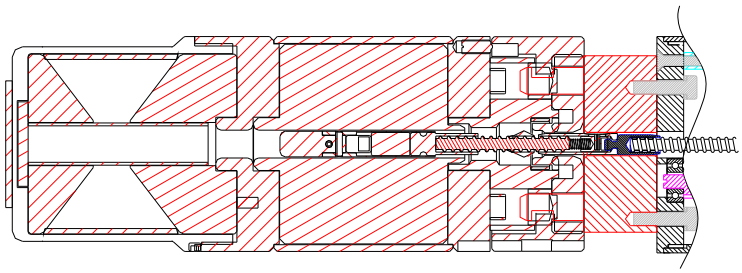
When storing the system, the exposure device must be kept physically secure to prevent tampering or removal by unauthorized personnel. The storage area must be secured such that no unauthorized personnel are allowed entrance. The exposure device must be kept locked and secured during storage.

The Model 979 must be stored in a clean and environmentally protected (dry) storage area that also provides considerations to minimize the potential danger from fire or explosion.

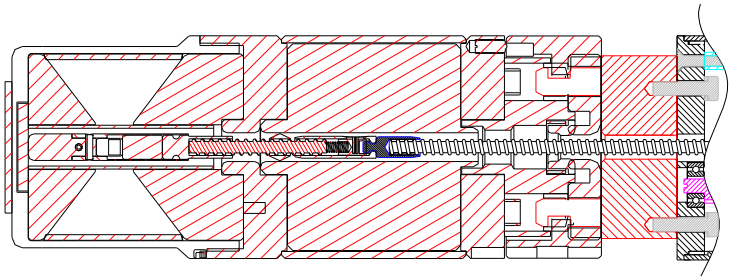
SECTION V
OPERATION

A. Principles of Operation

The source assembly, which contains the radioactive sealed source capsule, is positioned such that the sealed source capsule is located in the shielded storage position in the exposure device. This sealed source assembly is attached to the actuator. When the actuator receives a signal, it moves the source from its shielded storage position to the exposed position inside of the beam port of the Model 979 crawler head. The emergent beam will depend on the actual collimation of the crawler head's beam port. The radioactive sealed source assembly never leaves the exposure device during operation.



Stored Position



Exposed Position

B. Safety Precautions

This system may be operated only by personnel properly authorized under a license issued by the responsible Regulatory Authority. Operating personnel must be physically present and in direct surveillance of the controlled areas whenever the exposure device is being used.

Since the source emits high levels of radiation, it is good practice to operate the system from as great a distance as practicable, and, if possible, from behind a radiation shield such as a heavy steel or concrete object or the corner of a building.

Radiography must only be performed in areas which are properly controlled and marked as specified by the applicable regulatory requirements. While assembling the system it is important to keep the exposure device locked at all times except when operating.

C. Daily Inspection

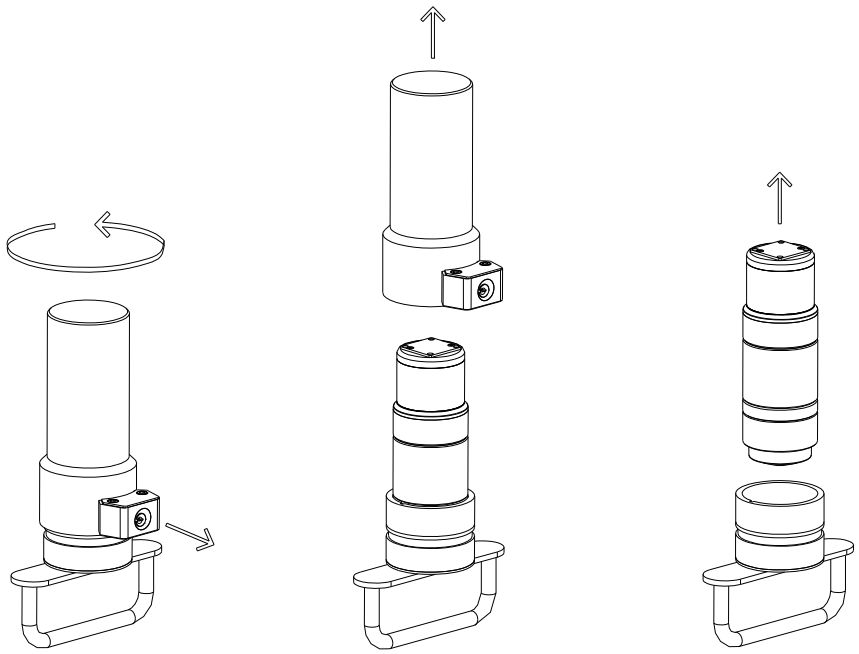
Daily inspection of the system is required to ensure the equipment is in the proper operating condition. The inspection should be performed prior to the start of each shift.

