

# ADVANCED MEDICAL SYSTEMS OPERATING PROCEDURE

## SOURCE INSTALLATION AND EXCHANGE PROCEDURES USING CATALOG 3320-3320 AR LOADING AND EXCHANGE CONTAINERS AT AUTHORIZED THIRD PARTY FACILITIES

ISP-18 Rev. 1/95

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- 1.0 PURPOSE: To provide a procedure for the safe transfer or exchange of high output Cobalt 60 sealed sources at authorized third party facilities.
- 2.0 PRECAUTIONS AND LIMITATIONS:
  - 2.1 This procedure is applicable to source transfers or exchanges performed at customer sites on a variety of Picker and AMS manufactured teletherapy/radiography equipment.
  - 2.2 This procedure requires two (2) individuals, a Class 1 Service Engineer and an assistant. The Class 1 Service Engineer has been specifically approved by the NRC to perform this procedure. The person assisting must be agreeable to the task and have received Part 19.12 training for this procedure.
  - 2.3 Sources should be exchanged only by, or in the physical presence of, persons specifically licensed by the NRC or an agreement state to perform these operations.
  - 2.4 An individual licensed to perform source exchanges may perform only those operations described in the procedures.

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Date: 1-24-95

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- 2.5 The person making the exchange is obligated to refuse to make an exchange should any condition or action present a situation wherein the exchange cannot be made within the limitations of these procedures.
  - 2.6 Prior to the commencement of the operations outlined in this procedure, the licensee for whom the exchange is being performed will relinquish control over the use of, and the keys for, the equipment and its Controlled Areas to the licensed person performing the exchange. At such time as the source has been exchanged, and it has been determined by the licensed person performing the exchange that the equipment is in safe operating condition, control of the equipment and Controlled Areas will be returned to the licensee.
  - 2.7 At certain times during this procedure (specifically during the actual source transfer), the Class 1 Service Engineer will be alone in the room. During these periods, it is important that communication between the engineer and assistant be maintained.
    - a. Visual communication may be possible by utilizing the closed circuit television equipment that is often installed in the room.
    - b. Audio communication may be possible by utilizing an intercom system.
- 3.0 INSTRUCTIONS:
- 3.1 Equipment Required
    - 3.1.1 The following equipment is either shipped with the 3320/3320AR exchange container or hand carried to the job site:
      - 1 - Audible Detector
      - 1 - Victoreen 491 (or equivalent) survey meter
      - 1 - Nuclear Associates Minimonitor II (or equivalent) survey meter
      - 2 - 200mR Pocket Dosimeters
      - 2 - 5R Pocket Dosimeters
      - 1 - Dosimeter Charger
      - 1 - Drawer "T" Handle
      - 2 - Pair Disposable Gloves
      - 1 - Pushrod Extension
      - 1 - Swivel for Pushrod Extension
      - 1 - Spring Loaded Pushrod Support

- 1 - Brass Head to Container Adapter
- 1 - Service Manual for specific unit
- 1 - Cable hoist, hand ratchet type (1/2 ton capacity minimum)
- 1 - Sling
- Generous supply of paper towels, plastic bags and masking tape
- Hand tools, as required
- Hardware, as required
- Shipping tags, labels and placards, as required

3.1.2 The following additional equipment is shipped only as needed:

- 1 - Hanger pull
- 1 - Collimator Lifting Fixture, service tools
- 1 - Head Tilting Wrench
- 1 - Head Bearing Locking Screws
- 1 - 1/2" Impact Wrench

### 3.2 Inspection and Source Exchange Container

NOTE: This procedure is to be followed once the source exchange container (SEC) has been removed from the shipping overpack.

3.2.1 Check the container for any signs of mishandling or damage.

- a. If any damage is noted, immediately check for radiation leakage and contamination as outlined in Step 3.2.2.
- b. If determined to be safe, take whatever action is necessary to repair the damage.
- c. If the damage presents a safety hazard, call the Chairman of the Isotope Committee or the Radiation Safety Officer (RSO) for advice or assistance.

3.2.2 Perform a radiation survey of the container to determine if any point reads more than ten (10) mR/hr at one (1) meter.

- a. If any point exceeds 10mR/hr at 1 meter, something is wrong.
- b. Proceed carefully to find the cause, avoiding exposure to high radiation levels.

