

Operation Manual



Model IR100 Portable Gamma Ray Exposure System

Warning

Do NOT unpack, assemble, operate, disassemble, or carry this device unless properly utilizing the required/appropriate radiation monitoring instrumentation.

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Description

General

The Model IR100 Portable Exposure System is an improved isotope handling unit developed to provide safe storage and accurate remote positioning of industrial radiographic sources.

Designed for use with Iridium 192 sources, the System IR100 features maximum operator protection, together with unusual flexibility of application. In use, the equipment positions the radioactive source at the end of a long, flexible tube, where its 360° (panoramic) radiation pattern may be used to full advantage, either for multiple specimen work, or for circumferential exposure techniques. Positive mechanical control of the source is maintained at all times.

Sources can be safely replaced or exchanged in the field using the Models IR-50 and other Approved Source Changer.

Exposure Device

- 1.2.1 SOURCE ASSEMBLY - 100 curies of Iridium 192 are sealed inside a stainless steel capsule. The capsule is swaged onto a short length of cable. A special fitting at the end of this Source Cable serves to connect the Source Assembly to a Drive Cable.
- 1.2.2 EXPOSURE DEVICE - A stainless steel housing containing 32 pounds (nominal) of depleted uranium (U^{238}) shielding. A curved passage through the depleted uranium allows the passage and storage of the source assembly.
- 1.2.3 CONTROL CABLE CONNECTOR - A special connector on the end of the Control Cable for attaching the Control Cable Assembly to the Exposure Device.
- 1.2.4 DUST CAP - A protective cover which threads into the Camera Lock Body for storage.
- 1.2.5 DUST CAP STORAGE PLUG HOLDER - A threaded receptacle in the handle which conveniently holds the Dust Cap during operation, when the cap is not in the Camera Lock Body.
- 1.2.6 **SAFETY LATCH PLATE**
A blade that is used to capture or release the source assembly. It is located on top of the Lock Body. Up indicates capture, down indicates released.
- 1.2.7 SOURCE TUBE CONNECTOR - A built-in connector on the end of the Exposure Device for attaching the Source Tube.
- 1.2.8 SAFETY PLUG - A threaded plug which screws into the Source Tube Connector to seal the passage and prevent movement of the Source during transit.
- 1.2.9 SAFETY PLUG HOLDER - Located in the handle.

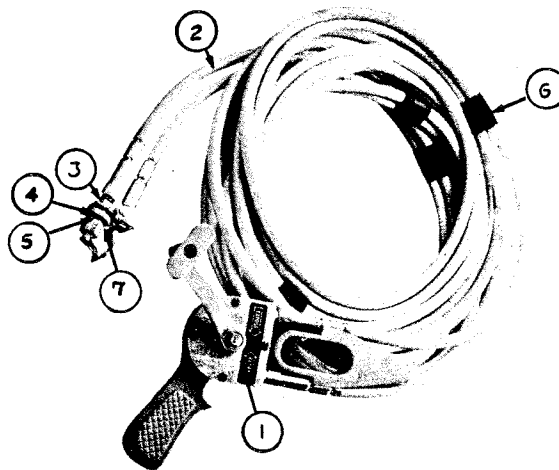
DOUBLE CHECK ALL PARTS OF DEVICE AND ACCESSORIES.

Source Tube Assembly

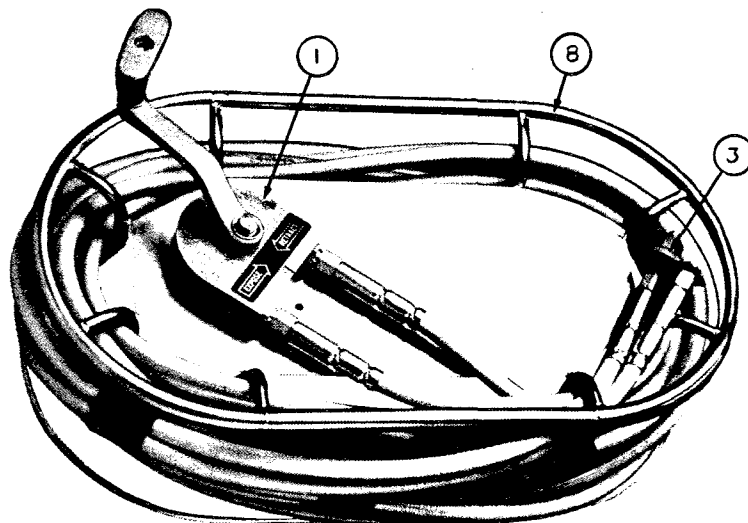
- 1.3.1 SOURCE TUBE - A flexible yellow vinyl covered metallic hose consisting of one, two, or three 7-foot sections through which the Source is moved by the Drive Cable.

