201 - 283-3264

Advanced Radiation Service

271 PLAINFIELD ROAD

EDISON, NEW JERSEY 08820

OPERATING & EMERGENCY PROCEDURES
(6-e of NRC Form 313R)

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OPERATING & EMERGENCY PROCEDURES MANUAL
(6-e of NRC Form 313 R)

For reference purposes a copy of these Operating & Emergency Procedures must be carried wherever and whenever radiographic operations are performed by the radiographers employed by Advanced Radiation Service.

The Operating & Emergency Procedures Manual contains a step by step outline of the exposure procedures and emergency procedures which must be followed and includes Technical Operations manuals for the following:

Type 533 projector
Type 660 projector
Type 680 projector
Type 771 source changer
Type 650 source changer

Also included are instructions for receiving, shipping and transporting of byproduct material.

A copy of "Working Safely in Gamma Radiography" (NUREG/ER-0024) is included, as well as a copy of the Company's NRC License and Federal Registry 10 CFR, parts 19, 20, 21, 30, 34, 40 & 71. The sections from 10 CFR, including NRC-3 Notice to Employees, can be found in the Appendix at the end of the Administrative Manual.

Advanced Radiation Service

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OPERATING & EMERGENCY PROCEDURES

I. SCOPE OF ADVANCED RADIATION SERVICE'S PROCEDURES

To assure the safe operation of all radiography at Advanced Radiation Service, each Radiographer must be thoroughly familiar with the Operating & Emergency Procedures and 10 CFR, Parts 19, 20, 21, 30, 34, 40 and 71.

II. The following definitions will be used throughout these procedures:

(a) Radiographer - an individual who performs or who, in attendance at the site where the sealed source(s) are being used, personally supervises radiographic operations and who is responsible to the licensee for assuring compliance with the requirements of the NRC's regulations and the conditions of the license.

(b) Assistant Radiographer - an individual who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools or radiation survey instruments in radiography.

(c) Radiation Safety Officer - is the man responsible for operating and maintaining overall administrative procedures as outlined in the Administrative Manual as well as having full responsibility for the strict adherence to all phases of the Operating & Emergency Procedures.

(d) Restricted Area - any area access to which is controlled by the licensee for purposes of protecting individuals from exposure to radiation and radioactive materials.

(e) Radiation Area - any area accessible to personnel in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 2 millirem.

(f) High Radiation Area - any area accessible to personnel in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

(g) Dose - the quantity of radiation absorbed per unit of mass by the body or any portion of the body.

OPERATING & EMERGENCY PROCEDURES
(Per Item 6(e) of Form 313R)

SCOPE AND DEFINITIONS (continued)

(h) Rad - is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit of mass of the tissue. One rad is the dose corresponding to the absorption of 100 ERGS per gram of tissue (one millirad (MRAD) = 0.001 RAD).

(i) Rem - is a measure of the dose of any ionizing radiation of body tissue in terms of its estimated biological effect relative to a dose of one roentgen (R) of x-rays. (One millirem (MREM) = 0.001 REM).

(j) Storage Container or Shipping Container or Source Changer - the radiation shielded device in which sealed sources may be stored, transported or used for source changing.

(k) Sealed Source - any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material.

(l) Radiographic Exposure Device - any radiation-shielded instrument containing a sealed source fastened or contained therein in which the sealed source may be moved from a shielded to an unshielded position for the purpose of radiographic exposure.

(m) Radioactive Material - any material producing Alpha rays, beta rays, Gamma rays, X-rays, neutrons or other atomic particles.

(n) Calendar Quarter - any three consecutive months.

(o) Daily - work days only.

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OPERATING & EMERGENCY PROCEDURES

III. DUTIES OF RADIOGRAPHER

i. Radiographers shall be duly trained and qualified according to the provisions of Advanced Radiation Service's Personnel Training Program as found in the Administrative Manual, Section 8.

ii. Radiographers have the authority to use only the sealed sources for which Advanced Radiation Service is licensed.

iii. If Advanced Radiation Service employs Assistant Radiographers, a Radiographer will be in attendance at all times and closely supervise all operations performed by such assistant radiographers.

iv. A Utilization Log Book shall be maintained in which the location, time and duration of every exposure will be recorded.

v. Radiation survey results including the location and time of each survey will be recorded.

vi. Records of calibration and repair of survey meters as well as records of calibration of pocket dosimeters will be maintained. Whoever performs the calibration of survey meters must send Meter Calibration Certificates to Advanced Radiation Service, and Mr. Kurtz will be responsible for maintaining these records.

vii. Film badge reports and daily pocket dosimeter readings must be maintained.

viii. Daily equipment inspections must be recorded, particularly any replacements or repairs.

ix. Quarterly maintenance of the equipment and inspection of same must be recorded.

x. The Radiographer, if he is also the Radiation Safety Officer, must provide On-the-Job Training according to Section 8 of the Administrative Manual.

xi. Quarterly inventory records must be maintained, including source changes, location of devices, changes in number or type of exposure devices.

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OPERATING & EMERGENCY PROCEDURES

III. DUTIES OF RADIOGRAPHER (con't.)

xii. Source changes for Iridium^{192} should be performed.

xiii. Transportation of sealed sources between the storage location and field sites for purposes of industrial radiography.

Advanced Radiation Service

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OPERATING & EMERGENCY PROCEDURES

IV. PERSONNEL MONITORING PROCEDURES

i. General Instructions

A film badge and pocket dosimeter must be worn by all personnel engaged in radiographic operations at Advanced Radiation Service. The same personnel monitoring equipment must also be worn by any individual who does the following:

** Enters a restricted area under such conditions that he receives a dose in excess of 25% of the applicable limits, or might receive such a dose. (See VI also).

** Enters a restricted area though under 18 years of age under such conditions that he might receive a dose in excess of 5% of the applicable limits (See VI also).

** Enters a High Radiation Area (definition on page 1).

Each film badge and pocket dosimeter is identified by the wearer's social security number and thus may be worn only by that particular person. They should be worn in a breast pocket or belt pouch.

ii. Film Badge Procedures

New film badges are issued biweekly to radiographic personnel at Advanced Radiation Service. The badges worn during the previous two week period must be given to the Radiation Safety Officer, Mr. Kurtz, to send promptly for processing to Landauer Corporation, Glenwood, Illinois.

When not in use, badges will be stored in Mr. Kurtz's office. The control badges should be stored in an area designated for them and processed with the personnel badges. The storage area should be free from measurable radiation.

Mr. Kurtz should make sure that he receives the film badge reports promptly from Landauer and should review them prior to displaying for inspection by personnel. Mr. Kurtz will inform the radiographers and other personnel of any unusually high reports.

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OPERATING & EMERGENCY PROCEDURES

IV. PERSONNEL MONITORING PROCEDURES (con't.)

iii. Pocket Dosimeter Procedures

Pocket dosimeters must be handled very carefully because they are very delicate instruments. Any suspected damage should be immediately reported to the Radiation Safety Officer.

The dosimeter must be charged to zero prior to each shift and recorded in the Dosimeter Log. The process for charging is as follows:

** Insert the dosimeter into the charging socket
** Hold the dosimeter in contact by pressing down against the spring.
** Look through the dosimeter at hairline and scale. Turn the large adjusting knob until dosimeter reads zero.
** Remove the dosimeter from the charger (Victoreen Model 2000A) and recheck hairline position by looking through the dosimeter against a source of light.

Pocket dosimeters should be checked often during a workday. If the dosimeter is discovered to not be fully discharged, the wearer should stop work immediately and notify Mr. Kurtz, who will send the wearer's film badge immediately to Landauer for processing to determine whether an overexposure has occurred. He will also check out the pocket dosimeter in the calibrator (Dosimeter Corporation of America's model 3060).

iv. Calibration of Pocket Dosimeters

To calibrate a pocket dosimeter, it must be exposed to a source of known intensity (in this case Cesium 137 using the calibrator model 3060). The radiographer must follow the directions for calibration supplied by Dosimeter Corporation of America and record the results in the log book. If the dosimeter is 20% or more inaccurate, it must be removed from service and replaced. If one is dropped, it must be recalibrated before use again. If the dosimeter cannot hold a charge or cannot discharge in the calibrator, it is probably defective and must be replaced, after noting in the log.

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OPERATING & EMERGENCY PROCEDURES

V. RADIATION SURVEYS

i. General

A radiation survey must be performed only with a calibrated survey meter to determine the boundaries of the restricted areas and to be sure that sources are properly retracted into their containers after exposures and prior to storage. Surveys should also be used to confirm that the exterior surfaces of transportation vehicles are within acceptable unrestricted limits.

ii. Operating Procedures

Advanced Radiation Service uses the following survey meters:

a) Eberline Model E 130G Survey Meter; range 0-1000 mr/hr

b) Victoreen Type 592B and/or Type 692, range 0-1000 mr/hr

Before using a survey meter, the radiographer must be sure that the meter has a current calibration sticker showing that it has been calibrated within the past 3 months. If not, it must be calibrated before it can be used again.

Check the battery strength of the survey meter by turning the selector switch to the "BAT" position. If the meter does not read within the check band, the batteries must be replaced. Radiation measurements are performed by turning the selector switch to one of the three operating ranges. After a minimum of ten seconds has elapsed, the meter readings should be recorded.

iii. Occasions for Conducting Radiation Surveys.

a) To confirm that the "Radiation Area" perimeters are properly located - by surveying during a test exposure.

b) To confirm that a source has been properly stored prior to the start of radiographic operations; to confirm proper retraction of source after each exposure and again prior to storage.

c) To confirm that the source has been properly stored in the source changer for transportation from the supplier to the user.

d) To confirm that a source has been properly transferred from the source changer to exposure device.

OPERATING & EMERGENCY PROCEDURES

V. RADIATION SURVEYS (con't.)

iii. Occasions for Conducting Radiation Surveys (con't.)

e) To determine the Transport Index of containers of materials or components to be shipped.

f) To confirm that radiation levels in the passenger compartment and three feet from the outside surfaces of vehicles used to transport licensed material are within required limits.

g) To check approximate level of contamination of leak test swabs prior to mailing.

iv. Specific Techniques

a) Proper location of the perimeter of the "Radiation Area" must be confirmed or adjusted as necessary while the source is exposed before or during the initial radiographic exposure and when the source-target configuration for an exposure is different from that of the earlier exposure.

b) Assurance that sources are properly stored within a shielded container by surveying the entire circumference of the device and the entire length of the guide tube if there is one used.

c) Surveying passenger compartments of transporting vehicles must include the entire compartment. Surveying exterior surfaces of same vehicles must include the entire periphery of the vehicle at the horizontal plane.

v. Procedures for Calibrating Survey Meters

a) When Advanced Radiation Service needs to have a survey meter calibrated, Mr. Kurtz will contact either XID or Technical Operations to do the calibrating.

b) The attached procedures for model 773 survey calibration device describe those that would be used by eith Tech Ops or XID. See 6-c in the Administrative Manual for these procedures.

Advanced Radiation Service

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OPERATING & EMERGENCY PROCEDURES

VI. RESTRICTING AND POSTING RADIOGRAPHY WORKSITES

i. "Restricted Area". Any area exposed to radiation above 2 mr/hr to which access by personnel at Advanced Radiation Service is prohibited by roping off and placarding the area. Unrestricted areas shall have maximum radiation levels of 2 mr/hr, 100 mr in any seven consecutive days, and 500 mr during a calendar year to persons continually present.

ii. "Radiation Area". Any area accessible to personnel in which radiation exists, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of five mr, or in any five consecutive days a dose in excess of 100 mr.

iii. "High Radiation Area" Any area accessible to personnel where radiation exists, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive a does over 100 mr in one hour.

iv. Determining and Posting "Radiation Areas". Prior to using the exposure device, the Radiographer shall locate the boundary of the Radiation Area. Factors used to calculate such boundaries are the source strength in curies at the time of usage, the nature and degree of collimation and other shielding. Please see chart at the end of this section. The area within this boundary shall be a "Radiation Area". The perimeter of this area shall be roped off and posted with yellow/magenta warning signs which show the standard radiation symbol reading "Caution-Radiation Area". The entire perimeter must be monitored continually.

v. Determining and Posting "High Radiation Area". After completing the above, the Radiographer shall calculate the location of the "High Radiation Area" perimeter and post warning signs which read "Caution - High Radiation Area" along this perimeter. Calculations shall be based on the location of the "Radiation Area" perimeter and the inverse square law.

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OPERATING & EMERGENCY PROCEDURES

VI. RESTRICTING AND POSTING RADIOGRAPHY WORKSITES (con't.)

vi. Controls at Exposure Site. All restricted areas shall be under constant surveillance by the Radiographer to prevent entry by unauthorized personnel. The Radiographer shall inform the guard or responsible personnel at the worksite of the anticipated duration of radiographic operations. If, for any reason, unauthorized personnel cannot be prevented from entering the Restricted Area, the source shall be retracted to its stored position immediately and further operations suspended until the area is vacated of unauthorized personnel.

vii. Testing the Restricted Area. After the perimeters described above are determined by calculation and posted, the perimeters of the Restricted Area shall be surveyed and adjusted as necessary during the first exposure.

viii. Radiation Dosage Limitations

1. Restricted Area

a) 1.25 rem per quarter calendar year to the whole body, head, trunk, active blood forming organs, lens of eyes or gonads.

b) 3.0 rem per calendar quarter to the whole body provided his accumulated lifetime occupational exposure does not exceed 5 (N-18) rem, where N is his age in years.

c) 18.75 rem per calendar quarter to the hands and forearms, feet and ankles.

d) 7.5 rem per quarter to the skin of the whole body.

NOTE: Persons 18 years old or under are further restricted to no more than 10% of the above limits.

2. Unrestricted Areas

a) Two millirem in any one hour.

b) One hundred millirem in any seven consecutive days.

c) Five hundred millirem per calendar year.

RADIATION LEVEL/DISTANCE CHART A
Iridium-192 (unshielded)

5 curies	
feet	mR/hr
1.0	29500
16.0	100
*35.0	24.1
76.8	5
121.5	2

10 curies	
feet	mR/hr
1.0	59000
24.3	100
*35.0	48.2
108.6	5
171.8	2

15 curies	
feet	mR/hr
1.0	88500
29.7	100
*35.0	72.2
133.0	5
210.4	2

20 curies	
feet	mR/hr
1.0	118000
34.4	100
*35.0	96.3
153.6	5
242.9	2

25 curies	
feet	mR/hr
1.0	147500
*35.0	120.4
38.4	100
171.7	5
271.6	2

30 curies	
feet	mR/hr
1.0	177000
*35.0	144.5
42.0	100
188.1	5
297.5	2

35 curies	
feet	mR/hr
1.0	206500
*35.0	168.6
45.4	100
203.2	5
321.3	2

40 curies	
feet	mR/hr
1.0	236000
*35.0	192.6
48.6	100
217.2	5
343.5	2

45 curies	
feet	mR/hr
1.0	265500
*35.0	216.7
51.5	100
230.4	5
364.3	2

50 curies	
feet	mR/hr
1.0	295000
*35.0	240.8
54.3	100
242.8	5
384.0	2

55 curies	
feet	mR/hr
1.0	324500
*35.0	264.7
57.0	100
254.7	5
402.8	2

60 curies	
feet	mR/hr
1.0	354000
*35.0	289.0
59.5	100
266.1	5
420.7	2

65 curies	
feet	mR/hr
1.0	383500
*35.0	313.1
61.9	100
276.9	5
437.9	2

70 curies	
feet	mR/hr
1.0	413000
*35.0	337.1
64.3	100
287.4	5
454.4	2

75 curies	
feet	mR/hr
1.0	442500
*35.0	361.2
66.5	100
297.5	5
470.4	2

80 curies	
feet	mR/hr
1.0	472000
*35.0	385.3
68.7	100
307.2	5
485.8	2

85 curies	
feet	mR/hr
1.0	501500
*35.0	409.4
70.8	100
316.7	5
500.7	2

90 curies	
feet	mR/hr
1.0	531000
*35.0	433.5
72.8	100
325.9	5
515.3	2

95 curies	
feet	mR/hr
1.0	560500
*35.0	457.5
74.9	100
334.8	5
529.4	2

100 curies	
feet	mR/hr
1.0	590000
*35.0	481.6
76.8	100
343.5	5
543.1	2

105 curies	
feet	mR/hr
1.0	619500
*35.0	505.7
78.7	100
352.0	5
556.5	2

110 curies	
feet	mR/hr
1.0	649000
*35.0	529.8
80.6	100
360.3	5
569.6	2

115 curies	
feet	mR/hr
1.0	678500
*35.0	553.9
82.4	100
368.4	5
582.4	2

120 curies	
feet	mR/hr
1.0	708000
*35.0	557.9
84.1	100
376.3	5
595.0	2

* Average cranking distance (control box to free end of guide tube)

PART 6-e

RADIATION LEVEL/DISTANCE CHART B

Cobalt-60 (unshielded)

5 curies	
feet	mR/hr
1.0	72000
26.8	100
*40.0	45
120.0	5
189.7	2

10 curies	
feet	mR/hr
1.0	144000
37.9	100
*40.0	90
169.7	5
268.3	2

20 curies	
feet	mR/hr
1.0	288000
*40.0	180
53.7	100
240.0	5
379.5	2

30 curies	
feet	mR/hr
1.0	432000
*40.0	270
65.7	100
293.9	5
464.7	2

40 curies	
feet	mR/hr
1.0	576000
*40.0	360
75.9	100
339.4	5
536.6	2

50 curies	
feet	mR/hr
1.0	720000
*40.0	450
84.5	100
379.4	5
600.0	2

60 curies	
feet	mR/hr
1.0	864000
*40.0	540
92.9	100
415.7	5
657.3	2

70 curies	
feet	mR/hr
1.0	1008000
*40.0	630
100.4	100
449.1	5
709.9	2

80 curies	
feet	mR/hr
1.0	1152000
*40.0	720
107.3	100
480.0	5
758.9	2

90 curies	
feet	mR/hr
1.0	1296000
*40.0	810
113.8	100
509.1	5
805.0	2

100 curies	
feet	mR/hr
1.0	1440000
*40.0	900
120.0	100
536.6	5
848.5	2

110 curies	
feet	mR/hr
1.0	1584000
*40.0	990
125.8	100
562.8	5
890.7	2

* Average cranking distance (control box to free end of guide tube)

OPERATION MANUAL

MODEL 533
PORTABLE GAMMA RAY PROJECTOR

Revised April 14, 1965

WARNING

Do not unpack, assemble, operate, disassemble, or carry this device except in the presence of appropriate radiation measuring instruments.

CONTENTS

ILLUSTRATIONS

1. DESCRIPTION

1.1. General

The Model 533 Portable Panoramic Gamma Ray Projector is an advanced isotope handling unit developed to provide safe storage and accurate remote positioning of industrial radiographic sources.

Designed for use with Iridium 192 sources, the Model 533 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 and visual indication of its location are maintained at all times.

Sources can be safely replaced or exchanged in the field with the Model 414 Source Changer.

1.2. Source Shield Assembly (See Figures 1 and 2.)

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 stainless steel cable. A special, spring-locked fitting at the end of this Source Cable serves to connect the Source Assembly to a Drive Cable. This connection can be broken only by a special wrench, which is included.

1.2.2. SOURCE SHIELD – an aluminum housing containing 34 pounds of depleted uranium (U^{238}) shielding. A curved passage through the shield houses the radioactive Source.

1.2.3. CONTROL CABLE CONNECTOR – a built-in locking connector on the right side of the Source Shield for attaching the Control Cable Assembly.

1.2.4. STORAGE COVER – a cover, with attached chain, which locks into the Control Cable Connector for storage.

1.2.5. STORAGE COVER HOLDER – a receptacle which conveniently holds the Storage Cover during operation, when the cover is not locked into the Control Cable Connector.

1.2.6. SELECTOR LEVER – a lever provided at the Control Cable Connector to LOCK the Storage Cover in place, to CONNECT the Control Cable, or to OPERATE the projector.