- c. If the radiation level on the surface of the container is more than one (1) R/hr at any point, do not, under any circumstances, proceed without consulting with the Chairman of the Isotope Committee and/or the RSO.

- 3.2.3 Remove the bottom plate, the drawer cover plate and the top cover plate. Next, lift out the plug in the top cavity, wet smear the plug and replace the plug.

**CAUTION:** Keep away from the open top cavity as a highly collimated beam of radiation (10-100R/hr) is emitted when the plug is removed.

- 3.2.4 If any wet smear, after drying, indicates greater than 200 cpm above background, notify the RSO before proceeding.

- 3.2.5 Verify that the container is level and the bottom most part of the skid is between 11-3/4 inches and 12 inches above the floor.

### 3.3 Preparation of Unit for Source Exchange

- 3.3.1 Over the years, Picker and AMS have manufactured a variety of equipment involving various designs of source heads, collimators and stands, making available a large number of combinations. Refer to the appropriate manual for the unit being worked on. This procedure will deal with the handling of individual components.

- 3.3.2 Lock source shutter mechanism (shutter wheel) in the "beam off" position. See appropriate unit manual for locking instructions.

- 3.3.3 Remove the collimator (performing wet smear checks as indicated).

**CAUTION:** Removing a collimator creates an imbalance in the unit. Take precautions as outlined in the appropriate unit manual.

a. 3313 Series

This collimator weighs about 500 pounds. It should be maneuvered onto a soft pad on the floor or onto a "dolly" capable of handling the weight. The dust shield is part of the machine head, so no preliminary contamination check is necessary before removing.

b. 3347 Series

Take a wet smear of the periphery of the collimator bearing ring before removing. This collimator can be installed or removed in either one piece (200 lbs.) or in two pieces (100 lbs. each).

c. 3706 Series and 183435 Collimator

The collimator (but not the collimator bearing ring) may be removed before contamination check is made.

Perform a wet smear contamination check of the periphery of the collimator bearing ring before removing.

3.4 Prepare Machine Heads

3.4.1 Model #581, #581A, #581B Heads.

- a. After collimator removal, pierce a small hole in the port dust shield through which a cotton swab stick can pass.
- b. Take a wet smear contamination check.
- c. Remove the dust shield and lead port block.
- d. Insert the proper "head to source exchange container" adapter.

3.4.2 Model #583, #583A, #583B, #590, #590A and #590B Heads.

- a. Remove "saddle" (where applicable) and take a wet smear of the exposed surface of the source wheel.
- b. Place the appropriate "head to container" adapter on the container.

3.4.3 Model #590C, D, E, F, G and 182972A Heads.

CAUTION: Radiation leakage may be several R/hr on the bottom surface of the head when the collimator bearing ring is removed.

- a. Insert the brass head-to-container adapter into the doughnut, align the center hole and secure together.
- b. Immediately after the removal of the collimator and bearing ring, mount the doughnut to the bottom of the head. This will reduce the radiation leakage greatly and help to offset the imbalance condition.

### 3.5 Maneuver Head to Mate with Source Exchange Container

3.5.1 Model C-5000 and V-2000 Vertical-Spring Counterbalance Units.

- a. Lock the yoke and head tilt movements. The stand will operate electrically and manually in the unbalanced condition.
- b. Maneuver exchange container under head and lower head electrically until it is close to mating. Manually lower head until mated.

3.5.2 Model V-3000, V-4, V-8, V-9, V-10,000 - Vertical Weight Counterbalanced Units.

- a. These units are delicately balanced and the head will rapidly rise to its upper limit if the collimator is removed without a restraining device. To prevent this rise, attach a cable hoist to the right side of the unit.



- b. Remove the shrouds from the stand and then remove one of the 1/2-13 bolts holding the side columns to the base plate.
- c. Using a longer 1/2-13 bolt, bolt the special sling provided in the kit to the column with the bolt through both loops in the ends of the sling.
- d. Electrically lower the head as far as it will go.
- e. Connect a cable hoist on the right hand side (viewing from the front) of the column between the sling and the top edge of the head support hanger.
- f. Pull up on the hoist until it is snug.
- g. The collimator may now be removed.
- h. The head may be raised and lowered to mate with the container by using the cable hoist.