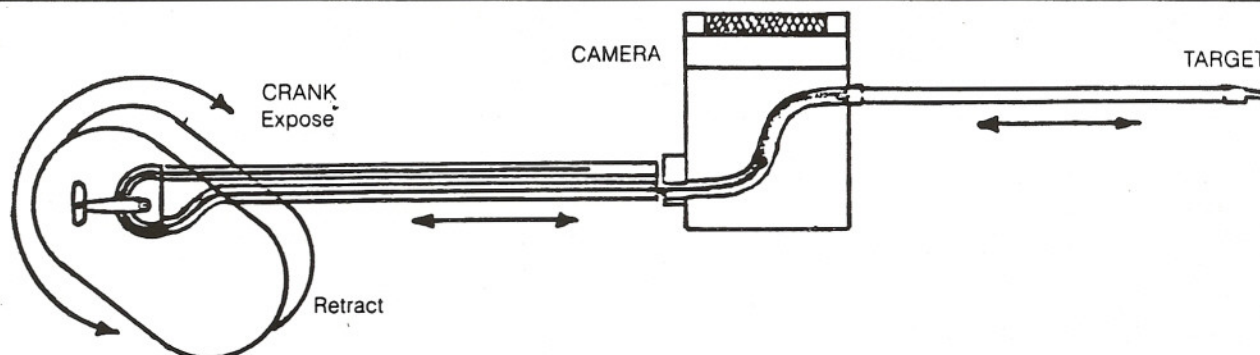
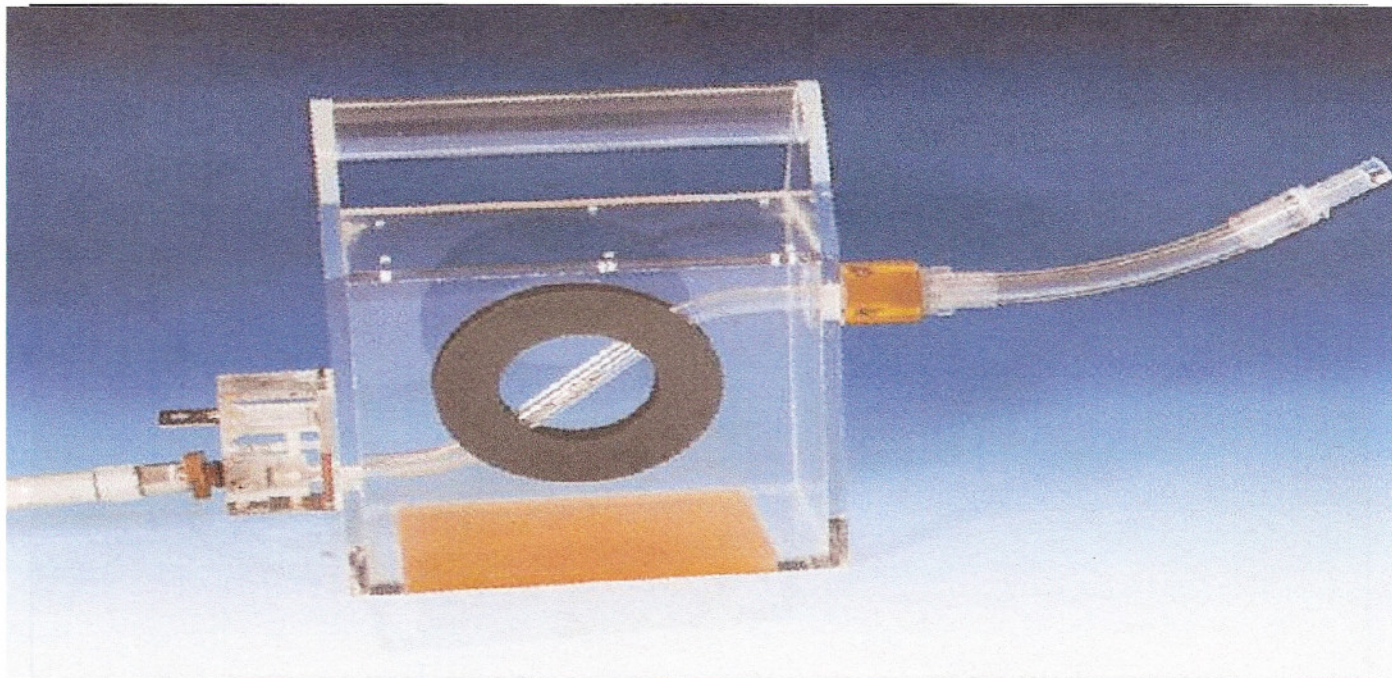
Control Assembly