1.2.7. SOURCE TUBE CONNECTOR – a built-in connector on the left

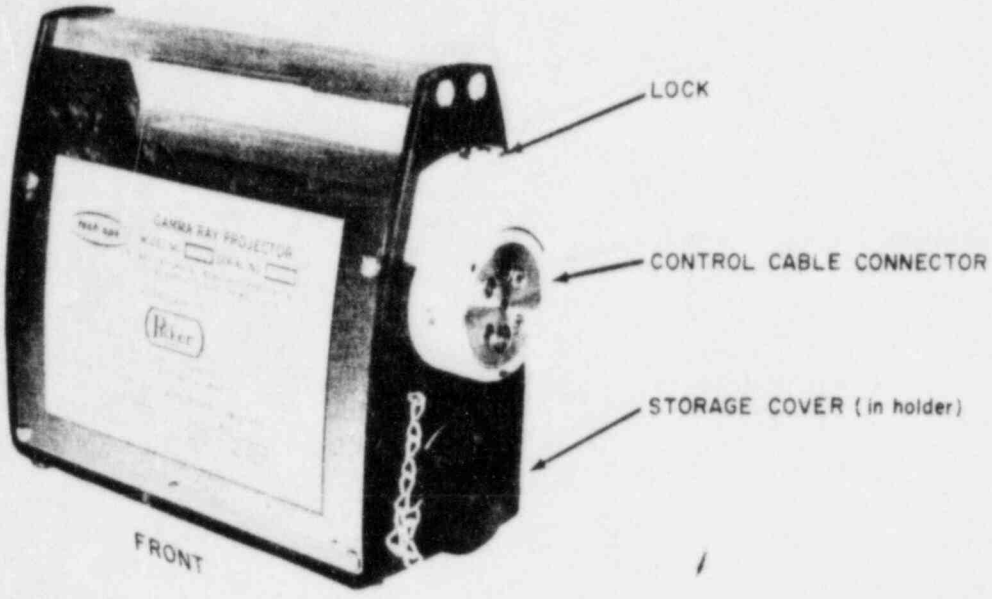


Figure 1. Source Shield, Front and Right Side

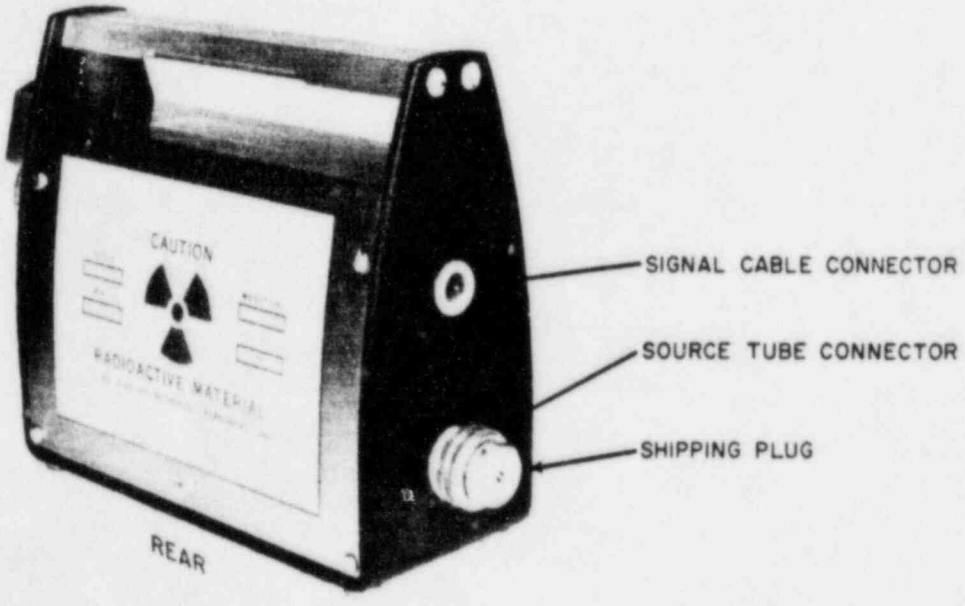


Figure 2. Source Shield, Rear and Left Side

side of the Source Shield for attaching the Source Tube.

1.2.8. SHIPPING 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. SIGNAL CABLE CONNECTOR – a built-in connector on the left side of the Source Shield for attaching the electrical Signal Cable.

1.3. Source Tube Assembly

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

1.3.2. SOURCE SWITCH - a switch connected to the end of one Source Tube section which indicates when the Source is in exposure position.

1.3.3. SIGNAL CABLE - an electrical cable in three sections parallel to the Source Tube, which connects the Source Switch to a Signal Circuit in the Control Unit.

1.4. Control Assembly (See Figure 3.)

1.4.1. CONTROL UNIT – a unit consisting of a Hand Crank assembly, Control Panel, and Signal Circuit built into a tubular cable reel.

1.4.2. HAND CRANK – a hand-operated crank on the Control Panel which permits the operator to move the Source from the Source Shield to its exposure position and back again.

1.4.3. SIGNAL LAMPS – three neon Lamps on the Control Panel which indicate Source position at all times when the unit is assembled – one Lamp is always flashing. The STORED Lamp flashes while the Source is safe in the Source Shield. The OPEN Lamp flashes while the Source is in transit through the Source Tube. The ON Lamp flashes while the Source is in the exposed position in the Source Switch. (While the unit is disassembled, the OPEN Lamp is flashing.)

1.4.4. SIGNAL CIRCUIT – a relaxation oscillator circuit housed beneath the Control Panel, which causes the Signal Lamps to flash approximately twice a second to indicate Source position.

1.4.5. CONTROL CABLE – three parallel, 25-foot sections attached to the Control Unit. An electrical Signal Cable connects the Signal Circuit to the Source position switches. Two Drive Cable Tubes house the flexible Drive Cable which mechanically positions the Source.

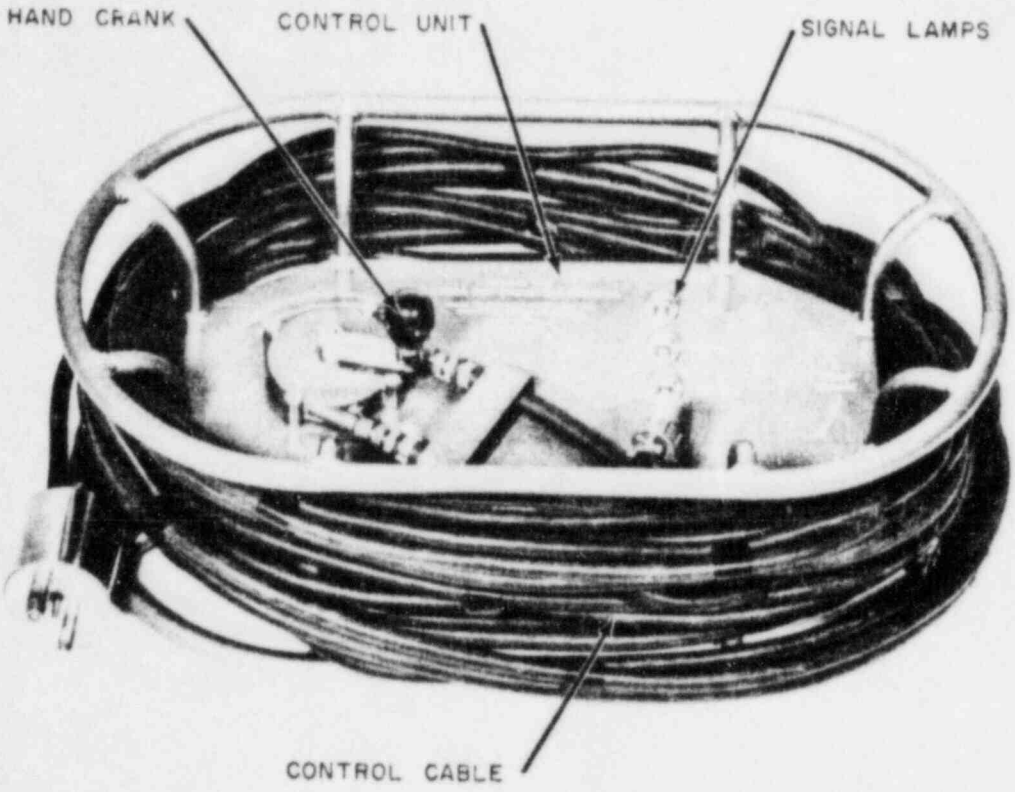


Figure 3. Control Assembly

1.5. Mounting Assembly

Fixtures are included to mount and hold the Source Switch in exact exposure position. The assembly includes a Tripod Base, Tripod Rod, Swivel Clamp, and a Source Switch Clamp.

1.6. Principles of Operation (See Figure 4.)

The Hand Crank moves the Drive Cable through the Drive Cable Tubes. The Drive Cable, locked to the encapsulated radioactive Source, pushes the Source from its storage position in the Source Shield through the Source Tube. While the Source is in transit, the OPEN Lamp on the Control Panel is flashing. When the Source reaches the end of the Source Tube, the Source Switch starts the ON Lamp flashing. The exposure time is calculated from the time the ON Lamp begins to flash. At the end of the predetermined exposure time, the Hand Crank is rotated in the RETRACT direction, causing the Drive Cable to pull the Source back into the Source Shield. When the Source is completely retracted, the STORED Lamp begins to flash.

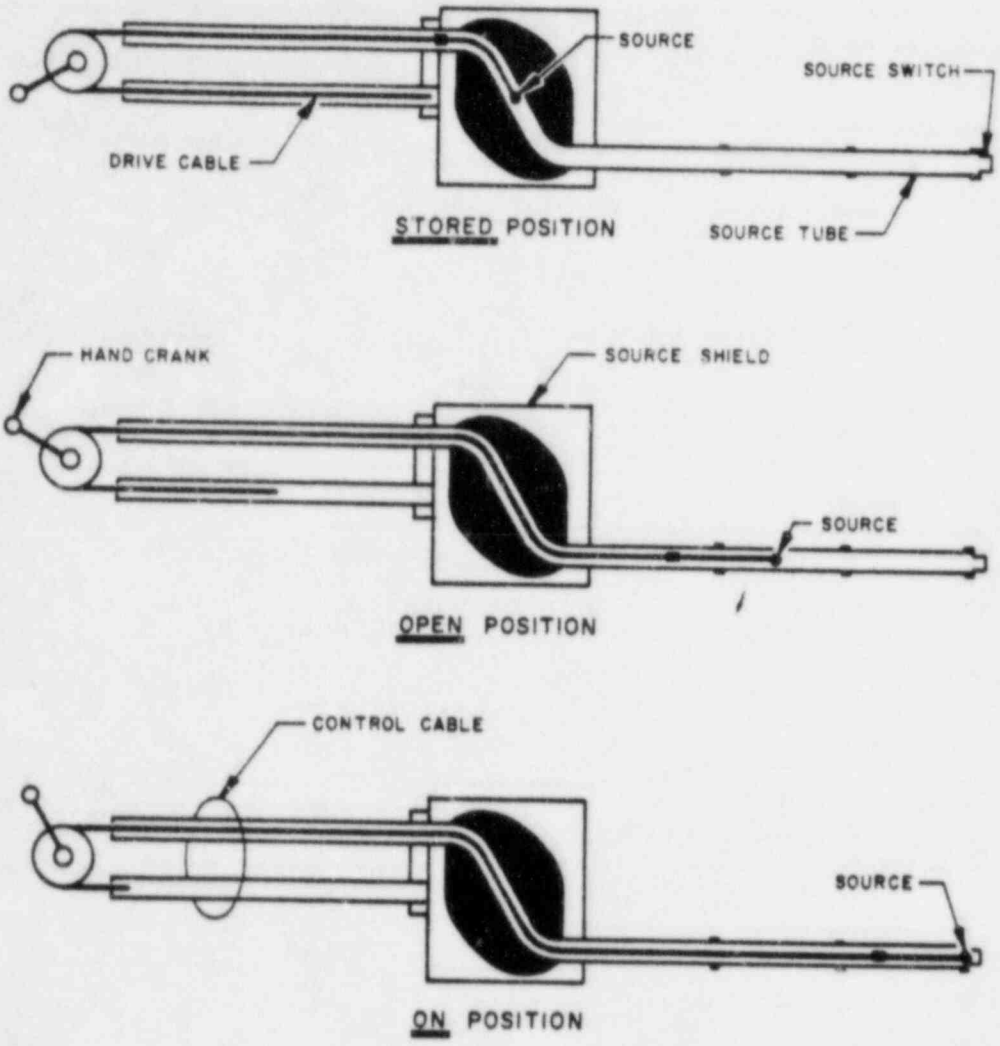


Figure 4. Mechanical Schematic

1.7. Specifications

1.7.1. SOURCE DATA

(a) Isotope: Iridium 192.

(b) Maximum Source Strength: 100 curies.

(c) Shielding: Conforms to AEC requirement, title 10 CFR part 31.101

1.7.2. SIZE AND WEIGHT

(a) Source Shield: 4 1/2 x 9 1/2 x 14 inches. Shield weight, 38 pounds, Carrying Case, 20 pounds, total, 58 pounds.

(b) Control Unit: 6 5/8 x 12 x 21 inches. Unit weight, 32 pounds, Carrying Case, 27 pounds, total, 59 pounds.

1.7.3. OPERATING SPECIFICATIONS

(a) Maximum distance, Source Shield to Control Unit: 25 feet.

(b) Distance, Source Shield to exposure position: 7, 14, or 21 feet.

(c) Source position reproducibility: ± 1/16 inch.

1.8. Equipment, Supplied and Accessory

1.8.1. EQUIPMENT SUPPLIED

(a) Source Shield.

(b) Three 7-foot Source Tube sections (Part No. A-40210).

(c) Source Switch (Part No. 40220-S with 7-foot Source Tube section.

(d) Control Unit complete with batteries and Control Cable.

1.8.2 RECOMMENDED ACCESSORY EQUIPMENT

(a) Iridium 192 Sources (see separate price list).

(b) Dose Rate Meter (Victoreen Model 592); Ranges: 0-10, 0-100, 0-1000 mr/hr.

(c) Dosimeter (Victoreen Model 541 A); Range: 0-200 mr/hr.

(d) Dosimeter Charger (Victoreen Model 561 A).

(e) Exposure Calculator (Catalog No. 534).

2. RECOMMENDED SAFETY PRECAUTIONS

2.1. General

Technical Operations' Gamma Ray Projectors are designed to afford the operator maximum protection from radiation. However, precautions consistent with accepted isotope handling practices must be observed at all times.

2.2. Radiation Measuring Instruments

The use of radiation measuring instruments is mandatory; all handling of isotope units should be monitored by proper radiation detectors. The following are recommended:

2.2.1. SURVEY METERS – Survey meters are used as a matter of routine to determine the radiation rate per unit time. Technical Operations recommends a gamma survey meter of the ionization chamber type, with a full scale range of at least 1000 mr/hr. (Geiger Counter ranges are generally too low.)

2.2.2. FILM BADGES – Personnel using or working near isotope equipment should wear film badges to provide permanent running records of the radiation dosage received.

2.2.3. POCKET DOSIMETERS – Technical Operations also recommends the use of pocket dosimeters, to allow personnel to determine the exposure received in any given period.

2.3. 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 Regulations, Title 10, Atomic Energy, Part 20.105.) Personnel operating equipment should always work at the maximum possible distance from the source. (The exposure rate varies inversely with the square of the distance from the source.) It is further recommended that personnel move away from the area while exposures are being made to avoid unnecessary or excessive dosages.

2.4. Exposure Time

Maximum radiation doses have been specified by the Atomic Energy Commission. (See Code of Federal Regulations, Title 10, Atomic Energy, Part 20.101.)

Maximum doses, however, should be avoided wherever possible. The maximum weekly dose should NEVER be received in a single exposure.

2.5. Shielding

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

2.6. Hand-Carrying

Hand-carrying should be limited to operations where absolutely necessary. Excessive 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.

2.7. Shipping

For shipment by carriers subject to control by the Interstate Commerce Commission, projectors must be crated and labelled in accordance with I. C. C. regulations. Crate must be plainly marked, "RADIOACTIVE MATERIAL" and "I. C. C. 55." Standard shipping labels, available for this purpose, are recommended.

When shipped with the contained iridium 192 the red label must be identified with "iridium 192", the number of curies contained, and radiation level on the exterior of the package.

When shipped without the contained isotope the red label must be applied and identified with "depleted uranium", 28 pounds and the radiation level on the exterior of the package.

3. UNPACKING

WARNING

Do NOT unpack this device except in the presence of appropriate radiation measuring instruments. Read Section 2, "Recommended Safety Precautions," thoroughly before proceeding.

The Model 533 Portable Gamma Ray Projector is shipped in two cardboard containers. Inspect cartons for external signs of possible damage. Open cartons and remove carrying cases. Remove from larger carrying case:

(a) Swivel Clamp

(b) Source Tube Clamp

(c) Tripod Base

(d) Tripod Rod

(e) Control Unit with attached Control Cable

Note

The neon Signal Lamp marked OPEN on the Control Panel should be flashing.

Remove from smaller carrying case:

(f) Source Shield

(g) Source Switch

(h) Three 7-foot Source Tube Sections

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

4. PREPARATION FOR USE

WARNING

Do NOT assemble this device except in the presence of appropriate radiation measuring instruments. Read Section 2, "Recommended Safety Precautions," thoroughly before proceeding.

4.1. Attaching Source Tube Assembly

(a) Locate Source Shield at desired distance (7, 14, or 21 feet) from specimens to be radiographed.

(b) Remove Shipping Plug from left side of Source Shield by cutting the seal wire and unscrewing plug from the Source Tube Connector. Discard seal wire.

(c) Remove plastic caps 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 one or two Source Tube sections as desired, adding section with attached Source Switch last.

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.

(d) Plug Signal Cable into Signal Cable Connector on Source Shield.

(e) Connect additional Signal Cable sections together.

4.2. Mounting Source Switch

(a) Place Tripod Base near specimen to be radiographed.

(b) Screw Tripod Rod into Base.

(c) Mount Swivel Clamp on Rod and adjust to desired height.

(d) Mount Source Switch Clamp on Swivel Clamp.

(e) Mount Source Switch on Source Switch Clamp, at collar.

(f) Adjust Swivel Clamp until Source Switch is in exact exposure position.

4.3. Attaching Control Assembly

(a) Place Control Cable Plug near Source Shield.

(b) Unreel Control Cable from Control Unit, carrying unit to maximum possible distance from Source Shield.

WARNING

For maximum safety, Control Unit and operator should be located behind a protective shield.

CAUTION

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

(c) Unlock Storage Cover on right side of Source Shield with key provided. Rotate Selector Lever to CONNECT position to release cover.

(d) Remove Storage Cover from Control Cable Connector and place in Storage Cover Holder.

(e) Engage the Drive Cable Terminal to the Connector by retracting the Locking Sleeve. The thumbnail or a coin may be used. Holding the Drive Cable in line with the Source Connector thus permits the ball end of the Drive Cable to be moved sideways and engaged. Release the Locking Sleeve to retain the Drive Cable Connector. Manually pull both parts of the Connector to be sure that the connection has been properly made. Insert Control Cable Plug into Control Cable Connector.

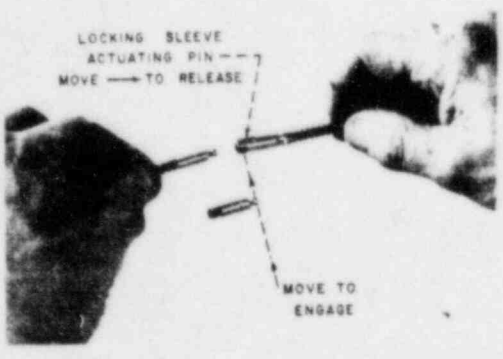


Figure 5. Engaging Connector

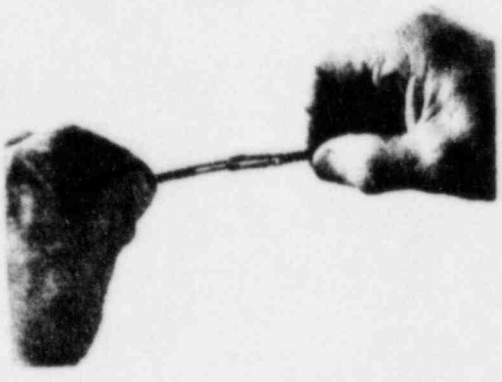


Figure 6. Connector Engaged

4.4. Checking Signal Lamps

Note

As soon as Control Cable is attached to Source Shield, the STORED Lamp on the Control Panel should begin flashing. Turn the hand crank in the retract direction (clockwise) to be sure that the Safe Light begins flashing. If the Safe Light does not flash, re-examine the Source Connector to be sure that the connection has been made properly.

Check operation of ON Lamp by pulling outward on Source Switch tip. (See Figure 7.)

WARNING

If ON Lamp does not flash when Source Switch tip is pulled out, DO NOT OPERATE PROJECTOR.