1. Check the operation of the survey meter and check to assure that the source is properly stored by measuring the radiation intensity at the surface of the device. This radiation level should not exceed 2 mSv/hr (200 mR/hr) even when the device is loaded to the maximum capacity.

2. Before the first radiographic exposure, perform a visual inspection of the device to ensure all fastening hardware on the locking mechanism are present and secure. Verify the device's engraved warning is clean and legible. Verify the source identification tag is present and is legible. Remove the protective cover and perform the no-go gauge checks of the source assembly connector according to the instructions described in "assembly before use". If operation is difficult or unusual during a test operation of the crawler (see Operation Section, part 2), return the source to the stored position. Perform a radiation survey of the equipment and secure the equipment according to the "disassembly after use" instructions. The system must be serviced before further operation.

D. Assembly before use

1. To remove the Model 979 Crawler Head from it's storage cover:
   a. Hold the rear cover (with handle) with the threads in an upward position.
   b. Unlock the storage cover's plunger lock. Unscrew the front storage cover (with lock assembly) while in an upright position.
   c. Lift the Model 979 crawler head out from the rear cover (with handle).
   d. Perform a survey on the crawler head to ensure the radiation level is less than 2mSv/hr (200mR/hr) on the surface.



Sequence for removal of the Model 979 crawler head from the storage cover

2. Remove the protective cover from the lock mechanism by rotating the selector ring from the “lock” position to the “connect” position. The connector end of the source assembly should protrude by approximately 0.4 inches (10mm) out of the lock.
3. Use the Model 550 no-go gauge on the source assembly and actuator connectors to verify the connectors are not worn or damaged.
4. Attach the drive cable (or rod) connector (part of the actuator) to the source assembly connector and perform the final no-go gauge check.
5. Draw the crawler head and the crawler head actuator together, aligning the two prongs on the actuator to the holes in the crawler head lock assembly.
6. Once the two are together, rotate the lock selector ring from “connect” to “lock”, which will mechanically link the two units together. **DO NOT** rotate the lock selector ring to “operate”!
7. Fit the four M5 screws to secure the crawler actuator to the crawler head. This provides an additional mechanical interlock between the two components.

E. Operation

1. Operation will depend on the overall actuator/controller system. For actuators other than the ELE025, refer to the actuator manufacturer instructions. For the ELE025 actuator, preset the exposure time prior to sending the controller assembly into the pipe. Refer to the controller unit manufacturer instructions for unit operation.

2. Insert the crawler system into the open end of the pipeline and restrict the immediate area to perform a test exposure. Rotate the lock mechanism selector ring from “lock” position to the “operate” position. Within the first several meters of the open end of the pipeline, perform operational checks of the start/stop/backup function of the crawler. While the area is under restricted access and with all personnel away from the crawler’s position, activate a complete exposure/time/retract cycle of the radiation source to ensure proper function of the entire crawler system. If any operational issues are found during this check, the deficiencies must be corrected prior to using the system for production radiography.

3. An advance work crew can set up the anticipated “Restricted” and High Radiation” areas forward of the crawler while it’s down line in the working position. The radiography crew must maintain direct surveillance of the “High Radiation” area and control access to the “Restricted Area” in the area where the crawler is in the exposure mode.