- 1.4.1 CONTROL UNIT - A unit consisting of a Hand Crank assembly, provided with a Cable Reel or Pistol Grip.
- 1.4.2 HAND CRANK - A hand-operated crank on the Cable Reel or Pistol Grip which permits the operator to move the Source from the Source Shield to its exposure position and back again.
- 1.4.3 TWO DRIVE CABLE HOUSINGS - House the flexible Drive Cable which mechanically positions the Source.



1. CRANK ASSEMBLY
2. DRIVE CABLE ASSEMBLY
3. DRIVE ASSEMBLY CONNECTOR
4. DRIVE CABLE
5. SOURCE CONNECTOR
6. RETAINERS
7. CAP
8. REEL ASSEMBLY





Principles of Operation

The Hand Crank moves the Drive Cable through the Drive Cable Housings. The Drive Cable connected to the encapsulated radioactive Source Pigtail Assembly, pushes the Source from its storage position in the Exposure Device

through the Source Tube for exposure and retracts the encapsulated radioactive Source Pigtail Assembly into the storage position.

Specifications

1.6.1 SOURCE DATA

- (A) Isotope: Iridium 192.
- (B) Maximum Storage Strength: 120 curies.
- (C) System Meets all N.R.C., I.A.E.A. and A.N.S.I. requirements.

1.6.2 SIZE AND WEIGHT

- (A) Exposure Device: 10-7/8 x 4-1/4 x 9-1/4 inches.
- Camera weight, 53 pounds (nominal).

1.6.3 OPERATING SPECIFICATIONS

- (A) Maximum distance, Exposure Device Control Unit: 25 feet.
- (B) Distance, Source Shield to exposure position: 7, 14, or 21 feet.

Manufacturer Supplied Equipment and Accessorys

1.7.1 EQUIPMENT SUPPLIED

- (A) Exposure Device.
- (B) Three 7-foot Source Tube sections.
- (C) Control Unit complete with Control Cable.

1.7.2 RECOMMENDED ACCESSORY EQUIPMENT

- (A) Iridium 192 Sources (see separate list).
- (B) Survey Meter (I.N.C. Model 2 or 4); Ranges: 0-10, 0-100, 0-1000 mr/hr.
- (C) Dosimeter Range: 0-200 mr/hr.
- (D) Dosimeter Charger (available on I.N.C. meters).
- (E) Exposure Calculator.
- (F) Source Collimator.
- (G) Source Stand

Recommended Safety Precautions

General

Industrial Nuclear Exposure Devices are designed to afford the operator maximum protection from radiation. However, precautions consistent with accepted isotope handling practices must be observed at all times.

Radiation Measuring Instruments

The use of radiation measuring instruments is mandatory; any handling of exposure devices shall be monitored by proper radiation detectors. The following are required:

2.2.1 SURVEY METERS

2.2.2 FILM BADGES OR TLD's (most regulatory agencies allow either)

2.2.3 POCKET DOSIMETERS (required by most regulatory agencies)

2.2.4 ALARMING RATE METERS (required in the I.S. and soon to be required in Canada)

Working Distance

Every precaution should be taken to insure adequate distance between the exposed source and areas accessible to personnel. Surrounding areas should be surveyed - any areas in which readings are excessive should be restricted and posted. (See Code of Federal Regulation, Title 10CFR Part 20, Agreement States regulations, or Canadian AEC regulations; as applicable.) Personnel operating equipment should always work at the maximum possible distance from the source to avoid unnecessary or excessive exposure. (The exposure rate varies inversely with the square of the distance from the source.)