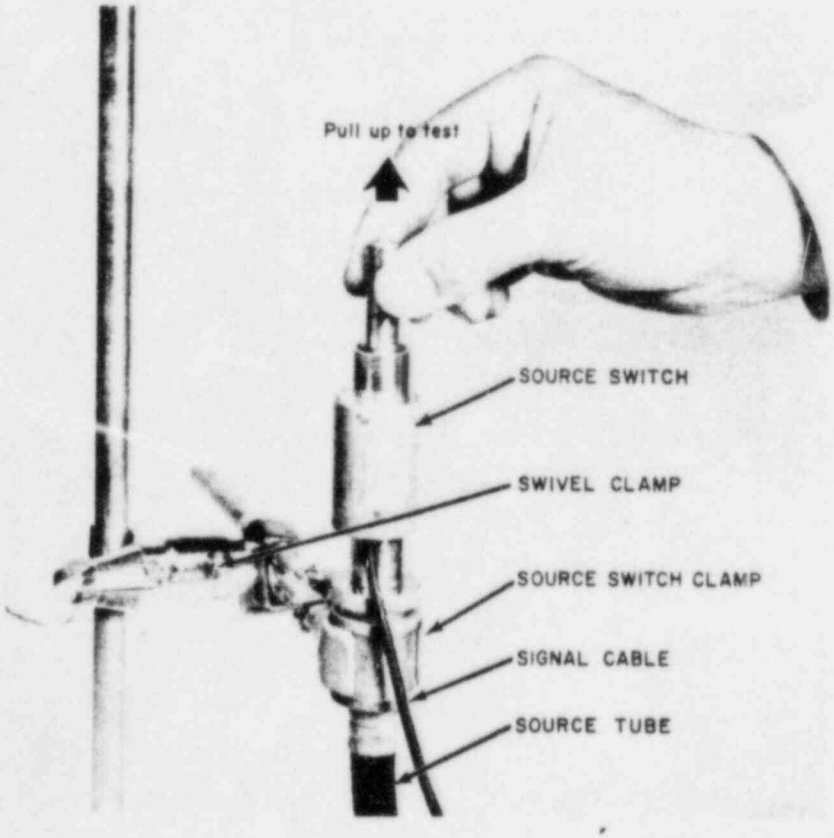


Figure 7. Checking Signal Lamps

5. OPERATION

WARNING

Do NOT operate this device except in the presence of appropriate radiation measuring instruments. Read Section 2, "Recommended Safety Precautions," thoroughly before proceeding.

(a) Rotate Selector Lever on Source Shield to OPERATE position.

(b) Turn the Hand Crank on Control Panel steadily in the EXPOSE (counter-clockwise) direction to move the Source out of the Source Shield toward the specimen.

Note

When the Source leaves the STORED position in the Source Shield, the OPEN Lamp on the Control Panel begins to flash. The OPEN Lamp continues to flash until the Source enters the tip of the Source Switch, when the ON Lamp begins to flash.

(c) If cranking becomes difficult, reverse direction until crank operates smoothly.

CAUTION

DO NOT FORCE CRANK. If after several reversals cranking is still difficult, turn Crank in the RETRACT direction until STORED Lamp begins to flash. Check Control Cable and Source Tube for excessively small bend radii.

(d) To retract the Source when exposure is completed, turn Crank in the RETRACT (clockwise) direction until STORED Lamp flashes.

WARNING

NEVER operate projector without Source Switch or with more than three Source Tube sections attached. Do NOT operate if Cables or Tubes are damaged.

6. DISASSEMBLY

WARNING

Do NOT begin disassembly until Source has been completely withdrawn into Source Shield and Signal Lamp on Control Panel indicates STORED.

(a) To disconnect Control Cable, rotate Selector Lever on Source Shield to CONNECT position. Gently pull out Control Cable Plug from Control Cable Connector until Source Cable End is exposed. (See Figure 8.)

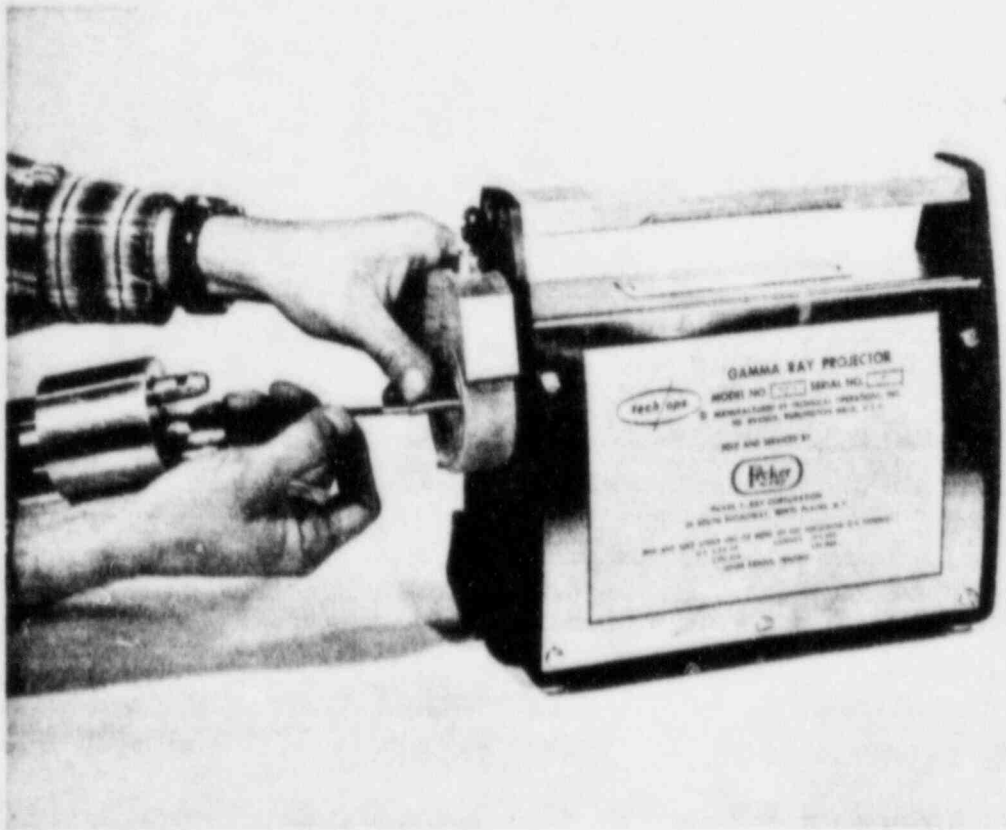


Figure 8. Disconnecting Control Cable

The Locking Sleeve must be retracted by moving the Actuating Pin in the direction shown. The thumbnail or a coin may be used. This permits the Drive Cable terminal to be moved sideways out of the hole, freeing it from the connection.

CAUTION

Do NOT twist or bend the connector. Move it sideways only! (See Figure 9.)

Figure 9. Disengaging Connector

(b) Remove Storage Cover from Storage Cover Holder and return to Control Cable Connector.

(c) Rotate Selector Lever to LOCK position.

(d) Carefully coil Control Cable around Control Unit and return to Carrying Case.

(e) Remove Source Switch from Tripod mounting and replace cloth bag.

(f) Disconnect Signal Connectors on Source Tube sections.

(g) Disconnect Source Tube sections and replace plastic caps.

(h) Disconnect Source Tube from Source Tube Connector.

(i) Replace Shipping Plug.

(j) Return Source Shield to Carrying Case and carefully coil Source Tube sections around it.

(k) Disassemble Tripod mounting fixtures for storage.

7. MAINTENANCE

7.1. 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. Such impedance can result in a hazardous loss of source control.

7.2. Control Cable

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. Re-cover Control Cable Plug when not in use.

7.3. 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 and cover Source Switch when not in use.

7.4. Signal Circuit

The Signal Circuit requires very little power. Batteries and lamps need only occasional replacement.

7.4.1. REPLACING BATTERIES

(a) Remove cover from Signal Circuit housing beneath Control Panel by removing four screws.

Note

Before removing old batteries, note carefully their relative positions and the locations of the connecting leads.

(b) Remove batteries and replace with Burgess XX45, or equivalent.

Replace cover.

WARNING

Do NOT touch battery terminals – a moderate shock hazard exists.

7.4.2. REPLACING SIGNAL LAMPS

(a) Unscrew and remove plastic globe from Lamp.

(b) Push bulb in gently, twist, and remove.

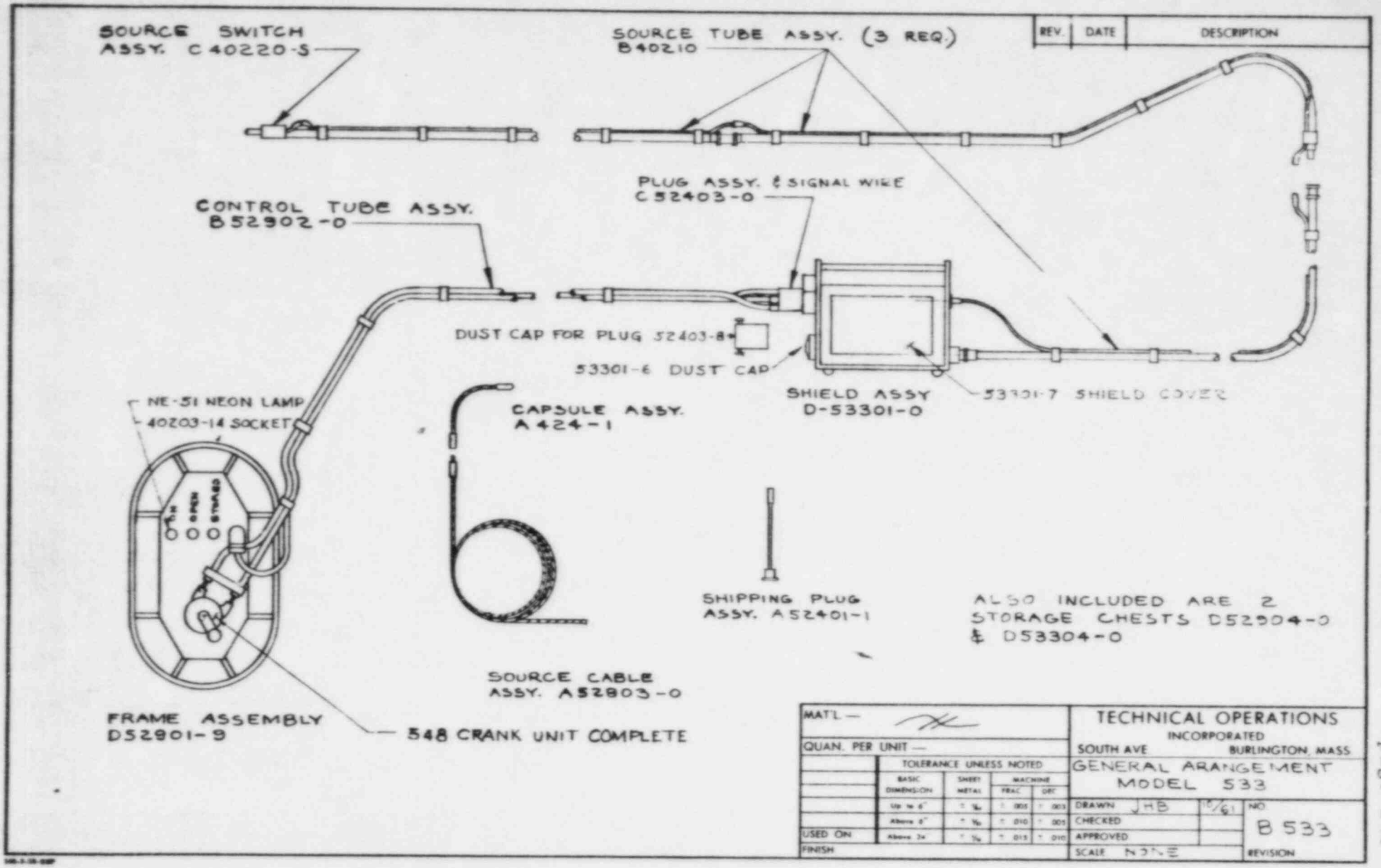
(c) Replace with Dialco NE-51, and replace globe.

7.5. Cleaning and Lubrication

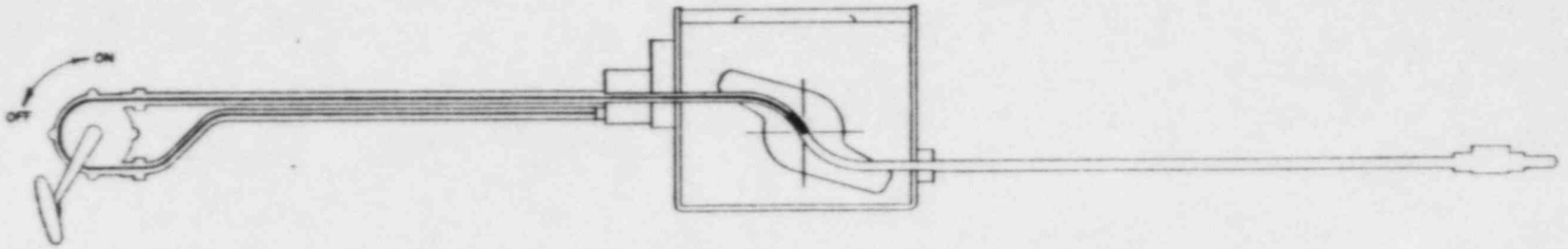
See Service Memo, "Cleaning and Lubrication of Control Cables, Drive Cables, Crank Unit, and Source Tubes."

7.6. Source Replacement

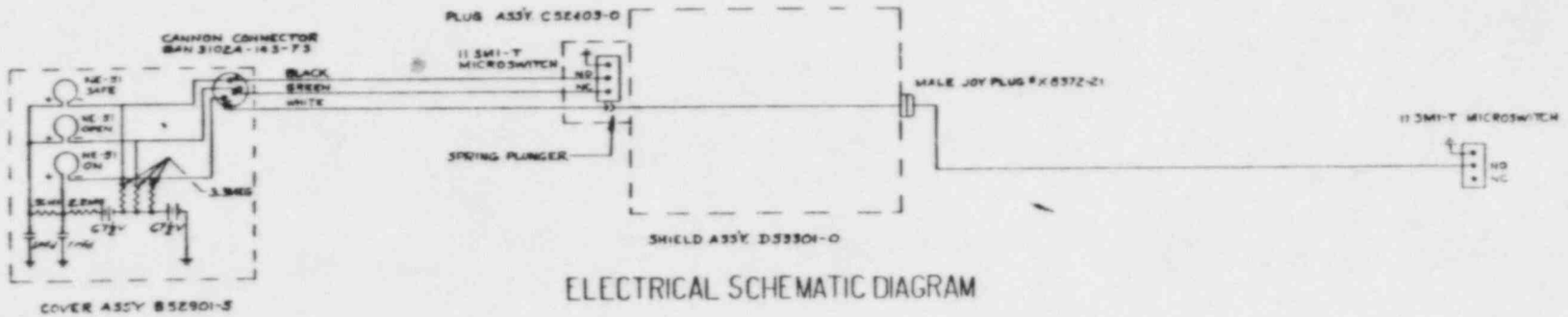
Renewal sources are available from Technical Operations for replacement in the field. For instructions, see Source Changer Operation Manual.


SOURCE SWITCH ASSY. C40220-S
SOURCE TUBE ASSY. (3 REQ.) B40210
REV. DATE DESCRIPTION
PLUG ASSY. & SIGNAL WIRE C52403-0
CONTROL TUBE ASSY. B52902-0
DUST CAP FOR PLUG 52403-8
53301-6 DUST CAP
SHIELD ASSY D-53301-0
53301-7 SHIELD COVER
NE-51 NEON LAMP
40203-14 SOCKET
CAPSULE ASSY. A424-1
SHIPPING PLUG ASSY. A52401-1
ALSO INCLUDED ARE 2 STORAGE CHESTS D52904-0 & D53304-0
SOURCE CABLE ASSY. A52803-0
FRAME ASSEMBLY D52901-9
548 CRANK UNIT COMPLETE
MAT'L —
QUAN. PER UNIT —
TOLERANCE UNLESS NOTED
BASIC DIMENSION
SHEET METAL
MACHINE FRAC
MACHINE DEC
Up to 6"
Above 6"
Above 24"
USED ON
FINISH
TECHNICAL OPERATIONS INCORPORATED
SOUTH AVE BURLINGTON, MASS.
GENERAL ARRANGEMENT MODEL 533
DRAWN JHB 5/61
CHECKED
APPROVED
SCALE NONE
NO. B 533
REVISION

REV	DATE	DESCRIPTION



MECHANICAL SCHEMATIC DIAGRAM



ELECTRICAL SCHEMATIC DIAGRAM

TECHNICAL OPERATIONS INCORPORATED		
SOUTH AVE		BURLINGTON, MASS
MECHANICAL & ELECTRICAL SCHEMATIC MODEL 533		
DRAWN PHG	8/6/69	NO C 533
CHECKED		
APPROVED		
SCALE NONE		REVISION

INST. NAME – 533 SHIELD ASSEMBLY

MODEL NO.

JOB. NO.

DATE: 10/61

NO. OF UNITS –

DELIVERY DATE –

SHEET 1 OF 2

BM NO. 533

REV.

TECHNICAL OPERATIONS, INC.
SOUTH AVENUE
BURLINGTON, MASSACHUSETTS

ITEM	USED WITH	PART NAME AND DESCRIPTION	MATERIAL OR MFR. & CAT. NO.	DRAWING NO.	REV. NO.	STORES NO.	NO. PIECES: INST.	THIS ORDER	BALANCE ON HAND	ADD'L ORDERED	P.O. NO.	P.O. DATE	VENDOR	REQ. DELIV. DATE	DATE REC'D.	NEW BALANCE	WITHDRAWN THIS ORDER	BALANCE FORWARD	REMARKS
0		533 SHIELD ASSY.		D53301-0			1												
1	0	SHIELD HOUSING	1/4 SHEET	D53301-1			1												
			6061-T6 ALUM																
2	0	HANDLE	5/8 x 1 5/8 BAR	B53301-2			1												
			245 ALUM																
3	0	BACK-UP PLATE	3/8 PLATE CRS	A53301-3			1												
4	0	SELECTOR LEVER	1 1/8 PLATE	B53301-4			1												
			245-T4																
5	0	LOCK BODY	1 1/8 PLATE	B53301-5			1												
			245-T4																
6	0	STORAGE COVER	1" PLATE	A53301-6			1												
			245-T4																
7	0	SKIN	.040 SHEET	C53301-7			1												
			303 S. ST.																
8	0	STORAGE COVER HOLDER	3/8 ID x 5/8 OD SS.	TUBING A53301-8															
			1/4 ID x 3/8 O.D. SS. 32 SHEET	TUBING			1												
9	0	CONNECTOR	1 1/2 DIA. ROD	B53301-11			1												
			303 STAINLESS																
10	0	ADAPTOR	1" DIA. ROD	A49001-10			1												
			245-T4																
11	0	LOCK RETAINER	1018 STEEL	B52402-3			1												
12	0	LOCK BODY	1018 STEEL	B52402-4			1												
13	0	CABLE LOCK PIN	5/16 DIA. DRILL ROD CARBON ST.	A52402-6			2												
14	0	SWITCH PLUNGER	1/2 DIA. BRASS ROD	A52402-10			1												
15	0	CONTACT	#4-40 NC THREADED BRASS	A52402-11			1												
			ROD & NUT																
16	0	WASHER	1020 STEEL	A52402-18			1												
17	0	LOCK BODY	303 SS	B53301															

INST. NAME – 533 SHIELD ASSEMBLY

MODEL NO.

JOB. NO.

DATE: 10/61

NO. OF UNITS –

DELIVERY DATE –

SHEET 2 OF 2

BM NO. 533

REV.

TECHNICAL OPERATIONS, INC.
SOUTH AVENUE
BURLINGTON, MASSACHUSETTS

ITEM	USED WITH	PART NAME AND DESCRIPTION	MATERIAL OR MFR. & CAT. NO.	DRAWING NO.	REV. NO.	STORES NO.	NO. PIECES: INST.	THIS ORDER	BALANCE ON HAND	ADD'L ORDERED	P.O. NO.	P.O. DATE	VENDOR	REQ. DELIV. DATE	DATE REC'D	NEW BALANCE	WITHDRAWN THIS ORDER	BALANCE FORWARD	REMARKS
18	0	SHIPPING PLUG ASSY.		A52401-1			1												
19	0	ROLLPINS	1/8 DIA. 1/2 LG.				2												
20	0	SOC. HD. SCREWS (WITH NYLON INSERT)	1/4-20NC X 1 1/4 LG NYLOCK				4						STD. PRESSED STEEL CO.						
21	0	RETAINING RING	TRUARC #5101-87				1												
22	0	RETAINING RING	TRUARC #5100-100				1												
23	0	SPRING 5/16 O.D. X 1" LG.	.023 WIRE				1						HARDWARE PRODUCTS CO.						
24	0	SPRING 1/4 O.D. X 1/2 LG.	7 TURNS .023 WIRE				2						HARDWARE PRODUCTS CO.						
25	0	NYLON BUSHING	GRIES #4 X 1/4 LG. #974301				2												
26	0	ROLLPINS	1/16 DIA. 5/16 LG				2												
27	0	MALE PLUG	JOY MFG. CO. #X8372-21				1												
28	0	BAKELITE WASHER 5/16 O.D. X 1/2 I.D. X .040 THICK					1												
29	0	LOCK	CORBIN PIN TUMBLER #02220				1						CORBIN LOCK DIV. AMERICAN HARDWARE CORP.						
30	0	#18 600V INSULATION WIRE 14" LONG																	
31	0	SOLDER TYPE LUG	H.H. SMITH INC #1488-4				1						SAGER ELECTRICAL SUPPLY CO. BOSTON						
32	0	VINYL COATED GLASS TUBING #12 GRADE A																	
33	0	BALL RETAINER	AUGAT #6016-3CC	A53201-9			2						AUGAT BROS. INC. ATTLEBORO, MASS.						
34	0	1/4 DIA. STEEL BALL					2												
35	0	BUMPER		A53201-10			4												
36	0	533 SHIELD CASTING		D53305-0			1												
37	36	533 SHIELD TUBE		B53305-1			1												
38	0	CRADLE BLOCK		A53301-12			2												
39	0	SHIM		A53301-13			2												
40	0	"U" BOLT		A53301-14			2												
41	0	DOWEL PIN	1/8 DIA. X 7/8 LG.				2												
42	0	RETAINING RING	TRUARC #5105-62																
43	0	RETAINING RING	TRUARC #5105-75																

OPERATION and MAINTENANCE MANUAL Model 660 SERIES GAMMA RAY PROJECTION SYSTEMS

TECHNICAL OPERATIONS, INC.
Radiation Products Division
Burlington, Mass. 01803
Phone (800) 225-1383 (toll free)
[in Mass. call (617) 272-2000]

WARRANTY
AND
LIMITATION OF LIABILITY

Technical Operations, Incorporated (hereinafter referred to as *the manufacturer*) warrants its product which it manufactures and sells to be free of defects in material and workmanship for a period of 1 year from 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 it transportation prepaid; or, at its option, to returning the purchase price thereof.