F. Disassembly after use

1. Survey the external surfaces of the device to assure that the radiation levels do not exceed 2 mSv/hr (200 mR/hr). Perform a survey at one meter from the external surfaces of the device to assure that the radiation levels do not exceed 100 µSv/hr (10 mR/hr).

2. Make sure that the source is in the fully stored position (actuator must have an indicator) and rotate the selector ring to the “lock” position.

3. Remove the four M5 screws which secure Crawler Actuator to the Crawler Head.

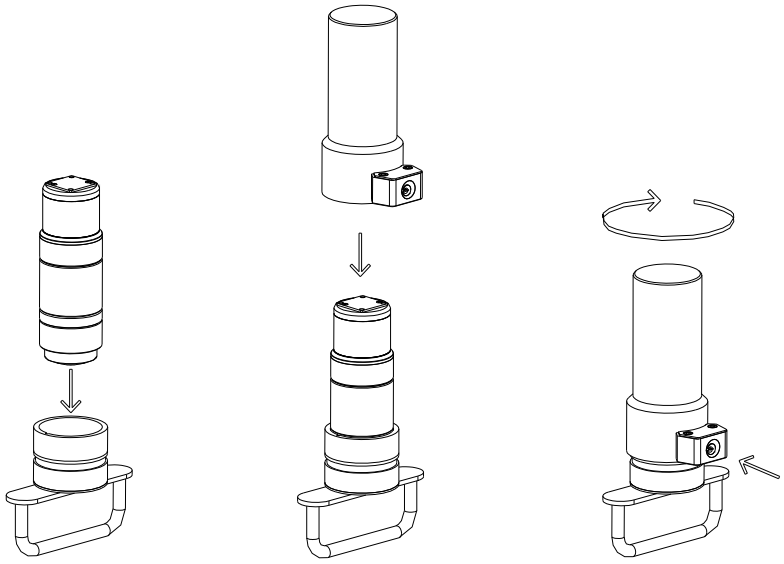
4. Rotate the lock mechanism selector ring to the “connect” position from the “lock” position.

5. Separate the crawler head actuator and the Model 979 crawler head by approximately 1.5 inches (3.8 cm).

6. Detach the drive cable (or rod) connector from the sealed source assembly connector.

7. Install the protective dust cover and rotate the lock selector ring into “lock” position.

8. Place the locked crawler head into its storage cover in the following sequence;
   a. Hold the rear cover (with handle) with the threads in an upward position.
   b. Place the crawler head (lock mechanism side) into the rear cover and index.
   c. Screw the front cover onto the rear cover while being held in the upward position.
   d. Engage the plunger lock and remove the key.
   e. Place the locked storage cover containing the Model 979 into the Pelican shipping container and secure with a padlock.



Sequence to install the Model 979 crawler head into the storage cover

G. Emergency Response Procedure

These immediate actions should be taken to protect personnel by establishing and maintaining a restricted area around the radiation device allowing time to perform Emergency Response Actions in a controlled manner. Any of the following conditions warrant implementation of the Emergency Response Procedures:

- Inability to return the source to the fully shielded position within the device.
- Damage to the device shielding creating elevated dose rates around the device.
- A failure of any component that's critical to the safe operation of the device.

During performance of emergency response actions, the Radiation Safety Officer or their alternate must maintain control of the affected area.

Actions to be Performed

1. **Stop and Think**: Recognize an emergency situation exists. Attempt to reduce external dose rates by adding supplemental shielding (e.g., lead, concrete block, steel, etc) around the elevated dose rate areas of the device.

2. **Re-Establish the Restricted Area Boundaries**: Survey the area and re-establish, or adjust as necessary, the restricted area boundaries. Maintain control of radiation areas to ensure no unauthorized personnel can gain access to the device or restricted area.

3. **Notify AEA Technology QSA, Inc and the Responsible Regulatory Authority**: Advise of the situation, giving as much detail as possible and obtain advice on further actions to take to return conditions to normal. Information should include identification of the equipment involved, the cause of the incident, actions taken to establish a safe condition, doses to all personnel involved and corrective actions taken to prevent recurrence (if known at the time).