Exposure Time

Maximum radiation doses have been specified by the N.R.C. (See Code of Federal Regulations, Title 10, N.R.C., Part 20, agreement states regulations, or Canadian regulations.) Maximum doses, however, should be avoided wherever possible.

Shielding

Wherever possible, the Control Unit and operating personnel should be positioned behind a shield. Shielding materials commonly used to absorb or reduce radiation are concrete, iron, steel, and lead.

Tungsten collimators may also be used to absorb or reduce radiation.

Hand-Carrying

Hand-carrying should be limited to operations where absolutely necessary. Unnecessary personnel exposures can result from hand-carrying the unit close to the body or legs for periods of more than one-half hour per person per week. Anyone carrying the unit should wear a dosimeter or film badge on the part of the body nearest to the source.

Shipping

Each person authorized by specific license, issued by a cognizant regulatory agency to receive, possess, use, or transfer licensed materials, must conform to all applicable regulations.

Quality Assurance

Pursuant to 10CFR71, a licensee must establish, maintain, and execute a Quality Assurance Program for his shipping activities.

Damage

2.9.1 If damage occurs to the equipment while the source is in "Expose" position:

- (A) Secure the restricted area to a 2 mr/hr. boundary.
- (B) Follow your company's operating and emergency procedure instructions.

2.9.2 If damage occurs to the equipment while the source is in "Safe" position:

- (A) **Do not** use any damaged equipment until it has been properly repaired and tested.
- (B) All camera repairs must be made by the manufacturer.
- (C) Ship the loaded camera in its shipping container; ensuring that the source is in the "safe" position, with the safety plug and the dust cap in place; and, that the surface reading does not exceed 200 mr/hr. Use the proper labeling in accordance with the requirements of 49CFR.

Warning

Tampering with or altering of this device is prohibited and will void its warranty.

It is strongly recommended that only INC manufactured and/or approved accessories (control cables, etc.) be used with the IR100 exposure device in order to minimize the possibility of safety-related problems.

Unpacking/Warranty

Warning

Do NOT unpack, assemble, operate, disassemble or carry this device unless properly utilizing the required/ appropriate radiation monitoring instrumentation. Read Section 2, "Recommended Safety Precautions," thoroughly before proceeding.

Unpacking

The model IR100 Portable Exposure System is shipped in a metal drum; with the controls and accessories shipped in a cardboard container. Inspect all shipping containers for any external signs of damage. Open containers and remove the contents.

Remove from cardboard container:

- (A) Control Unit with attached Control Cable.
- (B) Three 7-foot Source Tube sections.

Remove from metal drum:

- (C) Exposure Device.

Examine all items for damage. Check all items against packing list.

Warranty

Industrial Nuclear Company uses reasonable precautions to insure that all merchandise is free from defects and is accurate to specifications and warrants only that its merchandise is free from defects in materials and workmanship. Industrial Nuclear Company's warranty on the materials and workmanship, employed in its equipment, extends for a period of 12 months from the date of shipment for the IR-100, and for a period of 1 month from the date of shipment for the control and source tube assemblies; but there is no warranty if such equipment is not operated and maintained in accordance with the instructions provided by Industrial Nuclear Company. Industrial Nuclear Company's liability, under the aforesaid warranty, is limited to replacing or repairing, at its own plant, such of the above defects as are reported within the applicable warranty period.

Preparation for Use

Warning

Do NOT assemble this device unless properly utilizing the required radiation monitoring instruments. Read Section 2, "Recommended Safety Precautions," thoroughly before proceeding.

Attaching Source Tube Assembly

- (A) Locate Exposure Device at desired distance (7, 14, or 21 feet) from specimens to be radiographed.
- (B) Remove Safety Plug from front of Exposure Device by cutting the seal wire and unscrewing plug from the Source Tube Connector. Discard seal wire, insert plug in handle.
- (C) Remove covering from the ends of Source Tube sections to be used, and unroll tubes to full length. Attach one section of Source Tube to Source Tube Connector. Add second or third Source Tube sections as desired, ADDING SECTION WITH ATTACHED TIP LAST. Maximum permissible length is 21 feet.
- (D) Never Operate the Exposure Device with more than three Source Tube sections attached. Do not operate if cable or tubes are damaged.

Caution

Lay out Source Tube sections as straight as possible, avoiding point supports. A bend radius less than 20 inches may restrict movement of the Drive Cable.