The warranty on other manufacturers' 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.

Technical Operations, Incorporated assumes no liability or responsibility for the usage of any radioactive material or device generating penetrative radiation used in connection with this product. The use of such material or generators in any manner other than that prescribed in the Nuclear Regulatory Commission License or equivalent state license or permitted by any regulation of the Nuclear Regulatory Commission or state regulation may constitute a violation of such license terms.

All other warranties, except those warranties expressly stated herein, including warranties of merchantability or otherwise, are expressly excluded.

Printed in U.S.A.

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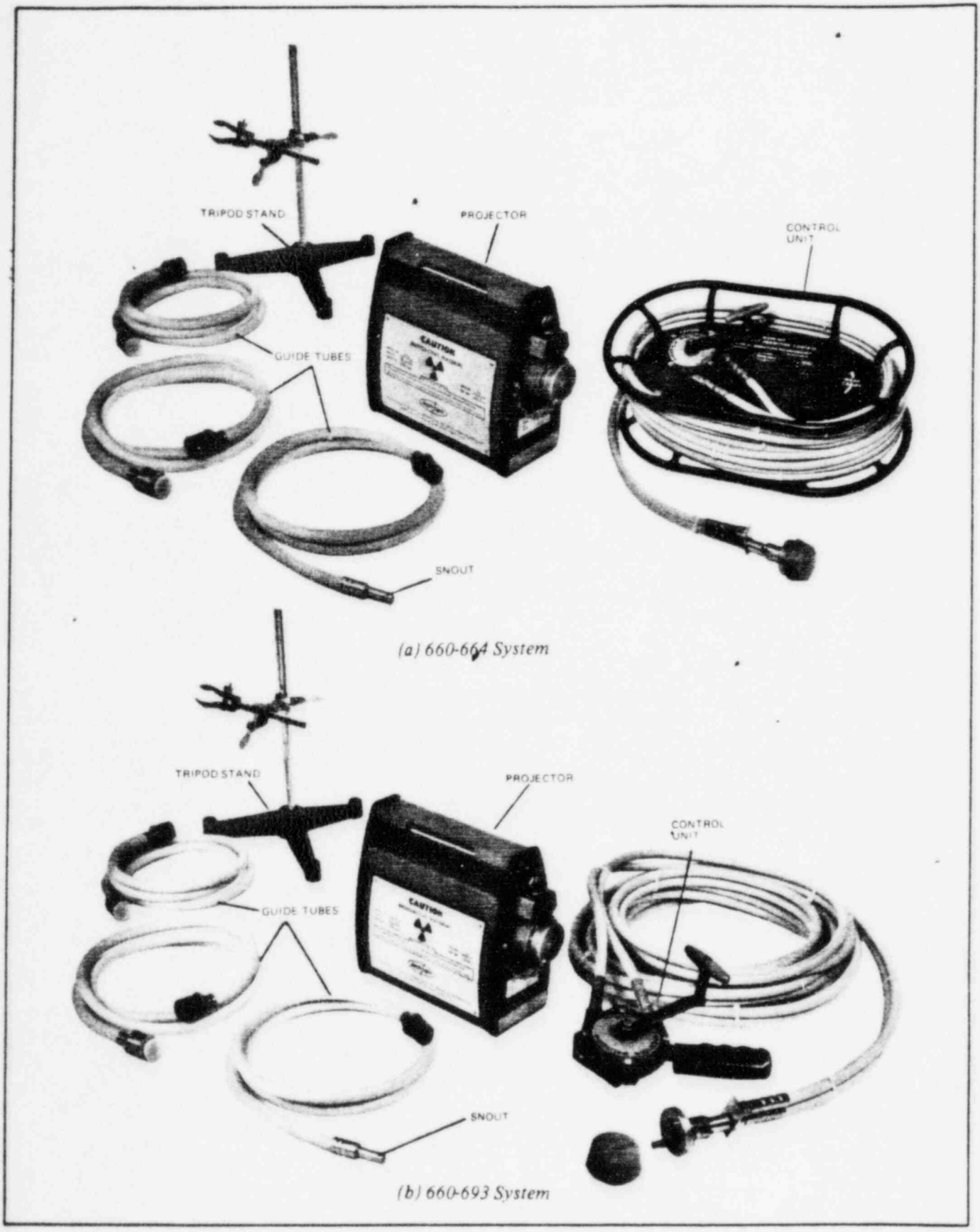


Figure 1-1. 660 Series Portable Gamma Ray Projector Systems.

Refer to Section II, Recommended Safety Precautions, before operating or servicing these systems.

SECTION I
GENERAL INFORMATION

1-1. GENERAL

The 660 Series Portable Gamma Ray Projector Systems, shown in Figure 1-1, are used primarily for industrial radiography. The systems operate in similar manner and differ only in the type of control unit supplied.

The portability feature of the system provides both a safe means of transporting the radioactive source and operating flexibility, particularly needed in limited access areas. In use, either system safely positions an Iridium^{192} radioactive source at a predetermined location. The 360° (panoramic) radiation pattern may be used to full advantage, either for multiple specimen work or for circumferential exposure techniques. Optional collimators are available which limit the panoramic pattern to a directional beam. The systems may be used with Iridium^{192} isotope sources up to a maximum of 100 curies. Iridium^{192} sources of other capacities are available, upon request. Basic source information is contained on the nameplate of the source shield (projector).

1-2. SYSTEM SAFETY

The systems provide maximum operator safety. A positive mechanical control of the source and an accurate visual indication of its position are given at all times. In addition, the systems have a fail-safe connection; where:

a. the system cannot be operated (source exposed) unless a secure connection to the control cable is made, and

b. the controls cannot be disconnected unless the source is properly stored in the shield.

1-3. SYSTEM COMPONENTS

All components of the 660-664 and 660-693 Systems are identified in Figure 1-1. Components common to both systems are discussed first. The separate control units are discussed last.

a. Gamma Ray Projector Model 660.

The Gamma Ray Projector, shown in Figure 1-2, can be used in either system. The projector serves as the storage and transport device of the radioactive source assembly. The projector consists of a steel housing which contains approximately 29 pounds of "depleted uranium" shielding material. When the source is properly stored in the projector, the effective shielding properties of the depleted uranium reduce radiation at the projector exterior to a level well below the regulatory mr/hr limits prescribed in applicable NRC regulations.

Figure 1-2 shows both ends of the projector. A special fail-safe connector is located at one end. This connector is used to engage the cable from the control unit. The safety features of the connector were discussed in paragraph 1-2. The control connector contains a three-position selection device – OPERATE, LOCK, and CONNECT. For maximum safety when the projector is disconnected from the control cable and guide tubes, the connector should be in the LOCK position with the attached lock and storage cover engaged and the key removed. All of the connector positions are discussed in detail in Section III, Operation. The guide tube connector is located at the other end of the Projector. Figure 1-2 identifies the connector. Also shown in Figure 1-2 is the storage plug which must be removed before the guide tubes are connected. The storage plug should be used to prevent dirt and dust from entering the projector whenever the projector is not in use.

The total weight of the projector is 44 pounds. The projector is 9½" high, 4¾" wide, and 12¾" long (includes handle and connectors).

b. Guide Tube Assembly.

The guide tube assembly consists of one seven-foot master guide tube and two seven-foot extender guide tubes (see Figure 1-1). The master is

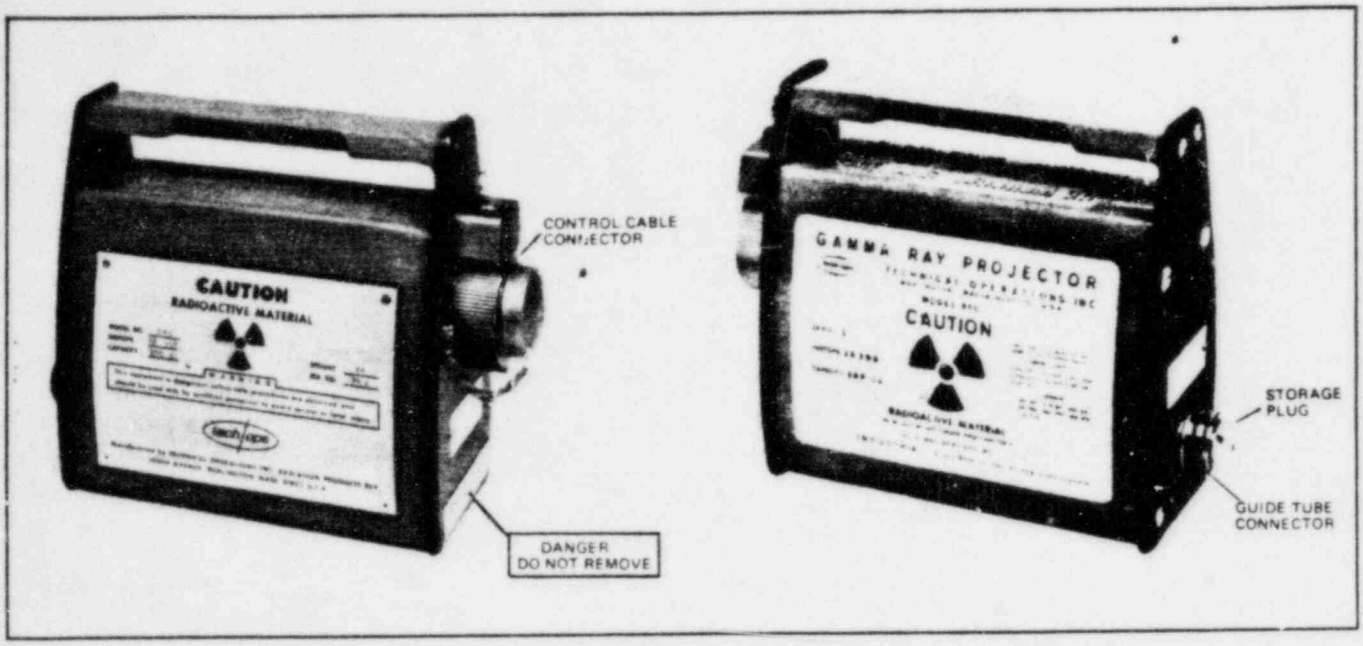


Figure 1-2. Model 660 Gamma Ray Projector.

the guide tube section which contains the snout or source stop at one end. The system should never be operated without the master guide tube attached to the projector. The two extender sections can be used as necessary to lengthen the guide tube to 14 or 21 feet. Both master and extender guide tubes are made from flexible stainless steel tubing with a protective polyvinyl covering. The three guide tube sections weigh approximately five pounds.

CAUTION

NEVER OPERATE THE SYSTEM WITH MORE THAN THREE GUIDE TUBE SECTIONS (MASTER SECTION PLUS TWO EXTENDER SECTIONS– TOTAL GUIDE TUBE LENGTH OF TWENTY ONE FEET).

c. Tripod Stand.

The tripod stand provides a means of securing the snout end of the master guide tube section so that the source can be positioned at the desired focal position. The stand has adjustable clamps which will provide an unlimited degree of positioning flexibility. The weighted tripod base provides a solid foundation for the stand. The tripod stand, complete with clamps, weighs approximately ten pounds.

d. Model 664 Control Unit.

The 664 unit is used with the 660-664 Gamma Ray Projector System. The unit consists of a hand crank, odometer, and 25-foot control cable, and lightweight convenient storage cable reel. In operation, the hand crank controls the movement of the source from the storage position in the projector to the exposure position in the master guide tube. The odometer indicates the distance in feet and inches that the source has been moved from its storage position. The reel provides a convenient storage facility for both the control cable and the three guide tubes. The outer control tubing is similar to the construction of the guide tubes. The inner spiral-wound flexible steel drive cable (the actual controlling element) terminates with the male section of a swivel-type fastener used to securely engage the female section which is attached to the leader cable of the radioactive source assembly. The control tube is terminated at one end by the connecting plug assembly which mates with the fail-safe connector on the projector and at the other end by fittings which attach it to the main frame of the control unit. The 664 control unit with the control cable weighs approximately twenty-two pounds.

e. Model 693 Control Unit.

The 693 unit is used with the 660-693 Gamma Ray Projector System. The basic purpose of the 693 is similar to that of the 664 unit. However, the 693 unit does not have the storage reel and is provided with a pistol grip handle for convenient operation. The 693 control unit with the control cable weighs approximately nineteen pounds.

1-4. RADIOACTIVE SOURCE ASSEMBLY

The radioactive source assembly is the most vital component in the system. It is supplied and must be ordered separately from other system components. The system can operate with various capacity sources up to the maximum 100 curies (+20%). The source is contained in a stainless steel capsule firmly attached to one end of the short leader cable.

The source can easily be changed in the field using a TO-414 or TO-650 Source Changer which also serves as a shipping container.

1-5. SYSTEM OPTIONAL ACCESSORIES

Table 1-1 lists the options available for both projector systems.

Also available is a complete range of radiation survey and personnel monitoring dosimeters.

1-6. PRINCIPLES OF OPERATION

The hand crank on the control unit moves the drive cable through the control tube. The control cable is locked to the encapsulated radioactive source via a short leader. Figure 1-3(a) shows the source in the stored position in the projector (hand cranked fully clockwise – in the full RETRACT position). Figure 1-3(b) shows the source being moved out of the projector and into the guide tubes. This action occurs by rotating the hand crank in the EXPOSE counterclockwise direction. Figure 1-3(c) shows the source reaching the snout which serves as a mechanical stop at the radiographic focal spot. The hand crank will not turn any farther and the odometer in the control unit should indicate a reading which approximates the total length of the combined guide tubes. To return the source to the projector (stored position), the hand crank is turned to the full RETRACT (clockwise) position.

1-7. SPECIFICATIONS

a. Source Data
- Isotope: Iridium ^{192} (A424-9 only)
- Maximum strength: 100 curies (+20%)
- Shielding: Conforms to NRC requirement, title 10 CFR part 34.21

b. Size and Weight
- Projector Size: 4¾ x 9½ x 12¾ inches
- Projector Weight: 44 pounds
- Model 664 Control Unit Size: 6 5/8 x 12 x 21 inches
- Model 664 Control Unit Weight: 22 pounds (with control cable)
- Model 693 Control Unit Weight: 19 pounds (with control cable)
- Guide Tubes: 5 pounds
- Tripod Stand: 10 pounds

c. Operating Specifications
- Maximum distance, projector to control unit: 25 feet
- Distance, projector to exposure position: 7, 14, or 21 feet
- Source position reproducibility: ±1/16 inch

Table 1-1. System Options

MODEL NO.	DESCRIPTION
527	Collimator with stand for directional 60° beam or 360° panoramic 20° wide-band beam
653	Side collimator
654	Front collimator
534	Slide-rule type exposure calculator with leather case
492D	GAMMALARM radiation monitor
492E	GAMMAFLASHER used with 492D GAMMALARM

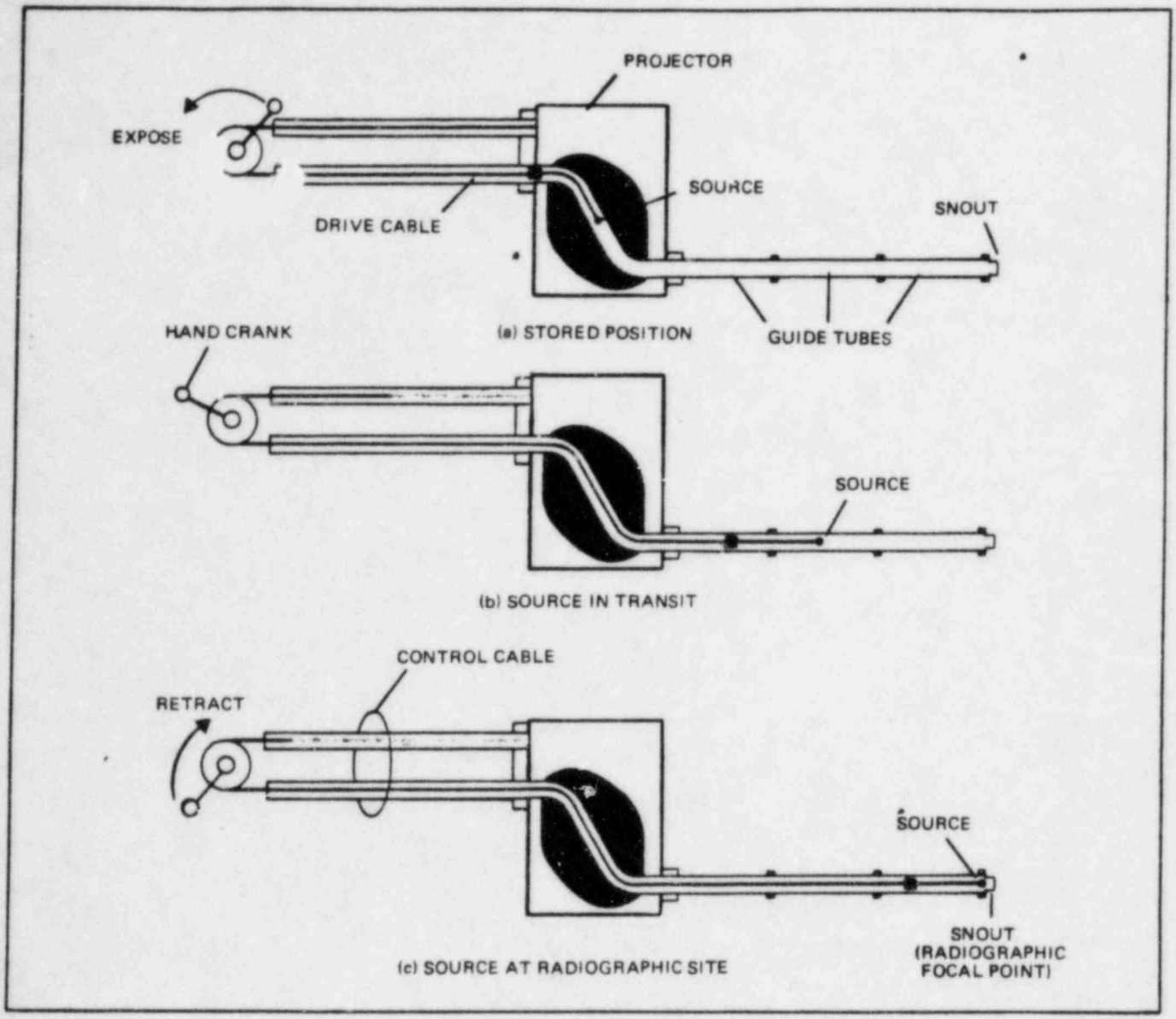


Figure 1-3. Mechanical Schematic.

SECTION II
RECOMMENDED SAFETY PRECAUTIONS

2-1. GENERAL

The Model 660 Ray Projector is designed to afford operators maximum protection from radiation. However, precautions consistent with accepted isotope handling practices must be observed at all times.

2-2. RADIATION MEASURING INSTRUMENTS

The use of radiation measuring equipment is mandatory; all handling of isotope units should be monitored by proper radiation detectors. The following are recommended:

a. Survey Meters.

Survey meters must be used as a matter of routine to determine the radiation rate per unit time. Technical Operations, Inc. recommends a gamma survey meter of the ionization chamber type, with a full scale range of at least 1000 mr/hr.

b. Film Badges.

Personnel using or working near isotope equipment should wear film badges to provide permanent running records of the radiation dosage received.

c. Pocket Dosimeters.

Technical Operations, Inc. also recommends the use of pocket dosimeters, to allow personnel to determine the exposure received in any given period.

2-3. WORKING DISTANCE

Every precaution should be taken to insure that adequate distance exists 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 Regulations, Title 10, Atomic Energy, Part 20.105.) Personnel operating equipment should always work at the maximum possible distance from the source. (The exposure rate varies inversely with the square of the distance from the source.) Always avoid unnecessary or excessive dosages.

2-4. EXPOSURE TIME

Maximum radiation doses to personnel are specified by State and Federal regulations. (See Code of Federal Regulations. Title 10, Atomic Energy, Part 20.101.) Always observe good radiographic techniques to keep doses to a minimum.