3.5.3 Model C-1000, C-2000, C-3000 Rotational - Magnetic Clutch Drive Units.

- a. The magnetic clutch on the C-arm drive on these units will safely hold the C-arm in the vertical position after the collimator has been removed.
- b. Engage the magnetic clutch.
- c. Have assistant lend his weight to balance C-arm. Momentarily releasing magnetic clutch, rotate the C-arm so that the head is in the 12 o'clock position. Re-engage clutch.
- d. Attach the appropriate "Head Tilting Wrench".
- e. Remove the shroud from the left foot of the unit and attach cable hoist between left foot and C-arm behind head.
- f. Have assistant maintain head tilting wrench horizontal. Unlock head bearing ring or yoke brake, drive or lock.

- g. Take up on cable hoist lowering head to about 9 o'clock position. Maneuver container under head, insert proper adapter and mate.

3.5.4 Model C-4, C-8, C-9, C-10,000 and C-12 Rotational Chain or gear Driven Units.

- a. These units can be maneuvered electrically after the collimator has been removed. Move unit in short arcs, adjusting head each time to keep bottom surface of head horizontal. Care must be taken not to damage yoke motor during mating operation. Move slowly.
- b. Secure the head to the container.

3.5.5 Model C-10,000 Rotational - Chain or Gear Driven - Fixed Yoke.

- a. The head must be removed from this unit to mate it with the container.
- b. With the head at the 6 o'clock position, secure the yoke to hinge brackets on each side of the bed frame with chains or cable hoist. This is to keep the unit in "O" position. Using the special collimator lifting fixture and a gantry, remove the collimator and set aside on a soft pad.
- c. Take a wet smear.
- d. Mount special head lifting fixture to flat surface of head. Attach gantry hoist.
- e. Remove head mounting bolts and index pins.
- f. Lift head out of yoke and set on floor.
- g. Attach lifting ears. Remove lifting fixture. Rotate head 180 degrees so that flat side is down.
- h. Fix ears so head will not rotate. Lift head, insert proper adapter, and mate to container.



3.5.6 Cyclops Hydraulic Mobile and Jib Crane Stands.

- a. These units can be maneuvered electrically in the unbalanced (collimator off) condition.
- b. Mate head to container using proper head to container adapter.
- c. Secure the head to the container.

3.5.7 Fixed Head Rotational Magnetic Clutch Drive.

- a. Remove the stand covers from one side. The head will be at 5 o'clock or 7 o'clock during this operation. If at 5 o'clock, remove left hand covers. If at 7 o'clock, remove the right hand covers.
- b. Check the stand to floor mounting bolts for tightness. If they are not tight, the unit could tip over during this procedure.
- c. Remove shutter motor access cover from above and behind the head.
- d. Remove the transformer and the cover and disconnect it from the terminal board.
- e. Remove all the wires coming up from the slip rings to the terminal board.
- f. Remove the stainless trim covers from the back of the head and disconnect the wires from the mercury switches and distance localizer assembly.
- g. Construct a wood cradle to hold the head.
- h. Swing the head around to the 5 o'clock position and position the head in the cradle (using padding to protect paint). Set the wheels of the dolly so that it can be pulled straight out away from the stand after the head is unbolted.

- i. Place a 4,000 lb. come-along hook into the top of the C-arm access hole. The other hook of the come-along is fastened to the outside of the left toe. If the 7 o'clock position of the head allows more room for this procedure, the come-along is fastened to the right toe.
- j. Take up on the come-along until the head rests firmly in the cradle. The come-along will prevent the barrier from swinging down once the head is removed.
- k. Remove the allen screws holding the head to the ring to separate the head from the stand. When loosening the last two bolts, watch to see if the come-along tension is right. This is done by watching to see that the C-arm barrier are rigid and that the head is snug in the cradle.
- l. In addition to the bolts that hold the head to the C-arm, there are two 3/8 inch centering pins holding the head. Use two screwdrivers to separate the head and C-arm.
- m. The head is now pulled away from the C-arm. Pull from the dolly and not from the head or cradle. Pull the dolly straight out, or the motor assembly will be damaged. Move to an area out of the swing of the C-arm and barrier.
- n. Replace the fixed head mounting ring with the rotating head mounting bearing ring and remount head. The unit can now be treated as a standard C-2000 unit with rotating head.
- o. After the source exchange is completed, reverse the procedure, and remount the fixed head mounting ring.