Attaching Control Assembly

- (A) Place Control Cable Connector End near Exposure Device.
- (B) Unreel Control Cable from Control Unit, forming cable in long loop returning crank to Exposure Device. Remove Dust Cap from Connector.
- (C) Remove Dust Cap from Lock Body and screw it in the handle.
- (D) Rotate Cable Drive Crank (expose) to reveal Drive Cable Connector.
- (E) Connect Drive Cable to Source Pigtail.
- (F) Rotate Cable Drive Crank (retract) to permit threaded connection of Drive Cable Housing to screw into Lock Body.

Caution

Lay out Control Cable as straight as possible, avoiding point supports. A bend radius less than 3 feet may restrict movement of the Drive Cable.

Operation

- (A) Turn the Hand Crank (retract) to release lock.
- (B) Rotate lock key on Exposure Device 90° clockwise.

Note: Failure to connect Drive Cable to the Source Pigtail Assembly will prevent unlocking of the device. Key cannot be removed except when Device is locked

- (C) Move Crank Assembly away from camera to the proper operating location.
- (D) Return to the device and depress the safety latch.
- (E) Turn the Hand Crank (expose) to move the Source Assembly out of the Exposure Device toward the target.

Note: The device is designed so that when the source is returned to the fully shielded position the safety latch will "pop-up", securing the source. The safety latch must be manually reset (depressed) prior to each crank-out of the Source Assembly. All surveys required by the applicable regulatory agency regulations to verify that the source is properly shielded must be performed at the appropriate times.

- (F) Turn the Hand Crank in the retract direction to return the Source Assembly from the target to the Exposure Device.

Caution

Never operate the Exposure Device with more than three Source Tube sections totaling 21' attached. Do not operate if cable or tubes are damaged.

This Device is designed to prevent accidental removal of the Source without proper connection of the Drive Cable. Verification of the connection must be performed (be retracting the Source Pigtail Assembly) before the Device can be unlocked. As a safety measure, a latching action occurs whenever the Source Assembly is fully retracted. The safety latch must be manually reset (depressed) prior to each crank-out of the Source Pigtail Assembly.

Note: The device is designed so that it can only be locked when the Source Pigtail Assembly is in the safe position in the device. Once locked, the unlocking procedure, as previously described, must be followed.

- (G) After source has been retracted to the secured position, apply forward (exposed direction) pressure on the crank assembly handle to ensure the source is secured (captured). Do not lock with Key (counter-clockwise) until source is in the fully retraced captured (shielded) position.



Lock Assembly

It is imperative that all components of the lock assembly be kept clean. No amount of dirt can be regarded as negligible. Dirt-clogged cables, tubes and connectors impede drive cable movement and cause excessive wear. Such impedence can result in a HAZARDOUS loss of source control.

Note: A dirty or "STICKING" crank or drive cable assembly can prevent the safety latch from remaining in the operate position.

Caution

In the unlikely event the safety loach pops up prior to the source assembly being captured in the safe position, simply depress the safety latch and resume cranking the source assembly into the safe position. **DO NOT**, under any circumstances, lock the device with the key until the source is captured in the safe position. If the above described condition persists and/or the safety latch cannot be depressed, **DO NOT** force the latch. Stop all attempts to correct the situation and call INC for assistance.

Disassembly

Caution

DO NOT begin disassembly until the source assembly has been completely retracted into the Exposure Device, and the required surveys of the device and source tube(s) have been completed.

(A) Secure lock.

Note: Key cannot be removed except when Device is locked.

(B) Remove Source Guide Tube(s) from Exposure Device.

(C) Replace Safety Plug. THIS SEQUENCE IS RECOMMENDED AS AN ADDITIONAL SAFEGUARD TO PREVENT ACCIDENTAL SOURCE REMOVAL.

(D) Disconnect Drive Cable Housing from camera.

(E) Disconnect Drive Cable from Source Pigtail.

(F) Replace dust cap on camera.

(G) Replace cap on Drive Cable Housing.

Maintenance

General

It is imperative that all components be kept clean. No amount of dirt can be regarded as negligible. Dirt-clogged Cables, Tubes, and Connectors impede Drive Cable movement and cause excessive wear. Such impedance can result in a hazardous loss of Source control.

Control Cable Assembly

Inspect Control Cable regularly for signs of damage. Avoid twisting or bending excessively. Recoil Control Cable carefully for storage. Avoid all contact with dirty surfaces - do not drag Cable around. Replace Control Cable Cap when not in use.