SECTION VI
SOURCE CHANGING

The sealed source and source assembly and lead collimators contained in the Model 979 crawler head may only be changed by AEA Technology QSA, Inc. or one of it's authorized service centers. Source changing of this device requires the use of a shielded cell and specially designed tools.

Therefore, the Model 979 crawler heads must be returned to AEA Technology QSA, Inc. or one of it's authorized service centers for source replacement. During this source replacement, the device can be inspected as part of it's annual inspection if this service is requested by the customer.

SECTION VII
MAINTENANCE REQUIREMENTS

Radiographic exposure device and associated equipment must be maintained regularly by trained and qualified personnel to ensure consistent and safe operation of the radiographic system. Routine inspection and maintenance also ensures the integrity and compliance of the exposure device as part of a Type A transport package.

The recommended inspection and maintenance requirements are based on the system's design, application, materials, anticipated work cycles, environmental factors of use under normal and abnormal conditions of industrial radiography and while in the transport system. A program of systematic maintenance will prolong the working life of the radiographic exposure device and associated equipment in addition to ensuring safety during use. By most national regulations, routine maintenance of the systems is required at intervals not to exceed 3 months in addition to the radiographer's daily inspections for obvious defects. The complete annual servicing ensures the integrity of the system.

Maintenance program administrators must recognize the need for maintenance intervals that are less than the required annual interval especially in cases where the systems are used in severe environmental conditions. Maintenance program administrators must ensure the systems are completely serviced immediately after certain jobs in severe conditions. Extreme or severe conditions may include, but is not limited to:

- Conditions where the equipment was immersed in water or mud.
- Subjected to high-concentrations of particulate such as fly ash or sand.
- Subjected to hot radiography conditions.
- Subjected to salt-water conditions, caustic or acidic materials.
- Subjected to accidental drops or falling objects.
- Whenever subjected to extreme environmental conditions.

QUARTERLY MAINTENANCE REQUIREMENTS

A. Quarterly Maintenance by user

1. Survey the external surfaces of the device to assure that the radiation levels do not exceed 2 mSv/hr (200 mR/hr).

2. Clean and inspect the exterior of the device for obvious damage. Report any defect that may impair its safe operation and withdraw it from service until repairs can be made. If a defect is found during the inspection, use a status indicator, such as a tag or label, to prevent inadvertent use.

3. Check that the "Caution or Danger, Radioactive Material" warning information engraved on the outer shell is legible. Do not cover the warning with any other labels. Verify the source identification is present and legible.

4. Check the plunger lock on the storage cover to ensure it locks the crawler head when the key is removed. The lock must function to prevent access or operation by unauthorized personnel.

5. Inspect the lock mechanism for loose or missing fastening hardware. Also grasp the lock mechanism and attempt to move it side to side and up and down to determine if the lock mechanism is loose.

6. Use the Model 550 no-go gauge on the source assembly connector to verify the female connector is not worn or damaged. Actuate the movable sleeve on the source assembly connector to verify it moves freely and does not stick in the connect position.

7. Perform a misconnect test of the actuator and drive cable (or rod) connector and lock mechanism and source assembly connector. **Do not** connect the actuator drive cable (or rod) connector to the source assembly connector. Attempt to engage the actuator to the device lock mechanism and rotate from the "connect" position to the "lock" position.

   WARNING: Do not rotate the selector ring beyond "lock" during this test. If rotated beyond the "lock" position, there is a risk of losing control of the radioactive source assembly.

If the misconnect can be made, remove the equipment from service until repairs have corrected the problem.

NOTE: When the Model 979 crawler head is returned to the manufacturer for source reloading it can receive an optional formal servicing. The servicing should be done at least annually if used under normal operating conditions.