2-5. SHIELDING

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

2-6. HAND-CARRYING

Hand-carrying should be limited to operations where absolutely necessary. Unnecessary personnel exposures can result from hand-carrying the unit for extended periods. Personnel carrying the unit should always monitor the exposure using a dosimeter or film badge on the part of the body nearest to the source.

2-7. SHIPPING

The Model 660 meets the requirements for a Type B shipping container under the regulations of the U. S. Nuclear Regulatory Commission, the U. S. Department of Transportation and the International Atomic Energy Agency. The container has been assigned USNRC Certificate No. 9033 for domestic shipments and IAEA Certificate No. USA-DOT-RAM-6-70 for international shipments.

Under the terms of USNRC regulations in 10CFR71.12(b), prior to the first shipment of the container, the shipper must register as such with the Transportation Branch, Division of Materials and Fuel Cycle Facility Licensing, USNRC.

In shipment the device must be locked and the storage plug must be inserted and secured with a tamper proof seal.

When shipped with the contained Iridium^{192}, the RADIOACTIVE YELLOW III label must be identified with "Iridium^{192}", the number of curies

contained, and the maximum radiation level measured at a distance of three feet from the surface of the container (Transport Index).

When shipped without the Iridium^{192} source, a RADIOACTIVE WHITE I label must be identified with "Depleted Uranium" and " Curies."

These shipping labels are shown in Figure 2-1 and are available from Technical Operations.

(a) With Isotope *(b) Without Isotope*

Figure 2-1. Typical Shipping Labels

SECTION III
UNPACKING AND STORAGE

3-1. INITIAL INSPECTION

If external damage to the shipping containers is evident, ask the carrier's agent to be present when the system is unpacked. Technical Operations, Inc. should be notified immediately if any components were damaged in transit.

WARNING

UNPACK THE SYSTEM ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION II.

3-2. UNPACKING

Portable Gamma Ray Projector System Components are normally shipped in two cardboard containers. Inspect cartons for external signs of possible damage. Open the cartons and remove the system components.

The components are as follows:

(a) Swivel Clamp
(b) Source Tube Clamp
(c) Tripod Base
(d) Tripod Rod
(e) Control Unit with attached Control Cable
(f) Projector
(g) Three 7-foot Guide Tube Sections

3-3. COMPONENT INSPECTION

Examine all components for damage. Check all items against packing list or Figure 1-1.

3-4. STORAGE

When storing the system between uses, keep the plastic caps, supplied with the system, in place on the three guide tubes. This eliminates dust accumulation within the tubes. During storage the storage plug must be inserted to meet the conditions of 10CFR34:21 and to prevent the entry of foreign material.

SECTION IV
OPERATION

4-1. PREPARATION FOR USE

WARNING

ASSEMBLE THE SYSTEM FOR USE ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION III.

a. Guide Tube Assembly

1. At the radiographic focal point, position and secure the snout of the master guide tube using the tripod stand and swivel clamps.

2. Remove the plastic dust caps and attach additional extender guide tubes, as necessary, to the master guide tube.

3. Determine the position of the projector (source shield) allowing for maximum possible operating shielding. Assuming appropriate shielding is available, the operator will be approximately twenty-five feet from the projector during actual operation.

4. Lay out the guide tubes as straight as possible directing them toward the projector. Note that the bend radius of the guide tubes should not be under twenty inches. Smaller bend radii may restrict the movement of the control cable.

NOTE

The guide tubes should not be subjected to any undue stress or abuse which could cause restrictions in the tubes.

5. Remove the storage plug from the projector connector and attach the last guide tube to the projector (see Figure 1-2).

CAUTION

NEVER OPERATE THE SYSTEM WITH MORE THAN THREE GUIDE TUBE SECTIONS (INCLUDING THE MASTER).

b. Control Unit.

1. Determine the operating site of the control unit. For maximum safety, the operator should be located behind a protective shield.

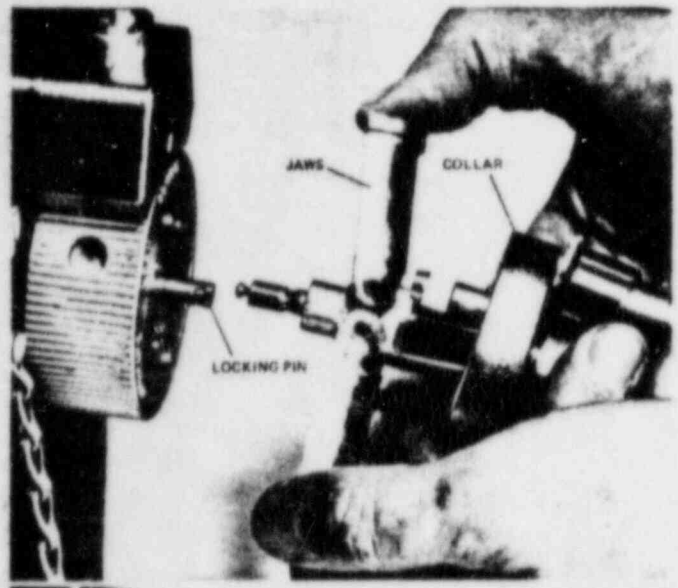
2. Lay out the control cable as straight as possible directing it toward the projector. Note that the bend radius should not be less than three feet. Smaller bend radii may restrict the movement of the control cable.

NOTE

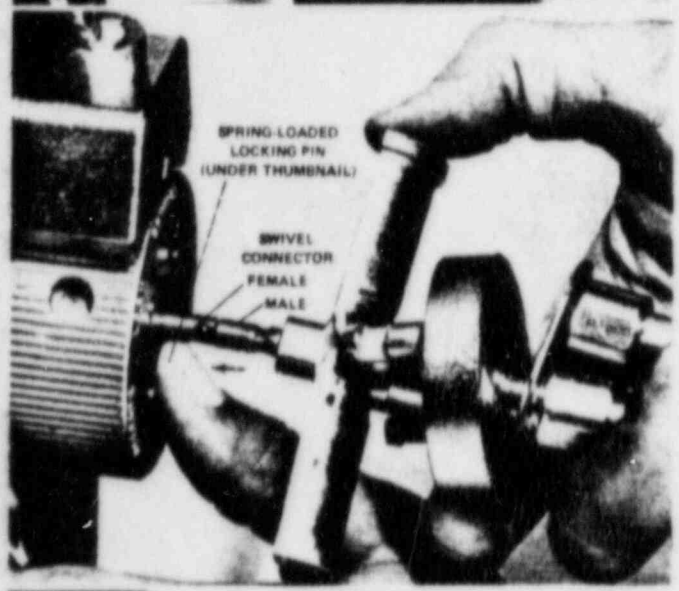
The control cable should not be subjected to any undue stress or abuse which could cause restrictions in the cable.

3. Attach the control cable to the projector in accordance with the following illustrated sequence:

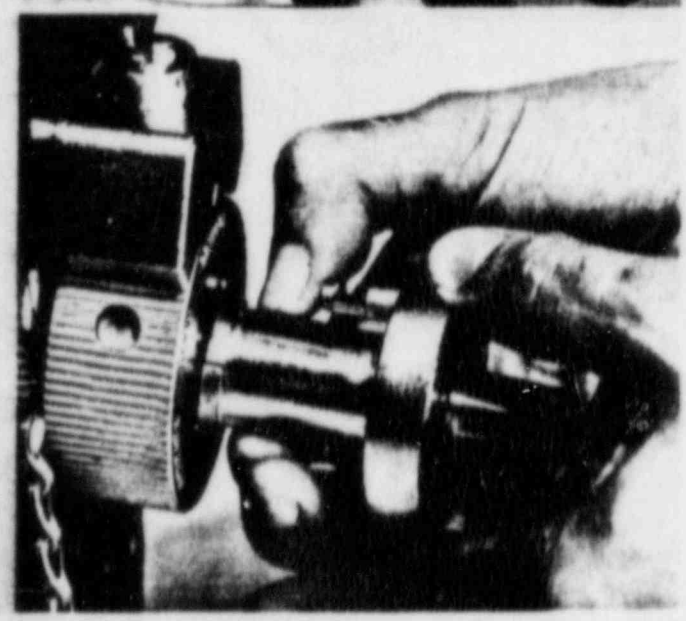
Unlock the projector with the key provided and turn the connector selector ring from the LOCK position to the CONNECT position. When the ring is in the CONNECT position, the storage cover will disengage from the projector as shown.



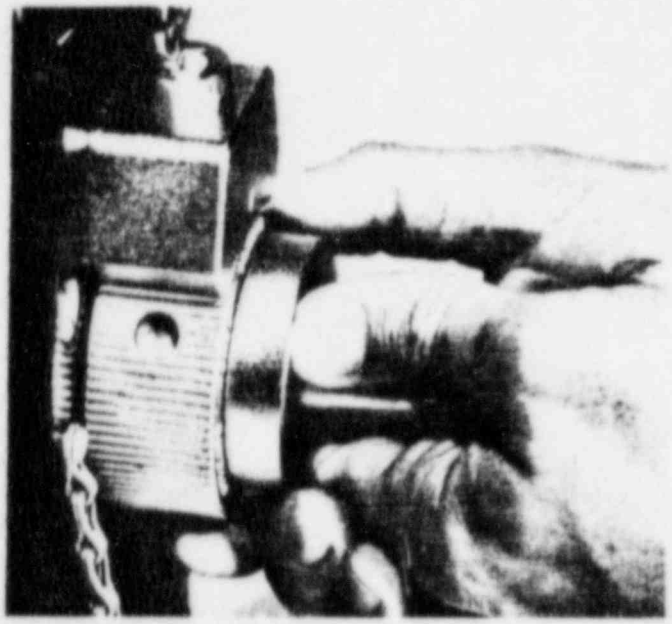
Slide the control cable collar back and open the jaws of the control cable connector. This exposes the male position of the swivel connector as shown.



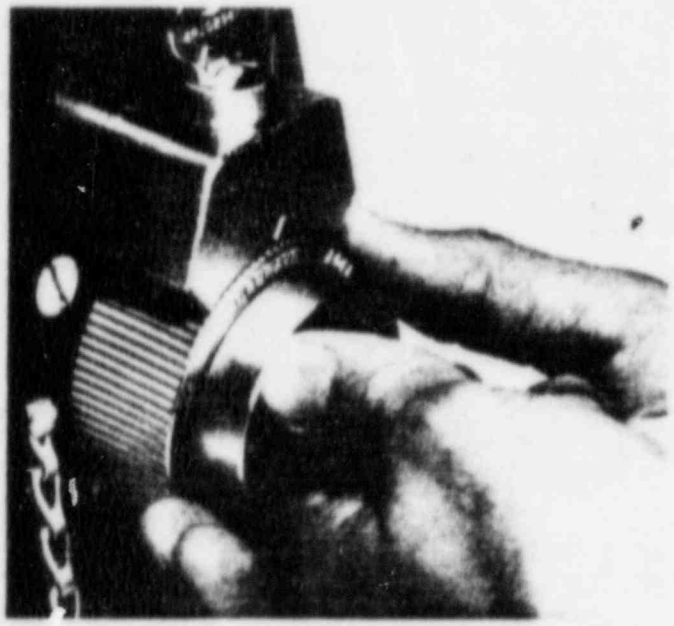
Engage the male and female portions of the swivel connector as shown by depressing the spring-loaded locking pin toward the projector with the thumbnail. Release the locking pin and test that the connection has been properly made.



Close the jaws of the control cable connector over the swivel-type connector.



Slide the control cable collar over the connector jaws.



Hold the control cable collar flush against the projector connector and rotate the selector ring from the CONNECT position to the LOCK position. Keep the projector in the LOCK position until actual operation is ready to start.

4-2. OPERATION

Thoroughly check all cable connections and bend radii and the position of the snout of the master guide tube. (This represents the radiographic focal point of the source.) To operate the system, perform the following:

WARNING

OPERATE THE SYSTEM ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION II.

a. Unlock the projector connector and rotate the selector ring to the OPERATE position. The source is now free to move.

NOTE

If cranking becomes difficult at any time during the next step, reverse the direction of the cranking to return the source to the stored position in the projector. First monitor the area with a survey meter to insure that the source is properly stored. Then check the control and guide tubes for excessively small bend radii and repeat the step.

b. At the control unit (in a shielded area), rapidly rotate the hand crank in the EXPOSE (counterclockwise) direction to move the source out of the projector and into the guide tubes toward the radiographic focal point. Both the Model 664 and 604 Control Units, shown in Figure 4-1 operate in similar fashion. Continue to rotate the hand crank until the source reaches the snout which serves as a mechanical stop for the source. The odometer reading will indicate the total distance the source traveled (approximately seven feet for one guide tube section, fourteen feet for two sections, and twenty-one feet for three sections).

c. Specimen exposure should be figured from the time that the source reaches the snout or stop.

d. To return the source to the projector, after the desired exposure time has elapsed, rapidly turn the hand crank in the RETRACT (clockwise) direction. Continue to turn the crank until the odometer reading reaches the 000 position. (source properly stored).

CAUTION

AFTER AN EXPOSURE, THE PROJECTOR SHOULD BE THOROUGHLY MONITORED WITH A SURVEY METER BEFORE CONTINUING WITH STEP E.

e. At the projector, rotate the connector selector from the OPERATE position to the LOCK position and secure with the projector lock.

NOTE

If the projector selector ring cannot be rotated to the LOCK position, the source has not been fully retracted. Check the control unit odometer reading. It should be 000. Turn the hand crank to the full clockwise (RETRACT) direction.

4-3. DISASSEMBLY

If the system is to be moved for another exposure or to be stored, the components should be disassembled. Unscrew the guide tube sections from each other and remove the master guide tube from the tripod stand. Place the plastic caps on the tube ends and projector connector to eliminate dust and dirt from entering the tubes. Store the tubes in an area where they will not be subjected to any undue stress or abuse which could cause restrictions. Insert storage plug into position and tighten.

To disconnect the control unit from the projector, perform the following:

a. Unlock the projector using the supplied key.

b. Rotate the connector selector ring from the LOCK position to the CONNECT position. When the selector ring reaches the CONNECT position, the control cable connector will partially disengage from the projector.

c. Slide the control cable connector collar over the jaws away from the projector.

d. Open the connector jaws and disconnect the swivel-type connector by depressing the spring-loaded locking pin towards the projector with the thumbnail and separating the male and female connections.

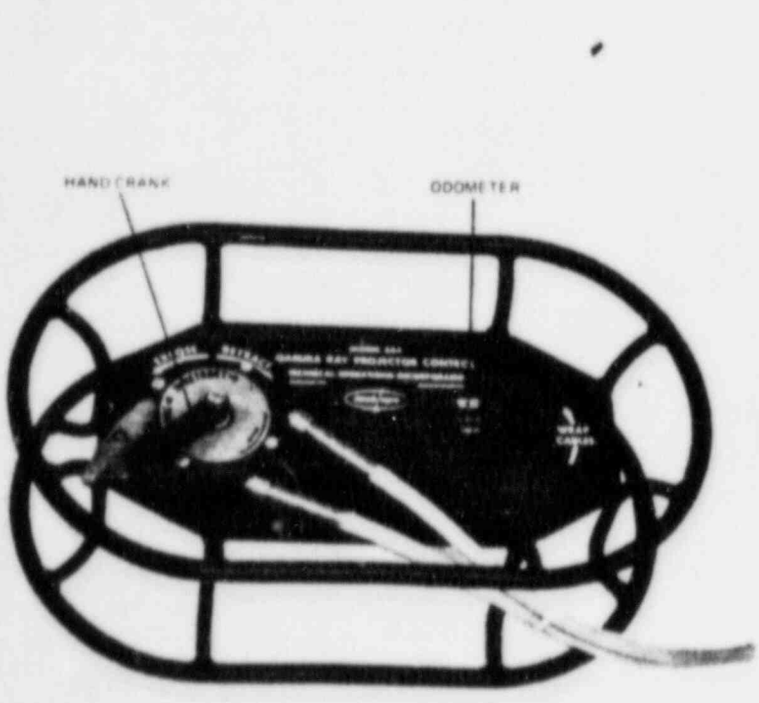
NOTE

If any difficulty is encountered, refer to the illustrated instructions given for making the connection for further assistance.

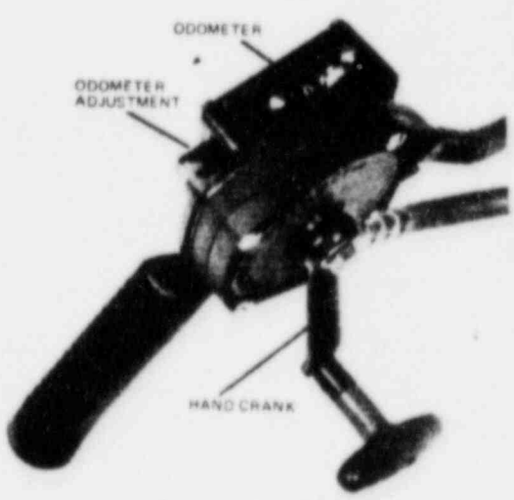
e. Replace the storage cover in the projector connector and rotate the selector ring to the LOCK position. Remove the key and engage the lock to secure the projector.

f. Coil the control cable in the 664 control unit or around the 693 control unit and store the unit in an area where the cable will not be subjected to undue stress or abuse.

g. Disassemble the tripod stand for storage.



(a) Model 664



(b) Model 693

Figure 4-1. Control Units.

SECTION V
MAINTENANCE

5-1. GENERAL

It is imperative that all system components be kept clean. No amount of dirt can be considered negligible. When the system must be operated in a dirty environment, particular care must be exercised to avoid dirt from entering the control or guide tubes. Dirt-clogged cables, tubes, and connectors impede the drive cable movement and could cause jamming.

5-2. CONTROL CABLE

Inspect the control cable regularly for signs of damage. Avoid twisting or bending the cable excessively. Recoil the control cable carefully for storage. Never drag the cable on the floor or ground. Use the protective cover (over the connector) when the control cable is not in use.

5-3. GUIDE TUBES

Inspect the guide tubes regularly for signs of damage. Avoid twisting or bending the tubes excessively. Recoil the guide tubes carefully for storage. Never drag the tubes on the floor or ground. Replace the plastic caps on the guide tubes connectors when not in use.

5-4. CLEANING AND LUBRICATING SYSTEM CABLES

The frequency of cleaning and lubrication depends on the amount and type of use. These procedures should be performed whenever the cranking of the control unit becomes difficult. Perform the following:

1. Disconnect the control cable from the projector.

2. Turn the hand crank in the EXPOSE (counterclockwise) direction until the cable disengages from the drive gear. This becomes apparent because further turning of the hand crank will have no effect on the control cable.

3. Pull the cable free from the control cable housing. Coil the cable (a radius of not less than four inches) and place the cable in a container of degreasing solvent. Do not use water-based cleaning agents. Allow the cable to soak as long as is necessary to remove all accumulated foreign matter.

4. Remove the control cable from the control unit by loosening the two fittings. (Before removing the fittings, label them to facilitate reassembly.)

5. Pour degreasing solvent into the control cable tubing to clean. Continue to flush the tubing until the solvent leaving the hose is free from impurities.

6. Use compressed dry clean air (do not exceed fifteen pounds) to thoroughly dry both the housing and cable. Any remaining solvent could cause permanent damage.

NOTE

Since the drive cable and control tubing has been thoroughly cleaned, care must be exercised to avoid any dust or dirt contamination during the remainder of this procedure.

7. Lightly grease the drive cable with MIL-G-23827A type grease. Other greases may form tars or corrosive compounds when exposed to radiation.

8. Carefully feed the cable into the tubing from the cable end which attaches to the projector.

9. When the cable reaches the control unit fitting, guide the cable into the hand crank housing. Slowly turn the hand crank in the RETRACT (clockwise) direction until the cable engages the crank gear.

10. Reconnect the two fittings which connect the control cable to the control unit.

11. Turn the hand crank in the RETRACT direction until the cable is completely contained in the housing. If the odometer reading is not 000 at

this time, refer to the odometer adjustment procedure given in this section.

To clean the guide tubes, flush them thoroughly with a cleaning solvent (chlorothene or carbon tetrachloride). Dry thoroughly with clean dry compressed air. Replace all plastic dust caps when storing the tubes.

5-5. REPLACING THE CONTROL CABLE

To replace the control cable, refer to the cleaning procedures given in paragraph 5-4.

5-6. ODOMETER ADJUSTMENT

The odometer in both the 664 and 693 control units, has a knob adjustment control. If the hand crank is in its full RETRACT position, the odometer should indicate 000. If not, slowly adjust the control to obtain a 000 reading. The odometer adjustments are located in Figure 6-4 for the 693 control unit and Figure 6-3 for the 664 control unit.

5-7. SOURCE REPLACEMENT

Renewal sources are available from Technical Operations, Inc. for replacement in the field. For instructions, see the procedure supplied with the replacement source.