Source Tube

Inspect Source Tube regularly for signs of damage. Avoid twisting or bending excessively. Recoil Source Tube carefully for storage. Avoid all contact with dirty surfaces - do not drag tube around. Replace plastic caps on Source Tube section connectors when not in use.

Cleaning and Lubrication

See Service Memo (Section 8), "Cleaning and Lubrication of Control Cables, Drive Cables, Crank Unit, and Source Tubes".

Source Replacement

Renewal Sources are available from industrial Nuclear for replacement in the field. For instructions, see Source Changer Operation Manual.

It is recommended that when a source is to be replaced that the IR-100 be returned to INC for inspection and maintenance of the lock assembly.

Service Memo

Cleaning and Lubrication

8.1.1 DRIVE CABLE AND CRANK ASSEMBLY

- (A) Cleaning and Lubrication
 - (1) Crank Drive Cable into a clean container of solvent and agitate for a few minutes. Inspect Cable for wear and kinks. Thoroughly drain and dry.
 - (2) Disassemble Crank Assembly and clean with solvent. Inspect for bearing wear, housing wear, rust, and damaged gear teeth.
 - (3) Lightly coat drive gear with grease and reassemble unit.

8.1.2 LOCK ASSEMBLY

- (A) Cleaning
 - (1) Cleaning may be accomplished by a flushing action. Solvent may be poured around the indicator and will flow through the mechanism and bottom drain.
 - (2) Lubrication is not required.

Lock Assembly Overhaul

Note: Do NOT Attempt any disassembly of the Lock Assembly until it has been verified that the Source Pigtail has been removed from the Exposure Device.

8.2.1 LOCK ASSEMBLY

- (A) Remove Drive Cable Receiver (retainer).
 - (1) With a small Allen Wrench remove the set screws in the Lock Body.
 - (2) Remove the retainer, spring, and slide receiver.
- (B) Remove Lock Cylinder and Indicator Plate.
 - (1) With an Allen wrench remove the screw under the Lock Cylinder.
 - (2) With a long Allen wrench remove the Allen screw in the Lock Body.

Note: This screw is inside the housing, under the lock cylinder and is accessible only from below. The screw (item 10 next page) must first be removed.

- (3) The safety latch plate is spring-loaded. Hold down lightly and with the key in the lock slightly rotated, remove the Lock Cylinder Assembly.
- (4) Remove the safety latch spring, and pin.

- (C) Clean all parts except the Lock with solvent.
- (D) Inspect all components for excessive wear or damage.

8.2.2 ASSEMBLY

- (A) Install latch, spring, and pin.
 - (1) Place camera on right side to install pin, spring and safety latch plate in the Lock Body. Safety latch must be installed with color section visible. See locked position view.
- (B) Install Lock Cylinder in body.
 - (1) Lock cylinder must be installed in unlocked position with hole in bottom of cylinder down to align with Allen screw installed through bottom of lock body.
 - (2) Lock cylinder must be properly inserted in Lock Body in order for cam to engage safety latch. Excessive insertion will misalign hole with Allen screw and may inhibit safety latch plate action.
 - (3) Secure Lock cylinder with Allen screw.
 - (4) Rotate Lock cylinder to "unlocked" position and test safety latch for smooth "up and down" travel.
 - (5) Insert the slide receiver. Note that the pin projecting from the receiver slide must be aligned so as to enter the hole inside the Lock Body cavity beside the large center hole. Correct rotation may be verified by observing that the index mark on the face of the receiver is at the bottom.
 - (6) Insert the large spring in the slide receiver.
 - (7) Fully insert Drive Cable receiver/retainer into Lock Body cavity and rotate until retainer screw holes align with holes in sides of Lock Body. Insert Allen set screw in bottom of Lock Body to hold retainer.
 - (8) To test for proper assembly:
 - (a) Depress safety latch and visually observe that the latch plate opening matches the hole through the slide receiver. This is the "operate" position.
 - (b) Push Drive Cable through camera and attach dummy pig tail to Drive Cable.

Note: Test dummy pig tail is extra long to prevent full dust cap installation.
 - (c) Pull Drive Cable with dummy pig tail back (retract) through camera. At this point, the safety latch should "pop-up" to the latched position. Test for proper action by depressing latch, push dummy pig tail out and return. With latch in "up" position and dummy pig tail trapped, rotate key to lock position. Pull cable back, rotate key to unlock. Finally, to verify

for proper assembly, depression of the safety latch to the "operate" position will permit removal of the pig tail through the outlet port of the camera.