3.6 Source Exchange Procedure Using Model 3320 AR Exchange Container

3.6.1 Perform and record a radiation leakage measurement on the surface of the top of the head. Mark the location for future reference.

3.6.2 Remove the 1/4-20 screw and square brass insert holding the bottom end of the pushrod in position. Install the pushrod extension onto the lower end of the pushrod by using a 10-32 x 1" socket head cap screw. Test for free movement of the pushrod by turning. If any binding is noticed, the screw holding the pushrod extension to pushrod is either not in far enough or is too long. The pushrod should have about 2" free vertical movement.

3.6.3 Insert the shaft of the "T" handle into the coil spring and screw this assembly all the way into the plunger, then back it out two (2) full turns. Mark the lower side of the drawer. When exchange is complete, this mark should be uppermost.

**CAUTION:** Do not loosen the drawer stop and pull out the drawer at this time, as this will greatly increase the radiation leakage above the container.

3.6.4 Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.

3.6.5 Remove the shutter lock.

3.6.6 At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

**NOTE:** The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

3.6.7 Loosen drawer stop screw.

CAUTION: Do not remove entirely.

3.6.8 Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

3.6.9 Gently push the "T" handle in as far as it will go.

3.6.10 Raise the pushrod gently until it can be felt that the source is up against the plunger tongue. Maintain this raised position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. Lower pushrod.

3.6.11 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

3.6.12 Call to assistant to electrically open the shutter of the therapy head. The timer must be set at 30 minutes or more so that the shutter will not close during the exchange.

3.6.13 Gently raise the pushrod as far as it will travel, rotate it until its pins seat in the holes of the source capsule. (The swivel may be used for this.)

NOTE: If the pushrod will not engage the source, the shutter wheel is not in proper alignment. In this event, lower the pushrod and have the assistant close the shutter. Verify that room radiation levels are safe. Have the assistant come into the room, with the control key, and position himself above the therapy head. From this position, as directed by the source exchanger, he can manually open the shutter and adjust the stop when the pushrod engages the source.

CAUTION: The assistant should be warned to keep all portions of his body above the head to container junction.

3.6.14 Keeping a firm upward pressure on the pushrod, unscrew the old source.

- a. If the old source is tight and will not unscrew with one hand pressure, place the spring loaded pushrod holder and the swivel between the pushrod and the floor.
- b. Adjust spring pressure so that it takes both hands to lift it off the floor when in place under the pushrod and swivel. This frees both hands for loosening the old source.
- c. If the source is still unmovable, a pipe wrench may be used on the pushrod.

NOTE: An impact wrench may also be utilized to break the source free. However, it should not be used to unscrew the source from the shutter.

3.6.15 After the source has been loosened, remove the pushrod holder again hold in place by hand. Unscrew source at least five (5) complete turns.

3.6.16 Turning the pushrod slightly, gently lower the pushrod to its bottom most position.

- a. If the source is completely loose and follows the pushrod down into the container, a noticeable flash of radiation will be detected by watching the gamma survey meter as the source passes the joint between the head and the container.
- b. In addition, an audible signal will be heard from the audible detector.
- c. If no "flash" is noticed, the source did not follow the pushrod down, and the operation of unscrewing and lowering should be repeated until successfully completed.

- 3.6.17 With two hands, gently push the drawer in until the scribe line is just visible.
- a. Unscrew the "T" handle two (2) full turns and release the new source from the plunger.
  - b. Lower pushrod to bottom most position (approximately 2" protruding from container).

- 3.6.18 Gently push the drawer into the innermost position. If necessary to close drawer, remove the pushrod extension.

NOTE: If pushrod pins are no longer in old source pinholes, the drawer will not close. Rotate pushrod to correct.

- a. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- b. Both sources are now safely stored in the exchange container and the radiation background should not be more than 20mR/hr at one (1) meter from the surface. Verify this with the survey meter.

- 3.6.19 Have the assistant close the shutter. Take possession of the shutter key.

- 3.6.20 Verify that the source has been removed from the head by surveying the top of the head.

- 3.6.21 If a Five Year Inspection and Preventive Maintenance is to be performed, proceed to perform the head and shutter related items at this time.

- 3.6.22 Once the head is reassembled, verify that the shutter mechanism is operating properly, then proceed to install the source.



3.6.23 Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector on this same position.