A dummy source is normally supplied with the system. A clip inside the storage cover of the projector converter is provided for dummy source storage. The dummy source can be used when the radioactive source has been removed (using a source changer) so that the control cable can be disconnected from the projector. Note that the fail-safe feature of the connector requires either a source or a dummy source properly stored in the projector before the control cable can be disengaged.

5-8. CONTROL UNIT REPAIR

Exploded views of both the 664 and 693 control units are given in Section VI (Figures 6-3 and 6-4). If parts must be replaced, use the index numbers of the related illustration as a guide to disassembly and reassembly. The illustrations also include a parts list for ordering replacements.

5-9. GAMMA RAY PROJECTOR

WARNING

THE SOURCE SHIELD PORTION OF THE PROJECTOR IS NOT REPAIRABLE IN THE FIELD. A COVER PLATE HAS BEEN ATTACHED (SEE FIGURE 1-2) TO PREVENT OPENING THE SHIELD WHICH COULD RESULT IN A SERIOUS RADIATION OVEREXPOSURE.

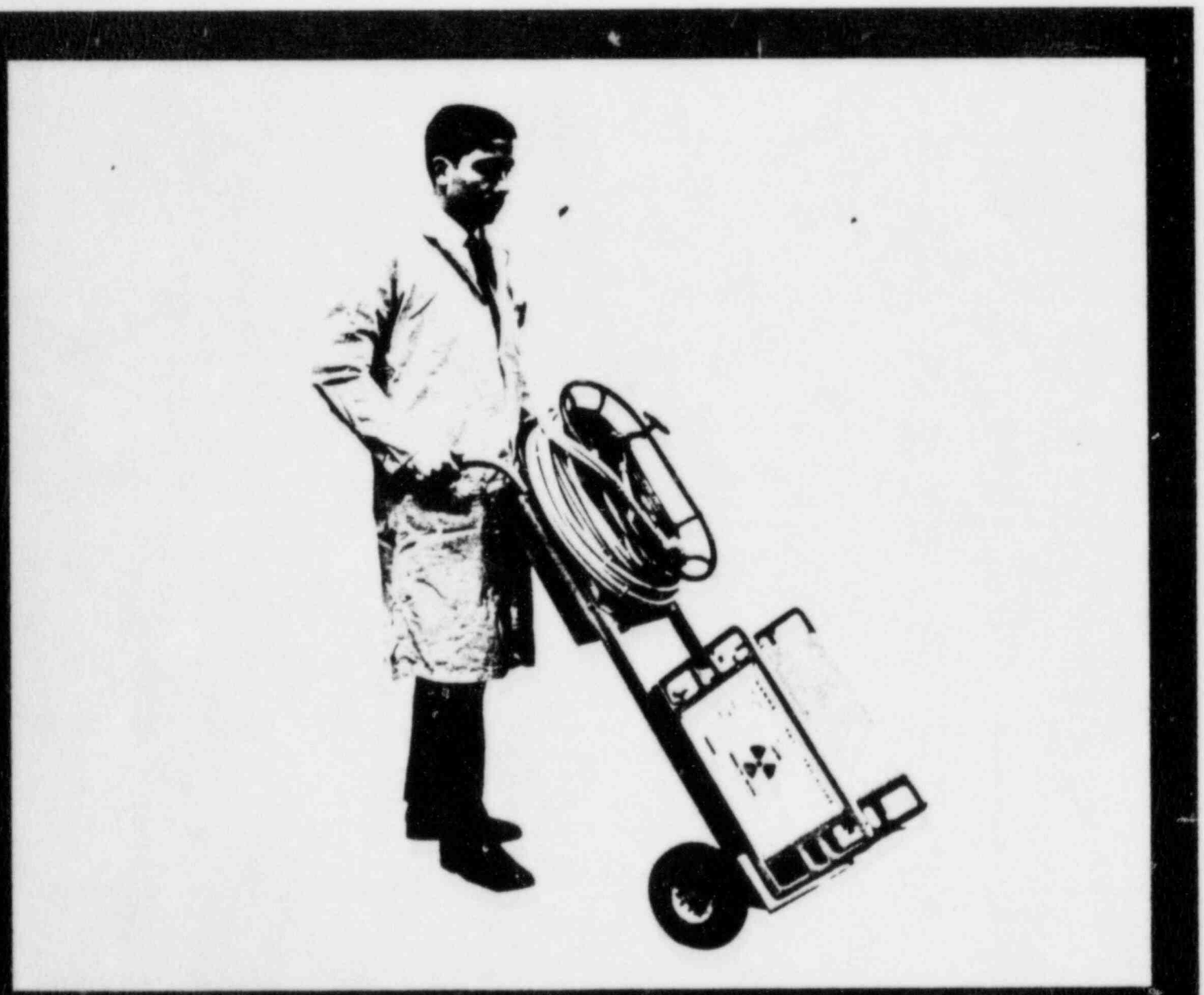
Radiation Products Division

tech/ops

Advanced Radiation Service

VII. OPERATING & EMERGENCY PROCEDURES (iii)

Cobalt 60 Series Gamma Ray Projection Systems



WARRANTY
AND
LIMITATION OF LIABILITY

Technical Operations, Incorporated (hereinafter referred to as *the manufacturer*) warrants its product which it manufactures and sells to be free of defects in material and workmanship for a period of 1 year from 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 it transportation prepaid; or, at its option, to returning the purchase price thereof.

The warranty on other manufacturers' 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.

Technical Operations, Incorporated assumes no liability or responsibility for the usage of any radioactive material or device generating penetrative radiation used in connection with this product. The use of such material or generators in any manner other than that prescribed in the Atomic Energy Commission License or equivalent state license or permitted by any regulation of the Atomic Energy Commission or state regulation may constitute a violation of such license terms.

All other warranties, except those warranties expressly stated herein, including warranties of merchantability or otherwise, are expressly excluded.

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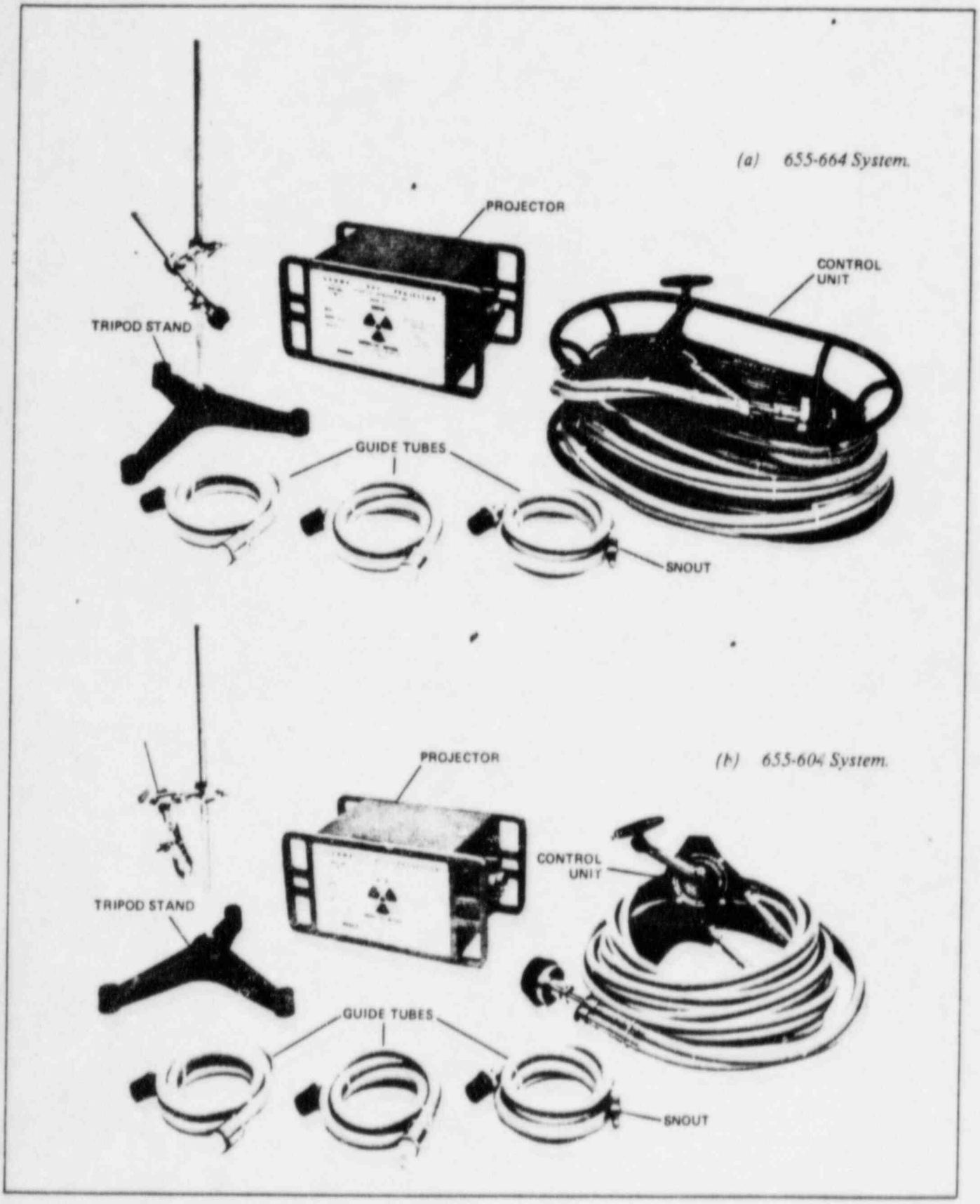


Figure 1-1. Cobalt^{60} Series Gamma Ray Projector Systems.

Refer to Section II, Recommended Safety Precautions, before operating or servicing these systems.

SECTION I
GENERAL INFORMATION

1-1. GENERAL

The advanced-design Cobalt^{60} Series Gamma Ray Projector Systems are used primarily for industrial radiography. The systems, which resulted from years of field experience, operate in similar manner and differ only in the capacity and the type of control unit supplied. Typical system components are shown in Figure 1-1.

The mobility feature of the systems provide both a safe means of transporting the radioactive source and operating flexibility, particularly needed in limited access areas. In use, the system safely positions a Cobalt^{60} radioactive source at a predetermined location. The 360° (panoramic) radiation pattern may be used to full advantage, either for multiple specimen work or for circumferential exposure techniques. Optional collimators are available which limit the panoramic pattern to a directional beam. The maximum capacity of the Cobalt radioactive source (+10%) for each system is as follows:

Model 670 System:	5 curies
Model 655 System:	50 curies
Model 672 System:	100 curies
Model 676 System:	250 curies
Model 680 System:	100 curies
Model 684 System:	10 curies

Cobalt^{60} sources of other capacities are available, upon request. Basic source information is given on the nameplate of the source shield (projector).

1-2. SYSTEM SAFETY

The Cobalt^{60} Series Systems provide maximum operator safety. A positive mechanical control of the radioactive source and an accurate visual indication of its position are given at all times. In addition, the systems have a fail-safe connection; where:

a. the system cannot be operated (source exposed) unless a secure connection between the source and control cable is made, and

b. the controls cannot be disconnected unless the source is properly stored in the projector.

1-3. SYSTEM COMPONENTS

All basic components of the Cobalt^{60} Systems are identified in Figure 1-1. Note only one size projector is shown. Common system components are discussed first. The two separate type of control units are discussed last. Systems are identified with a two-part number. The first part (three digits) identifies the projector model number (see paragraph 1-1 for related radioactive source capacities). The second part of the System number identifies the type of control unit supplied (either –664 for the reel type or –604 for the pistol-grip type).

a. Gamma Ray Projectors.

The size and weight of the projector will vary depending on its radioactive source capacity. All of the Cobalt^{60} Series Projectors can be used with either the 664 or 604 Control Units (discussed later). The projector serves as the storage and transport device of the radioactive source assembly. The projector consists of a steel housing which contains "depleted uranium" shielding material; the actual amount is related directly to the source capacity of the projector.

When the source is properly stored in the projector, the shielding properties of the depleted uranium reduce radiation at the projector exterior to a level well below the regulatory mr/hr limits prescribed in applicable AEC regulations.

Figure 1-2 shows both ends of the Model 655 Projector (the cart is optional). A special fail-safe connector is located at one end. This connector is used to engage the drive cable from the control unit. The safety features of the connector were discussed in paragraph 1-2. The control unit connector contains a three-position selector ring – OPERATE, LOCK, and CONNECT. For maximum safety when the projector is disconnected from the

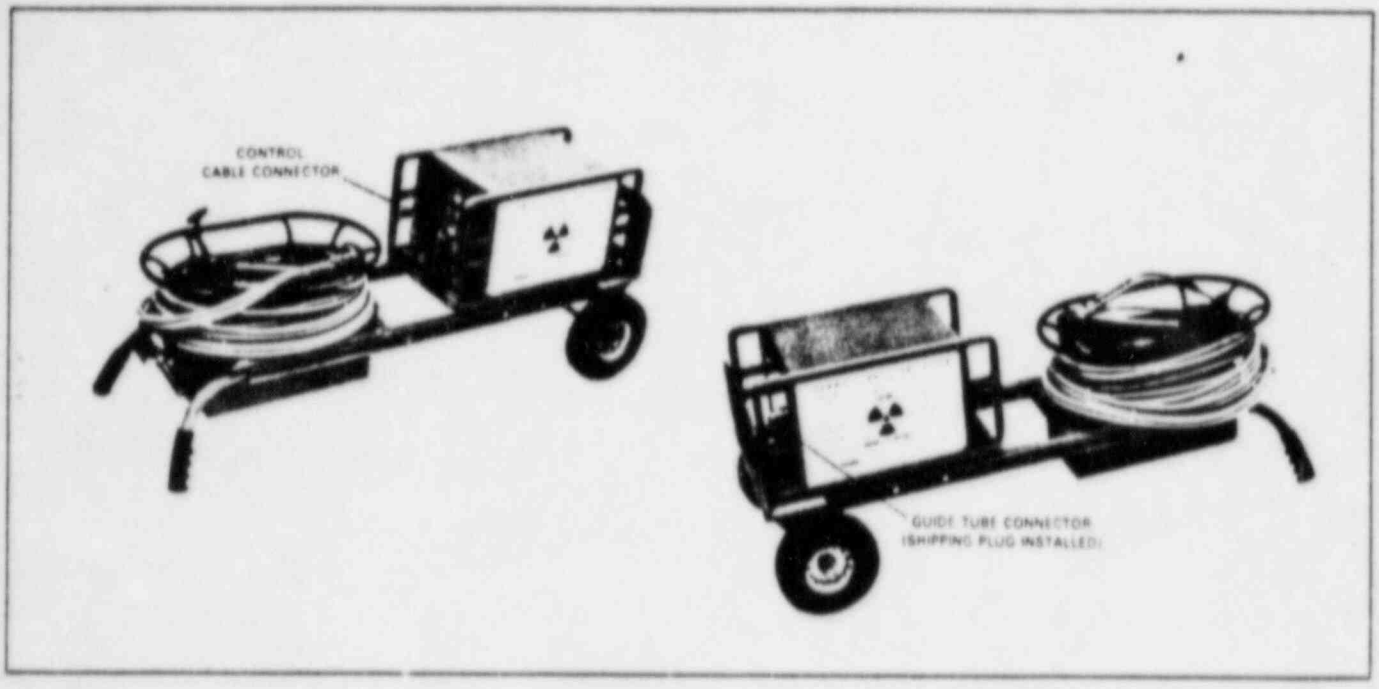


Figure 1-2. Typical Cobalt Gamma Ray Projector (Cart Optional).

control cable and guide tubes, the connector should be in the LOCK position with the attached lock and storage cover engaged and the key removed. All of the selector ring positions of the connector are discussed in detail in Section III, Operation

As shown in Figure 1-2 the guide tube connector is located at the other end of the projector. The shipping plug, shown installed in Figure 1-2, must be removed before the guide tubes can be connected. The shipping plug should be used to prevent dirt, dust, or other foreign material from entering the projector whenever the projector is not in use.

The total weights and sizes of the various projectors in the Cobalt ^{60} Series are given in the specifications (paragraph 1-7).

b. Guide Tube Assembly.

The guide tube assembly consists of one seven-foot master guide tube and two seven-foot extender guide tubes (see Figure 1-1). The master is the guide tube section which contains the snout or source stop at one end. The system should never be operated without the master guide tube being attached to the projector. The two extender sections can be used as necessary to lengthen the guide tube assembly to 14 or 21 feet. Both master and extender guide tubes are made from flexible stainless steel tubing with a protective polyvinyl covering. The three guide tube sections weigh approximately five pounds.

CAUTION

NEVER OPERATE THE SYSTEM WITH MORE THAN THREE GUIDE TUBE SECTIONS (MASTER SECTION PLUS TWO EXTENDER SECTIONS – TOTAL GUIDE TUBE LENGTH OF TWENTY ONE FEET).

c. Tripod Stand.

The tripod stand provides a means of securing the snout end of the master guide tube section so that the source can be positioned at the desired focal point. The stand has adjustable clamps which will provide an unlimited degree of positioning flexibility. The weighted tripod base provides a solid foundation for the stand. The tripod stand, complete with clamps, weighs approximately ten pounds.

d. Model 664 Control Unit.

The Model 664 Control Unit consists of a hand crank, odometer, and 25-foot control cable, and lightweight convenient storage cable reel. In operation, the hand crank controls the movement of the source from the storage position in the projector to the focal or exposure position at the end of the master guide tube. The odometer indicates the distance (in tenths of a foot) that the source has

been moved from its storage position. The reel provides a convenient storage facility for both the control cable and the three guide tubes. The outer control tubing is similar to the construction of the guide tubes. The inner spiral-wound flexible steel drive cable terminates with the male section of a spring-loaded, swivel-type connector. The male section is used to securely engage the female section of the connector which is attached to the leader cable of the radioactive source assembly.

The control tube is terminated at one end by the connecting plug assembly which mates with the fail-safe connector on the projector and at the other end by fittings which attach the cable to the main frame of the control unit. The complete 664 unit with the control cable weighs approximately twenty-two pounds.

e. Model 604 Control Unit.

The basic purpose of the Model 604 Control Unit is the same as that of the 664 unit. It provides an odometer indication of source position and the control cable supplied has an identical connector to the one on the 664 unit. The 604 unit is provided with a pistol-grip handle for convenient operation, however, it does not have a storage reel. The complete 604 unit with the control cable weighs approximately nineteen pounds.

1-4. RADIOACTIVE SOURCE ASSEMBLY

The radioactive source assembly is the most vital component in the system. It is normally ordered and supplied separately. The projectors in the Cobalt^{60} Series have various capacities ranging from 5 to 250 curies (+10%).

The source is contained in a stainless steel capsule firmly affixed to one end of a short leader cable. The other end of the leader cable has the female section of the swivel-type fastener described under the discussion of the Model 664 Control Unit (paragraph 1-3d). The source can easily be changed in the field using a Source Changer which also serves as a shipping container. The Source Changers for the Cobalt^{60} Series include Models T.O.-416, T.O.-488.

1-5. SYSTEM OPTIONAL ACCESSORIES

Table 1-1 lists the options available for the Cobalt^{60} Systems. Also available is a complete range of radiation survey and personnel monitoring dosimeters.

1-6. PRINCIPLES OF OPERATION

The hand crank on the control unit moves the drive cable through the control cable tube. The drive cable is locked to the encapsulated radioactive source via a short leader. Figure 1-3(a) shows the source in the stored position in the projector (hand crank fully clockwise–in the full RETRACT position). Figure 1-3(b) shows the source being moved out of the projector and into the guide tubes. This action occurs by rotating the hand crank in the EXPOSE (counterclockwise) direction. Figure 1-3(c) shows the source reaching the snout which serves as a mechanical stop at the radiographic focal spot. The hand crank will not turn any farther and the control unit odometer should indicate a reading which approximates the total length of the combined guide tubes. To return the source to the projector (stored position), the hand crank is turned to the full RETRACT (clockwise) position..

1-7. SPECIFICATIONS

The specification for the Cobalt^{60} Series systems are given in Table 1-2.