- (d) Complete insertion of Allen screws described in (7) and lock side screws with special short screws.
- (e) Replace screw under the Lock Cylinder.

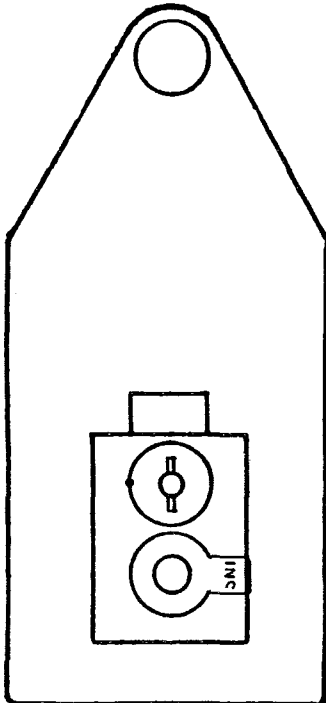
(C) Test complete system as follows:

- (1) Pull (retract) dummy pig tail.
- (2) Safety latch plate will "pop-up".
- (3) Push (expose) dummy pig tail. Dummy pig tail will not move out of camera.
- (4) Rotate key to lock position and remove. Dummy pig tail will not move out of camera. Safety latch plate cannot be depressed.

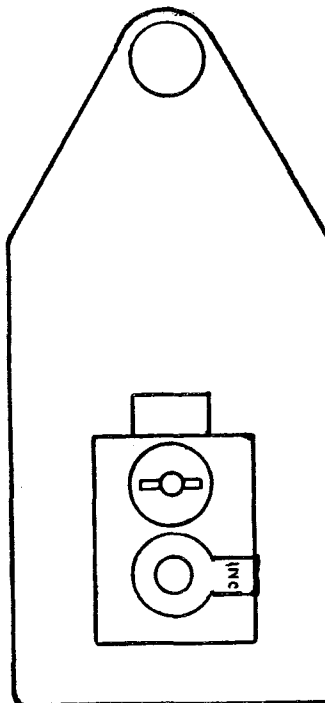
- (5) Insert key and attempt to rotate. (Do NOT force.) Key should not rotate to unlock position.
- (6) Pull (retract) dummy pig tail and rotate key to unlock position. Safety latch plate will depress slightly as key turns.
- (7) Release pull on dummy pig tail, key in unlock position. Indicator plate may now be manually depressed to "operate" position.
- (8) Rotate key to lock position. (Do NOT force.) Key should not rotate.
- (9) Remove dummy pig tail

Note: The lock must be in the "operate" mode to permit Source installation.

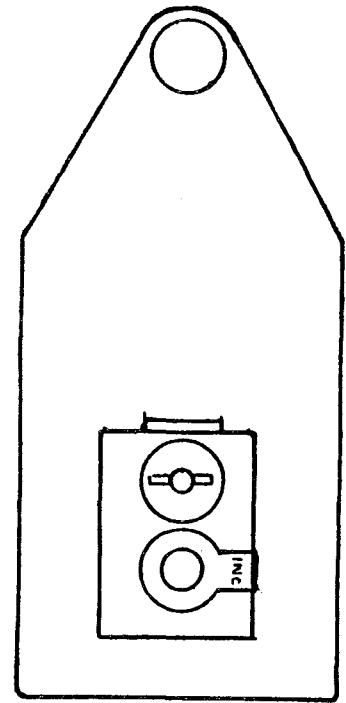
LOCKED
POSITION



UNLOCKED
POSITION



OPERATE
POSITION



1. LOCK BODY
2. LOCK CYLINDER, IR100-15
3. LOCK SET SCREW, 10-32, 3/32
4. SAFETY LATCH PLATE, IR100-13
5. SPRING
6. SPRING PIN — D36
7. KEY, D21
8. RETAINER SET SCREW, 8-32, 5/64
9. LOCKING SET SCREW, 8-32, 5/64
10. SCREW, 10-32, 3/32
11. RETAINER, IR100-18
12. SLIDE SPRING, IR100-17
13. SLIDE RECIVER, IR100-16
14. DRIVE CONNECTOR, 80A
15. DUMMY TEST PIGTAIL