3.6.24 At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

3.6.25 Loosen drawer stop screw.

CAUTION: Do not remove entirely.

3.6.26 Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

3.6.27 Gently push the "T" handle in as far as it will go.

3.6.28 Re-install pushrod extension and raise the gently until it can be felt that the new source is up against the plunger tongue. Maintain this raised position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. Lower the pushrod and old source.

3.6.29 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

3.6.30 Rotate drawer 180 degrees in whichever direction it will turn (it will only turn in one direction). This puts the new source in the upper position.

3.6.31 Reach up with both hands and gently push drawer in until the scribed line is just visible.

3.6.32 Loosen "T" handle two (2) complete turns.

3.6.33 Raise the pushrod gently until it can be felt that the old source is up against the plunger tongue. Maintain this position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. At this point, both the old and new sources are in the drawer plunger tongue.

3.6.34 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

3.6.35 Rotate drawer 180 degrees in whichever direction it will turn (it will only turn in one direction). This returns the new source to the bottom position.

3.6.36 Again reach up with both hands and gently push drawer in until the scribed line is just visible. This places the new source over the pushrod so that it may now be removed from the drawer plunger tongue. At this point, the mark that was put on the drawer when the exchange was started should again be in the original position.

- 3.6.37      Raise the pushrod gently until it touches the source in the drawer tongue. Rotate pushrod until the pins seat.
- a.      While holding the pushrod in this position, loosen the "T" handle two (2) complete turns. The source will then be released and will follow the pushrod down when it is lowered.
  - b.      Lower the pushrod. Again tighten the "T" handle to the limit. The new source is now resting on the pushrod.
- 3.6.38      Reach up with both hands and gently pull drawer out until it stops. Do not rotate drawer 180 degrees.
- CAUTION:    If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.
- 3.6.39      Have assistant open the shutter.
- 3.6.40      The path to the shutter wheel is now clear for the new source. Gently raise the pushrod until the new source touches the shutter wheel. A flash of radiation will again be noticed on the meter as the source passes the joint between the head and the container. Maintaining a firm upward pressure, turn the pushrod in a tightening direction until the source has turned at least three and a half turns and becomes as tight as possible using one hand on the pushrod cross handle. Now lower the pushrod to the bottom most position. There should be no flash of radiation noticeable on the meter if the source is threaded in the shutter wheel.
- 3.6.41      Have assistant close the shutter. The radiation level showing on the survey meter should drop considerably when the shutter is closed.

- 3.6.42 Reach up with both hands and gently rotate the drawer 180 degrees in whichever direction it will turn. This puts the old source in the bottom position. Now push the drawer inward until the scribe line is just visible.
- 3.6.43 Lift the pushrod gently until it touches the source in the drawer tongue.
- a. While holding the pushrod in this position, loosen the "T" handle two (2) complete turns. The source will then be released and will follow the pushrod down when it is lowered.
  - b. Lower the pushrod.
- 3.6.44 Gently push the drawer into its innermost position. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- 3.6.45 Remove the 10-32 x 1" cap head screw holding the pushrod extension to the pushrod. Raise the pushrod and insert 1/4-20 hex head screw and brass block. This secures the pushrod in its shipping position.
- 3.6.46 Attach the shutter locking bar.
- 3.6.47 Take possession of shutter operating key.
- 3.6.48 Perform a radiation leakage survey at the top surface of the head as previously marked. If the sources have been properly exchanged, this reading should be higher than the original reading.
- 3.6.49 Unmate the head from the container.
- CAUTION:** Keep body as far as possible from the open top cavity. The radiation levels in this area may be 10 to 100R/hr.
- 3.6.50 Remove adapter and insert plug into the container cavity.

- 3.6.51 Reinstall collimator to head.
- 3.6.52 Perform Beam Off Head Leakage Survey using appropriate data sheet. The average leakage shall not be greater than 2mR/hr at one (1) meter from the source, with no single spot exceeding 10mR/hr.
- 3.6.53 Complete the Five Year Inspection and PM.
- 3.7 Source Exchange Procedure for 3320 and 3320B Containers

NOTE: The Model 3320 container has only one source cavity and can be used only for loading and unloading a source.

The Model 3320B container is to be used for removing or loading a single Cesium source only.