B. ANNUAL MAINTENANCE REQUIREMENTS

The Model 979 crawler head must receive inspection and maintenance at least once a year. The locking mechanism and the crawler head must be disassembled for proper cleaning, inspection and lubrication on components critical to safety and proper function. To accomplish this annual servicing on the empty crawler head or to change lead collimation within the Model 979, the source assembly must be removed and stored in a shielded cell using specially designed tools. WARNING: Never attempt to service the Model 979 crawler head when a radioactive source is in the device.

The annual maintenance of the Model 979 crawler head is limited to service by the AEA Technology QSA, Inc. or one of the authorized service centers.

SECTION VIII
LEAK TESTING

The source assembly used in the Model 979 must be leak tested for removable radioactive contamination at intervals not to exceed six months or at intervals specified by local Regulatory Authority requirements. This can be accomplished using AEA Technology QSA, Inc. Model 518 Leak Test Kit or equivalent test kit.

This test must be performed in a properly secured Controlled Area. The individual performing this test should wear a direct reading pocket dosimeter and either a film badge or thermoluminescent dosimeter. The individual should also use a properly calibrated and operable radiation survey instrument.

1. Verify that the exposure device is locked. Verify that the source assembly is in the proper shielded storage position by surveying the exposure device at the surface and at 1 meter (40 inches) from the surface. The radiation levels should not exceed 2 mSv/hr (200 mR/hr) at the surface or 100 µSv/hr (10 mR/hr) at 1 meter (40 inches) from the surface when the device is loaded to its maximum capacity.

2. Dampen the wipe test swab with EDTA solution. Unlock the plunger and remove the protective dust cap. Wipe the area around the lock mechanism and sealed source connector that protrudes from the lock mechanism.

3. Place the wipe test swab in the plastic envelope.

4. Set the survey meter on its most sensitive range and determine the background radiation in a low background area. Move the wipe test swab towards the meter and observe the radiation level indication.

5. If there was no measurable increase above the background radiation level, place the plastic envelope in the mailing box and send to AEA Technology QSA, Inc. (In Canada, arrange for the wipe to be sent to AEA Technology QSA, Inc. by courier) Be sure to complete and return the identification sheet.

6. If the meter indicates an increase above the background radiation level, **DO NOT MAIL OR SEND THE WIPE TEST PATCH.** Contact AEA Technology QSA, Inc. for further instructions.

SECTION IX
INSTRUCTIONS FOR DISPOSITION

When the exposure device and/or the source have reached the end of their working life, they shall be dispositioned in a safe and proper way in accordance with applicable regulatory requirements.

Notice

This industrial radiography device is used as a special use radiographic exposure device and Type A shipping package for AEA Technology QSA, Inc. source assemblies. The user must be thoroughly familiar with this instruction manual before attempting operation and use of this equipment.

In order to use this equipment, users within the USA must be specifically licensed to do so. Applications for a license should be filed with the Materials Licensing Section of the appropriate U.S. Nuclear Regulatory Commission regional office or with the appropriate Agreement State office.

Prior to the initial use of the shipping package, the user must have in his possession a copy of the Type A test documentation, which may be obtained from AEA Technology QSA, Inc. upon request. This paragraph also applies to users from Agreement States.

Users of this equipment outside of the United States must comply with all regulatory, licensing and transportation rules and regulations as they apply in their respective countries.

SECTION IX

Warranty and Limitation of Liability

AEA Technology QSA, Inc. (herein referred to as the manufacturer) warrants its product which it manufactures and sells to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty shall not apply to any product or parts which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, abnormal conditions of operation, or use in any manner contrary to instructions.

The manufacturer's liability under such warranty shall be limited to replacing or repairing, at its option, any parts found to be defective in such respects, which are returned to the manufacturer, transportation prepaid; or at its option, to returning the purchase price thereof.

The warranty on other manufacturer's components shall be that of the original manufacturer whose warranty shall be binding.

In no event shall the manufacturer 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 the manufacturer.

AEA Technology QSA, 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 any manner other than prescribed in the U.S. Nuclear Regulatory Commission or equivalent Agreement State or permitted by any regulation of the U.S. Nuclear Regulatory Commission or State Regulation 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 and connectors, parts, and accessories manufactured by AEA Technology QSA, Inc.

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