Table 1-1. System Options

Model No.	Description
568	Miniature portable uranium collimator
574	Magnetic stand for 568 collimator
527	Collimator with stand for directional 60° beam or 360° panoramic 20° wide-band beam
653	Side collimator
654	Front collimator
534	Slide-rule type exposure calculator with leather case
492	GAMMALARM radiation monitor
572	GAMMAFLASHER used with 492 GAMMALARM
678	Cart for Model 670 Projector
679	Cart for Models 655, 672, and 676 Projectors

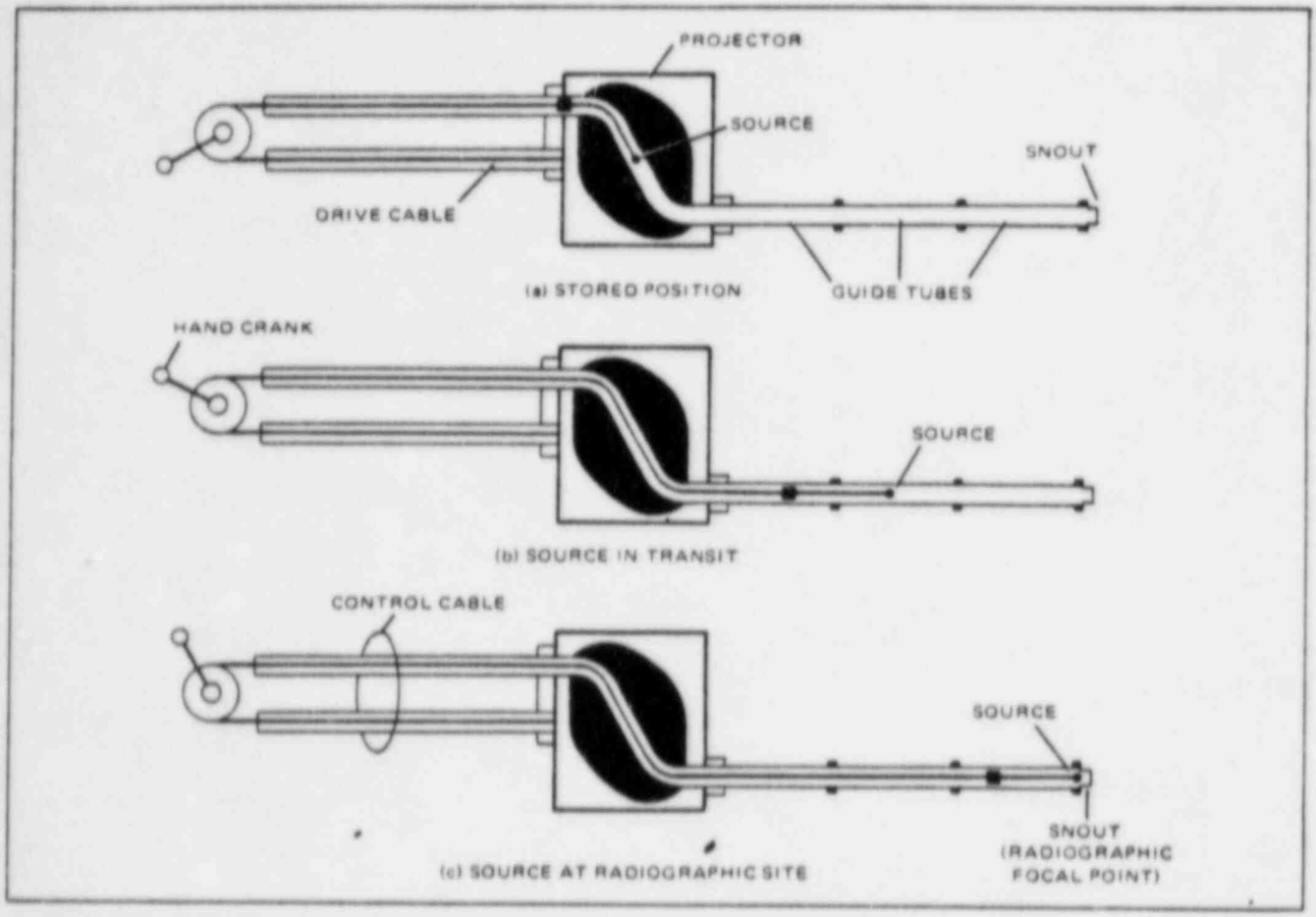


Figure 1-3. Mechanical Schematic.

Table 1-2. System Specifications.

a. Projector

Model No.	Capacity in Curies	Size (in inches) Width	Length	Height	Approx. Projector Weight	Approx. Uranium Shielding Weight	Source P/N
670	5	8 5/8	15 1/2	7 1/2	175	134	A424-10
655	50	11	19 3/4	10 1/4	385	280	A424-11
672	100	13 3/4	24 1/4	12 1/2	580	400	A424-12
676	250	15	29	14	545	370	A424-13
680	100	14 3/4	21	11 5/16	405	285	A424-14
684	10	13	17	9	215	150	A424-15

Note: Shielding conforms to AEC requirement, title 10 CFR part 34.21.

b. Other System Components Weights

Model 664 Control Unit (with control cable): 22 pounds
Model 604 Control Unit (with control cable): 19 pounds
Guide Tubes: 5 pounds
Tripod Stand: 10 pounds

c. Operating Specifications

Maximum distance, projector to control unit: 25 feet
Distance, projector to exposure position: 7, 14, or 21 feet
Source position reproducibility: ± 1/16 inch

Refer to Section II, Recommended Safety Precautions, before operating or servicing these systems.

SECTION II
RECOMMENDED SAFETY PRECAUTIONS

2-1. GENERAL

The Cobalt^{60} Series Projectors are designed to afford operators maximum protection from radiation. However, precautions consistent with accepted isotope handling practices must be observed at all times.

2-2. RADIATION MEASURING INSTRUMENTS

The use of radiation measuring equipment is mandatory; all handling of isotope units should be monitored by proper radiation detectors. The following are recommended:

a. Survey Meters.

Survey meters must be used as a matter of routine to determine the radiation rate per unit time. Technical Operations, Inc. recommends a gamma survey meter of the ionization chamber type, with a full scale range of at least 1000 mr/hr. (Geiger Counter ranges are generally too low.)

b. Film Badges.

Personnel using or working near isotope equipment should wear film badges to provide permanent running records of the radiation dosage received.

c. Pocket Dosimeters.

Technical Operations, Inc. also recommends the use of pocket dosimeters, to allow personnel to determine the exposure received in any given period.

2-3. WORKING DISTANCE

Every precaution should be taken to insure that adequate distance exists 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 Regulations, Title 10, Atomic Energy, Part 20.105.) Personnel operating equipment should always work at the maximum possible distance from the source. (The exposure rate varies inversely with the square of the distance from the source.) Always avoid unnecessary or excessive dosages.

2-4. EXPOSURE TIME

Maximum radiation doses to personnel are specified by State and Federal regulations. (See Code of Federal Regulations. Title 10, Atomic Energy, Part 20.101.) Always observe good radio-graphic techniques to keep doses to a minimum.

2-5. SHIELDING

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

2-6. SHIPPING

For shipment by carriers subject to control by the Interstate Commerce Commission, projectors must be packaged and labelled in accordance with I.C.C. regulations. The package must be plainly marked, "RADIOACTIVE MATERIAL" and "I.C.C. 55." Standard shipping labels, available for this purpose are recommended.

When shipped with the contained Cobalt^{60}, the red label must be identified with Cobalt^{60}, the number of curies contained, and the radiation level on the exterior of the package.

When shipped without the contained isotope the red label must be applied and identified with "depleted uranium", the amount in pounds, and the radiation level on the exterior of the package. Typical shipping labels are shown in Figure 2-1.

(a) With Isotope *(b) Without Isotope*

Figure 2-1. Typical Shipping Labels

SECTION III
UNPACKING AND STORAGE

3-1. INITIAL INSPECTION

If external damage to the shipping containers is evident, ask the carrier's agent to be present when the system is unpacked. Technical Operations, Inc. should be notified immediately if any components were damaged in transit.

WARNING

UNPACK THE SYSTEM ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION II.

3-2. UNPACKING

Cobalt^{60} Gamma Ray Projector System components are normally shipped in two containers. Inspect the containers for external signs of possible damage. Open the containers and remove the system components.

The components are as follows:

(a) Swivel Clamp
(b) Source Tube Clamp
(c) Tripod Base
(d) Tripod Rod
(e) Control Unit with attached Control Cable
(f) Projector
(g) Three 7-foot Guide Tube Sections

3-3. COMPONENT INSPECTION

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

3-4. STORAGE

When storing the system between uses, keep the plastic caps, supplied with the system, in place on the three guide tubes. Also keep the protective cover over the control cable connectors. The caps and cover eliminate dust accumulation within the guide tubes and control cable.

SECTION IV
OPERATION

4-1. PREPARATION FOR USE

WARNING

ASSEMBLE THE SYSTEM FOR USE ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION III.

a. Guide Tube Assembly

1. At the radiographic focal point, position and secure the snout of the master guide tube using the tripod stand and swivel clamps.

2. Remove the plastic dust caps and attach additional extender guide tubes, as necessary, to the master guide tube.

3. Determine the position of the projector allowing for maximum possible operating shielding. Assuming appropriate shielding is available, the operator will be approximately twenty-five feet from the projector during actual operation.

4. Lay out the guide tubes as straight as possible directing them toward the projector. Note that the bend radius of the guide tubes should not be under twenty inches. Smaller bend radii may restrict the movement of the control cable.

NOTE

The guide tubes should not be subjected to any undue stress or abuse which could cause restrictions in the tubes.

5. Remove the shipping plug from the projector connector and attach the last guide tube to the projector (see Figure 1-2).

CAUTION

NEVER OPERATE THE SYSTEM WITH MORE THAN THREE GUIDE TUBE SECTIONS (INCLUDING THE MASTER).

b. Control Unit

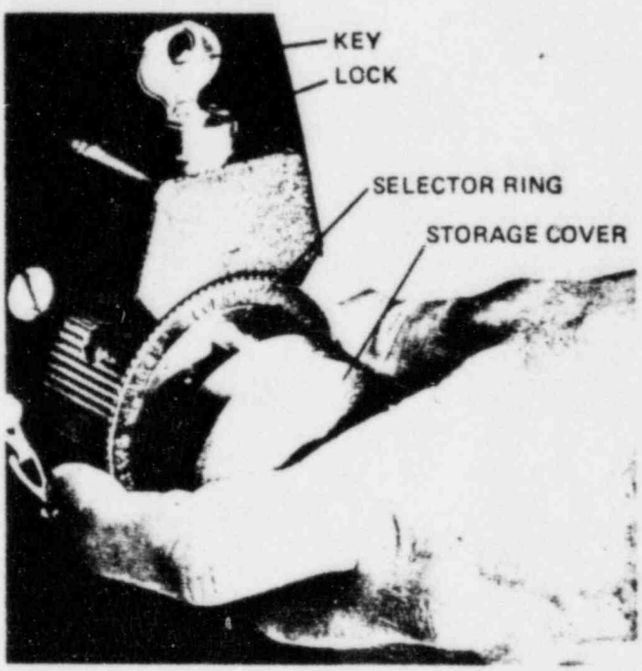
1. Determine the operating site of the control unit. For maximum safety, the operator should be located behind a protective shield.

2. Lay out the control cable as straight as possible directing it toward the projector. Note that the bend radius should note be less than three feet. Smaller bend radii may restrict the movement of the control cable.

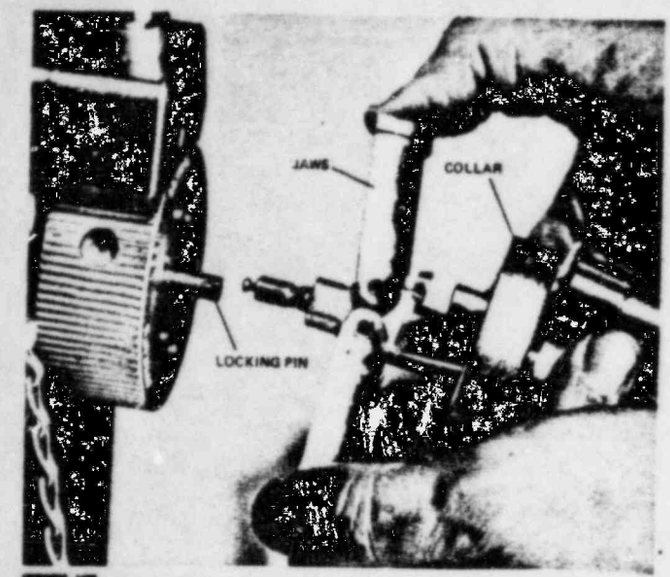
NOTE

The control cable should not be subjected to any undue stress or abuse which could cause restrictions in the cable.

3. Attach the control cable to the projector in accordance with the following illustrated sequence:

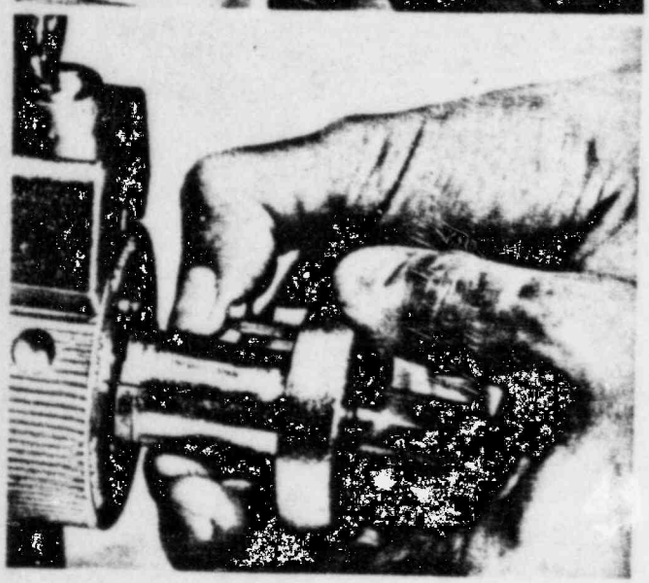


Unlock the projector with the key provided and turn the connector selector ring from the LOCK position to the CONNECT position. When the ring is in the CONNECT position, the storage cover will disengage from the projector as shown.

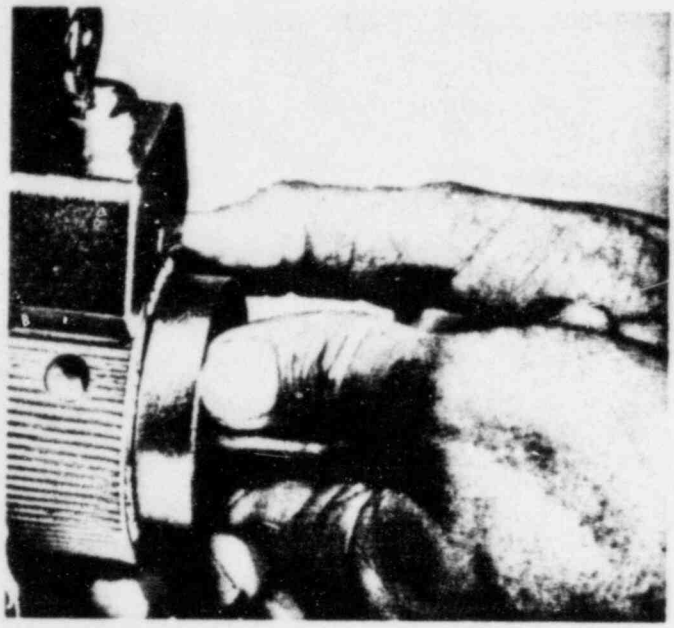


Slide the control cable collar back and open the jaws of the control cable connector. This exposes the male position of the swivel connector as shown.

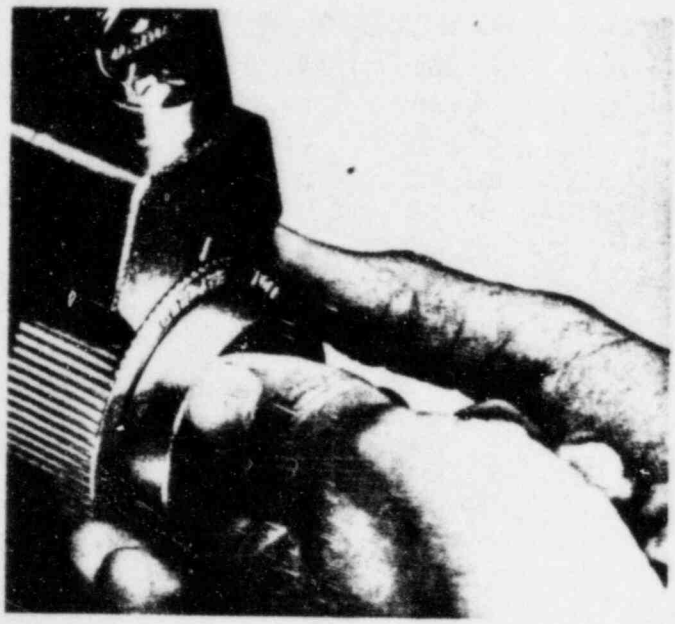
Engage the male and female portions of the swivel connector as shown by depressing the spring-loaded locking pin toward the projector with the thumbnail. Release the locking pin and test that the connection has been properly made.



Close the jaws of the control cable connector over the swivel-type connector.



Slide the control cable collar over the connector jaws.



Hold the control cable collar flush against the projector connector and rotate the selector ring from the CONNECT position to the LOCK position. Keep the projector in the LOCK position until actual operation is ready to start.

4-2. OPERATION

Thoroughly check all cable connections and bend radii and the position of the snout of the master guide tube. (This represents the radiographic focal point of the source.) To operate the system, perform the following:

WARNING

OPERATE THE SYSTEM ONLY IN AREAS MONITORED WITH APPROPRIATE RADIATION MEASURING EQUIPMENT. SEE SECTION II.

a. Unlock the projector connector and rotate the selector ring to the OPERATE position. The source is now free to move.

NOTE

If cranking becomes difficult at any time during the next step, reverse the direction of the cranking to return the source to the stored position in the projector. First monitor the area with a survey meter to insure that the source is properly stored. Then check the control and guide tubes for excessively small bend radii and repeat the step.

b. At the control unit (in a shielded area), rapidly rotate the hand crank in the EXPOSE (counterclockwise) direction to move the source out of the projector and into the guide tubes toward the radiographic focal point. Both the Model 664 and 604 Control Units, shown in Figure 4-1 operate in similar fashion. Continue to rotate the hand crank until the source reaches the snout which serves as a mechanical stop for the source. The odometer reading will indicate the total distance the source traveled (approximately seven feet for one guide tube section, fourteen feet for two sections, and twenty-one feet for three sections).

c. Specimen exposure should be figured from the time that the source reaches the snout or stop.

d. To return the source to the projector, after the desired exposure time has elapsed, rapidly turn the hand crank in the RETRACT (clockwise) direction. Continue to turn the crank until the odometer reading reaches the 000 position. (source properly stored).

CAUTION

AFTER AN EXPOSURE, THE PROJECTOR SHOULD BE THOROUGHLY MONITORED WITH A SURVEY METER BEFORE CONTINUING WITH STEP e.

e. At the projector, rotate the connector selector from the OPERATE position to the LOCK position and secure with the projector lock.

NOTE

If the projector selector ring cannot be rotated to the LOCK position, the source has not been fully retracted. Check the control unit odometer reading. It should be 000. Turn the hand crank to the full clockwise (RETRACT) direction.

4-3. OPERATOR DISASSEMBLY

If the system is to be moved for another exposure or to be stored, the components should be disassembled. Unscrew the guide tube sections from each other and remove the master guide tube from the tripod stand. Place the plastic caps on the tube ends and projector connector to eliminate dust and dirt from entering the tubes. Store the tubes in an area where they will not be subjected to any undue stress or abuse which could cause restrictions.

To disconnect the control unit from the projector, perform the following:

a. Unlock the projector using the supplied key.

b. Rotate the connector selector ring from the LOCK position to the CONNECT position. When the selector ring reaches the CONNECT position, the control cable connector will partially disengage from the projector.

c. Slide the control cable connector collar over the jaws away from the projector.

d. Open the connector jaws and disconnect the swivel-type connector by depressing the spring-loaded locking pin towards the projector with the thumbnail and separating the male and female swivel connector.

NOTE

If any difficulty is encountered, refer to the illustrated instructions given for making the connection for further assistance.

e. Replace the storage cover on the projector connector and rotate the selector ring to the LOCK position. Remove the key and engage the lock to secure the projector.

f. Coil the control cable in the 664 control unit or around the 604 control unit and store the unit in an area where the cable will not be subjected to undue stress or abuse.

g. Disassemble the tripod stand for storage.