The Picker Model 3320 and 3320 AR containers are easily converted to Model 3320B containers by replacing the Cobalt pushrod with a Cesium pushrod.

- 3.7.1 Inspect shipping container as per Step 3.2.
- 3.7.2 Prepare Model 592 machine head for source transfer.
  - a. Remove beam defining device (cone) per instructions in Section 8 of Picker Manual T55-226.
  - b. Perform a wet smear contamination check of the inner most diaphragm of the "cone" holder.
  - c. Lock the head in the upright position by using the lever on the right hand trunnion (see Figure 3, Manual T55-226).
  - d. Remove the decorative covers.

- e. Remove cone holder (see Figure 8, Manual T55-266).

CAUTION: When cone holder is removed, the radiation leakage will increase in this area to as much as 300mR/hr. Do not stand or place hands unnecessarily close to this area.

- f. Perform a wet smear contamination check of exposed section of shutter wheel.
  - g. Install head to container adapter.
- 3.7.3 Remove the shipping container top cavity plug.
  - 3.7.4 Move the shipping container under the head.
  - 3.7.5 Lower the head, maneuvering the container so that the head to container adapter enters the container top cavity. Lower until firmly seated. Secure machine head to exchange container.
  - 3.7.6 Evacuate the room and turn source to "ON" position to make sure shutter works electrically. Close shutter.
  - 3.7.7 Source Removal.
    - a. Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.
    - b. Remove the shutter lock.
    - c. At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.



NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

d. Loosen drawer stop screw.

**CAUTION:** Do not remove entirely.

e. Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

**CAUTION:** If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

f. Raise pushrod until it touches shutter wheel, then lower about 1/2 inch.

g. Have assistant open the shutter and note the meter reading.

h. Raise pushrod until it touches the source.

i. Rotate until it engages the source.

j. Keeping firm upward pressure, rotate the pushrod to unscrew right hand threaded source, three and a half turns (3-1/2) or more.

k. If the old source is tight and will not unscrew with one hand pressure, place the spring loaded pushrod holder and the swivel between the pushrod and the floor.

- l. Adjust spring pressure so that it takes both hands to lift it off the floor when in place under the pushrod and swivel. This frees both hands for loosening the old source.
- m. If the source is still unmovable, a pipe wrench may be used on the pushrod.

NOTE: An impact wrench may also be utilized to break the source free. However, it should not be used to unscrew the source from the shutter.

- n. Lower pushrod and source, noting the flash of radiation, indicated by the meter, as the source passes the point between the head and the container. When the source lowers into the container, the radiation level will drop significantly. If the level does not drop, it means the source has not been removed and lowered into the container. The removal sequence should be continued until the source is in the safe position in the container.
- o. Push the drawer into the container and secure drawer stop. Check the area with a survey meter to ensure all is safe.
- p. Unmate the machine head and container and insert lead plug into the container top cavity.
- q. Check the source cavity in head for contamination.
- r. Move the container a safe distance from the work area and proceed with repairs or maintenance on the head.

3.7.8 Source installation.

- a. Remate head and container.

- b. Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.
- c. Remove the shutter lock.
- d. At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

- e. Loosen drawer stop screw.

CAUTION: Do not remove entirely.

- f. Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

- g. Have assistant open the shutter.

NOTE:

The path to the shutter wheel is now clear for the new source. Gently raise the pushrod until the new source touches the shutter wheel. A flash of radiation will again be noticed on the meter as the source passes the joint between the head and the container. Maintaining a firm upward pressure, turn the pushrod in a tightening direction until the source has turned at least three and a half turns and becomes as tight as possible using one hand on the pushrod cross handle. Now lower the pushrod to the bottom most position. There should be no flash of radiation noticeable on the meter if the source is threaded in the shutter wheel.

- h. Have assistant close the shutter. The radiation level showing on the survey meter should drop considerably when the shutter is closed.
- i. Gently push the drawer into its inner most position.
- j. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- k. Unmate the head from the container.

**CAUTION:** Keep body as far as possible from the open top cavity. The radiation levels in this area may be 10 to 100R/hr.

- l. Remove adapter.
- m. Reinstall cone assembly head.
- n. Perform Beam Off Head Leakage Survey using appropriate data sheet. The average leakage shall not be greater than 2mR/hr at one (1) meter from the source, with no single spot exceeding 10mR/hr.
- o. Complete the Five Year Inspection and PM.