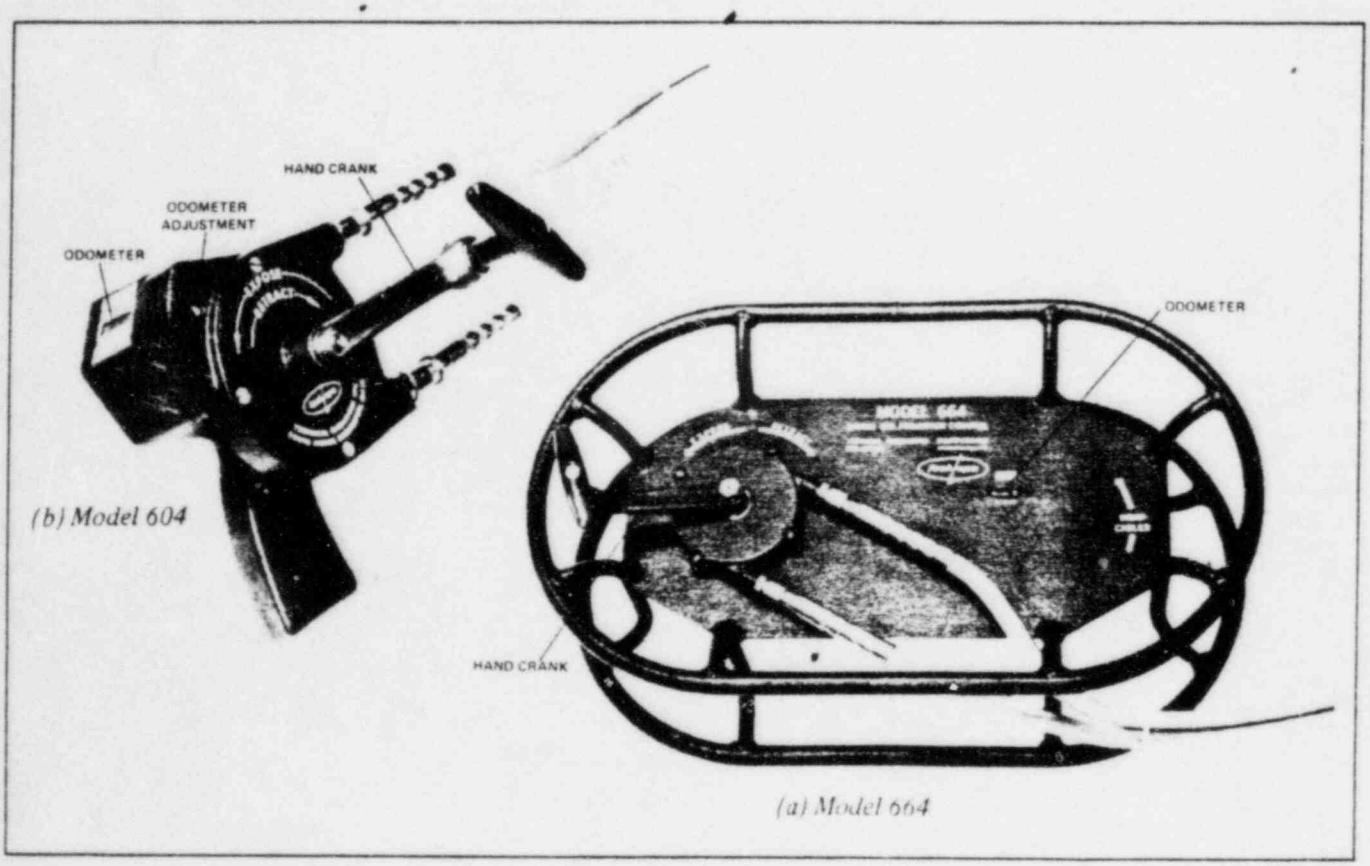


Figure 4-1. Control Units.

SECTION V
MAINTENANCE

5-1. GENERAL

It is imperative that all system components be kept clean. No amount of dirt can be considered negligible. When the system must be operated in a dirty environment, particular care must be exercised to avoid dirt from entering the control or guide tubes. Dirt-clogged cables, tubes, and connectors impede the drive cable movement and could cause jamming.

5-2. CONTROL CABLE

Inspect the control cable regularly for signs of damage. Avoid twisting or bending the cable excessively. Recoil the control cable carefully for storage. Never drag the cable on the floor or ground. Use the protective cover (over the connector) when the control cable is not in use.

5-3. GUIDE TUBES

Inspect the guide tubes regularly for signs of damage. Avoid twisting or bending the tubes excessively. Recoil the guide tubes carefully for storage. Never drag the tubes on the floor or ground. Replace the plastic caps on the guide tubes connectors when not in use.

5-4. CLEANING AND LUBRICATING SYSTEM CABLES

The frequency of cleaning and lubrication depends on the amount and type of use. These procedures should be performed whenever the cranking of the control unit becomes difficult. Perform the following:

1. Disconnect the control cable from the projector.

2. Turn the hand crank in the EXPOSE (counterclockwise) direction until the cable disengages from the drive gear. This becomes apparent because further turning of the hand crank will have no effect on the control cable.

3. Pull the cable free from the control cable housing. Coil the cable (a radius of not less than four inches) and place the cable in a container of degreasing solvent. Do not use water-based cleaning agents. Allow the cable to soak as long as is necessary to remove all accumulated foreign matter.

4. Remove the control cable from the control unit by loosening the two fittings. (Before removing the fittings, label them to facilitate reassembly.)

5. Pour degreasing solvent into the control cable tubing to clean. Continue to flush the tubing until the solvent leaving the tubing is free from impurities.

6. Use compressed dry clean air (do not exceed fifteen pounds) to thoroughly dry both the tubing and cable. Any remaining solvent could cause permanent damage.

NOTE

Since the drive cable and control tubing have been thoroughly cleaned, care must be exercised to avoid any dust or dirt contamination during the remainder of this procedure.

7. Lightly grease the drive cable with "Texaco-Unitemp" grease. Other greases may form tars or corrosive compounds when exposed to radiation.

8. Carefully feed the cable into the tubing from the cable end which attaches to the projector.

9. When the cable reaches the control unit fitting, guide the cable into the hand crank housing. Slowly turn the hand crank in the RETRACT (clockwise) direction until the cable engages the crank gear.

10. Reconnect the two fittings which connect the control cable to the control unit.

11. Turn the hand crank in the RETRACT direction until the cable is completely contained in

the housing. If the odometer reading is not 000 at this time, refer to the odometer adjustment procedure given in this section.

To clean the guide tubes, flush them thoroughly with a cleaning solvent (chlorothene or carbon tetrachloride). Dry thoroughly with clean dry compressed air. Replace all plastic dust caps when storing the tubes.

5-5. REPLACING THE CONTROL CABLE

To replace the control cable, refer to the cleaning procedures given in paragraph 5-4.

5-6. ODOMETER ADJUSTMENT

The odometer in both the 664 and 604 control units, has a screwdriver adjustment control. If the hand crank is in its full RETRACT position, the odometer should indicate 000. If not, slowly adjust the control to obtain a 000 reading. The odometer adjustments are located in Figure 4-1(b) for the 604 control unit and Figure 6-3 for the 664 control unit.

5-7. SOURCE REPLACEMENT

Renewal sources are available from Technical Operations, Inc. for replacement in the field. For instructions, see the procedure supplied with the replacement source.

A dummy source is normally supplied with the system. A clip inside the storage cover of the projector connector is provided for dummy source storage. The dummy source can be used when the radioactive source has been removed (using a source changer) so that the control cable can be disconnected from the projector. Note that the fail-safe feature of the connector requires either a source or a dummy source properly stored in the projector before the control cable can be disengaged.

5-8. CONTROL UNIT REPAIR

Exploded views of both the 664 and 604 control units are given in Section VI (Figures 6-3 and 6-4). If parts must be replaced, use the index numbers of the related illustration as a guide to disassembly and reassembly. The illustrations also include a parts list for ordering replacements.

5-9. GAMMA RAY PROJECTOR

WARNING

THE SOURCE SHIELD PORTION OF THE PROJECTOR IS NOT REPAIRABLE IN THE FIELD. SEAL WIRES HAVE BEEN ATTACHED TO PREVENT OPENING THE SHIELD WHICH COULD RESULT IN A SERIOUS RADIATION OVEREXPOSURE.

Advanced Radiation Service

14 Winding Road □ [redacted] □ 283-3264

OPERATING & EMERGENCY PROCEDURES

VIII. SOURCE CHANGING PROCEDURES

General Instructions

* Source changes must be performed by a Radiographer or Radiation Safety Officer at Advanced Radiation Service.

* Source changes can be performed for Iridium^{192} only. Model 650 Source Changer, manufactured by Technical Operations, will be used. This is a portable, shielded container for transferring encapsulated radioisotope sources into radiography projectors. Model 650 has depleted uranium for shielding and its design meets the Type B requirements of the U.S. Department of Transportation.

* The container capacity is 200 curies ± 20% of Iridium^{192}, with depleted uranium (U^{238}) shielding weighing 35 lbs. The housing is made of steel. Every loaded 650 Source Changer is shipped from Technical Operations with the following items:

  a) Source decay chart and leak test certification to be kept with Advanced Radiation Service's records by Mr. Kurtz, the Radiation Safety Officer.

  b) Source identification (ID) plate, which is to be affixed to the projector used by Advanced Radiation.

  c) Return shipping labels

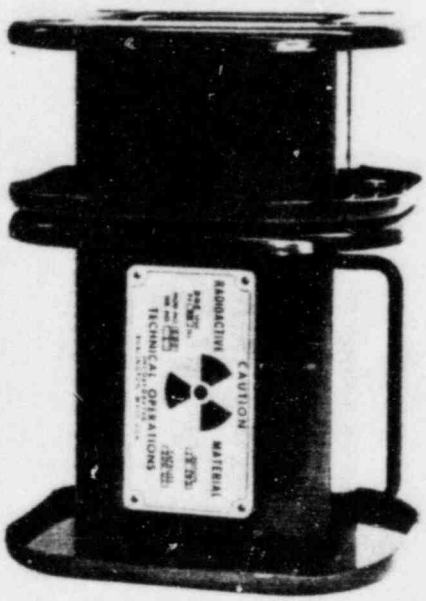
  d) Tamperproof seals

  e) Instruction manuals (see following pages), 650 & 771.

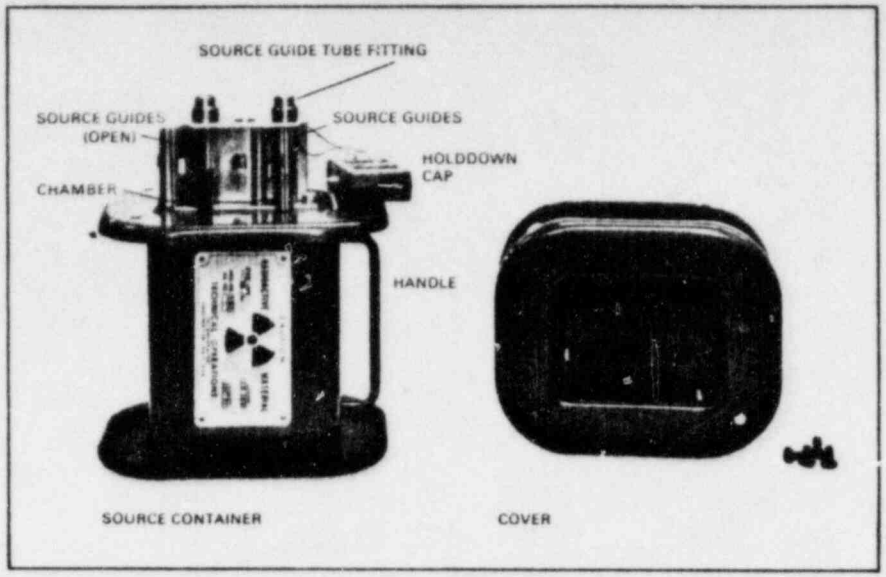
* All Cobalt^{60} sources can only be changed by the vendor of the source, not by Advanced Radiation Service.

OPERATING INSTRUCTIONS

SOURCE CHANGER
Model 650



TECHNICAL OPERATIONS, INC.
Radiation Products Division
Burlington, Mass. 01803



Model 650 Source Changer
(Source in a chamber – Parts Identification)

NOTICE

This container is for shipping **only** licensed sources of Technical Operations, Inc. No attempt to use this equipment should be made unless the user is thoroughly familiar with the instructions in this manual.

USER WAIVER AGREEMENT

The user agrees that Technical Operations, Inc. is not liable for any claims alleged to be due to use of the product.

The AEC forbids the use of this equipment and the exchange of sources unless the user is specifically authorized by the terms of his license.

If user is not authorized to make source changes, contact Picker Industrial. It has licensed personnel that can perform this operation. If user wishes to be licensed to perform source changes, application should be made to the Atomic Energy Commission, Division of Licensing and Regulations, Washington, 25, D.C. The application, in letter form, should specify by whom and under what conditions source exchanges are to be made. Refer to this instruction manual for detailed procedures. Additional copies may be obtained for incorporation in your operating procedures manual.

GENERAL DESCRIPTION

The Source Changer Model 650 is a portable shielding container for transferring encapsulated radioisotope sources into radiography projectors. The changer is designed to safely contain the radiographic sources during shipment and to permit field exchange of old for new sources without exposing the operator to unsafe radiation levels. The source changer has depleted uranium for shielding. The design of the unit meets the Type B requirements of the Department of Transportation.

QUICK REFERENCE DATA

Source types	Sealed sources (Tech Ops sources only) Isotope: Iridium 192 and Cobalt 60 Radiation: gamma rays Tech Ops: Model A424-1 Iridium Model A424-5 Cobalt Model 531-B Iridium
Container capacity	Iridium 192 – 200 curies Cobalt 60 – 75 millicuries
Shielding	Depleted uranium (U^{238}) – Wt. 35 lb.
Housing	Steel
Design	Complies with DOT – 55 & Type B Packaging
Effective radiation shielding	Well below regulatory mR/hr limits prescribed in 10 CFR 34. 21 and 49 CFR 389 (i), 393 (i).
Dimensions	13 1/4 H x 10 L x 8 1/4 W – inches
Shipping weight	66 lb.

SHIPMENT DATA

Every loaded Model 650 source changer is shipped with the following items:

1. Source decay chart and leak test certification. *Keep for user's records.*
2. Source identification (ID) plate. *Affix to user's projector.*
3. Return shipping labels.
4. Tamperproof seals.
5. Instruction Manual.

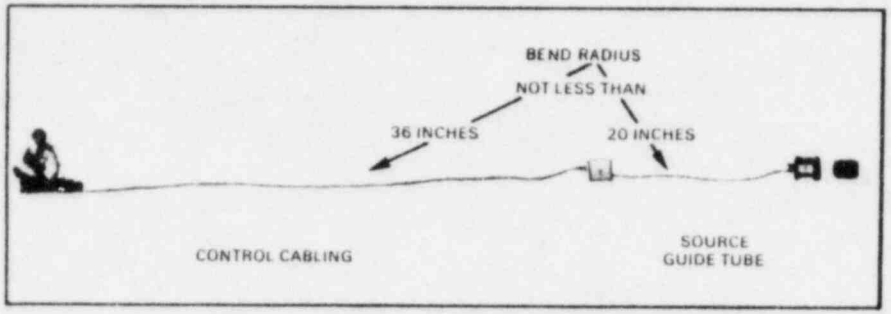
OPERATING INSTRUCTIONS - SOURCE CHANGING

WARNING

RADIATION HAZARD. All the precautions used when making radiographic exposures are applicable, in accordance with 10 CFR 34.

A. Locate source changer and projector in an area where the source may be exposed.

B. As illustrated in figure below, place units to minimize any bend radius in the source guide tube (7-ft. extension) and control cabling.



Typical Source-exchange Arrangement

1. Set projector as for an exposure.
2. Open source changer.
   a. To remove cover: break seal and unbolt.
   b. To remove source holddown cap: break seal and unbolt.

CAUTION

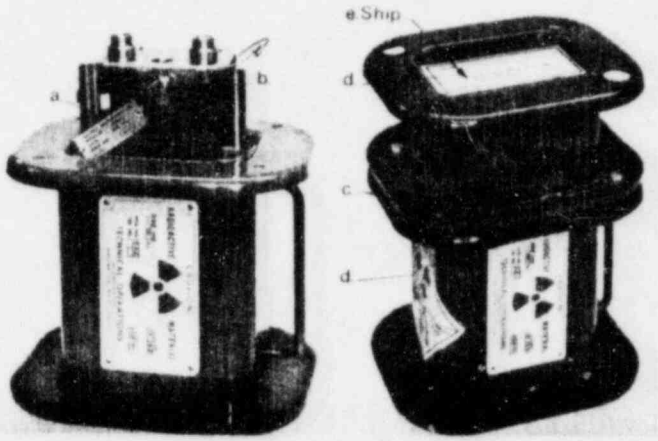
When cap is removed, source connector is exposed. Special care should be taken not to dislodge source when handling the changer.

3. Connect extension source guide tube from projector to the fitting above empty chamber. (Avoid sharp bends.)
4. Close and latch the source guides.
5. Crank source into the source changer.
   a. Survey this operation with a gamma survey meter to be sure source has been transferred from projector to changer.
   b. With a survey meter verify radiation level does not exceed 200 mR/hr at the surface of changer.
6. Open guides. Disconnect cable from source assembly. See instructions of figure A.
7. Disconnect the guide tube from changer. (If a new source is not to be transferred, go to step 15.)
8. Connect the guide tube to the fitting above chamber containing new source. (Avoid sharp bends.)
9. Crank projector drive cable until connector butts to source connector.
10. Couple the connectors. See instructions of figure A.

WARNING

When testing connectors for proper connection, do not move source more than 1/2 inch from its stored position.

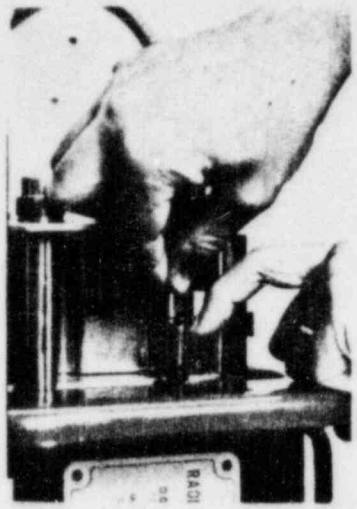
11. Close and latch the source guides.
12. Crank source to full retraction within projector.
    a. Survey this operation with a gamma survey meter to be sure source has been transferred into the projector.
    b. With a survey meter verify radiation level does not exceed 200 mR/hr at the surface of the projector.
13. Disconnect the source guide tube from changer.
14. Affix ID plate of new source to projector.
15. Prepare source changer for shipping:
    a. Attach ID plate of old source to holddown cap.
    b. Bolt holddown cap in place and seal. (Source guides open)
    c. Bolt changer cover in place and seal.
    d. Affix proper shipping labels and return to Technical Operations, Inc.
    e. Ship PREPAID



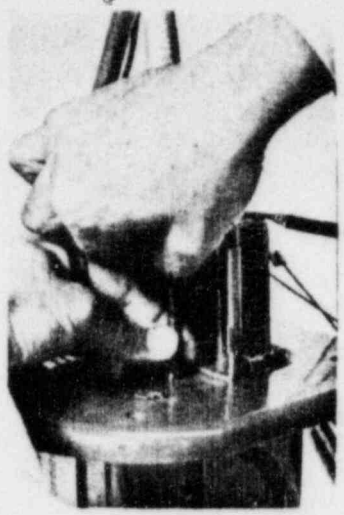
Preparing Source Changer for Shipment

NOTE

Please return container promptly. Rental charges will be made for containers held beyond normal transportation time.



Connecting/Disconnecting



Testing Connection

WARNING

Do not move source assembly more than 1/2 inch from its stored position when connecting/disconnecting or when testing for proper connection.

TO ENGAGE CONNECTORS

1. With fingernail move lock pin back from keyway. (Pressure on pin is downward toward stored position of source.)
2. Slide drive-cable connector into keyed sleeve and release pin.
3. Test connection by pulling between source and drive cable. (Note WARNING.)

TO DISENGAGE CONNECTORS

1. With fingernail move lock pin back from keyway.
2. Slide drive-cable connector out through keyway and release pin.

CAUTION

Move connector sideways only. Do not bend or twist.

Figure A. Procedures for engaging and disengaging the Model 550 source-assembly connector. Testing for proper connection must be performed.

Radiation Products Division, a division of Technical Operations, Inc. produces and manufactures a complete line of industrial radiographic devices. Its hot-lab facilities, modern and well-equipped, are available to industry for special projects and study programs.

PRODUCTS

Radioisotope sealed sources

Gamma Ray Projectors – portable & mobile

RADIOGRAPHIC ACCESSORIES

Calibrators

Irradiators

Radiation Area Monitors

Image Evaluation Instruments

Write or call Picker Industrial or Radiation Products Division for complete information.

TECH/OPS MODEL 771

SOURCE CHANGER - SHIPPING CONTAINER

OPERATION MANUAL

Technical Data

Size:	23 in. long, 24 in. wide, 20 in. high 58cm long, 61cm wide, 51cm high)
Weight:	690 Lbs. (314kg)
Capacity:	110 Curies of ^{60}Cobalt As Special Form
Transport Status:	Type B USNRC USA/9107/B IAEA USA/9107/B
Shielding:	Depleted Uranium Metal 200 Lbs. (91kg)

General

The Model 771 Source Changer - Shipping Container is designed for transferring encapsulated radioisotope sources into radiographic devices and for transporting these sources.

The U. S. Nuclear Regulatory Commission allows the use of this source changer only if the user is specifically authorized by the terms of his license.

If the user is not authorized to make source exchanges, contact Technical Operations, Inc. It has personnel who are authorized to perform this operation. If the user wishes to be licensed to make source exchanges, application should be made to:

Radioisotope Licensing Branch
Division of Fuel Cycle and Material Safety
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Prior to the first shipment of this source changer, the user, in addition, should register with:

Transportation Branch
Division of Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Operation

Note: All the precautions used when making radiographic exposures must be followed.

Wear personnel monitoring devices during all source changing operations. Monitor all operations with a calibrated, operable survey meter.

1. Upon receipt of the source changer, survey the source changer to ensure that the source is in the proper storage position.

2. Locate the source changer and projector in a restricted area. Locate the devices so as to avoid sharp bends in the guide tube or control housing.

3. Set the projector as for an exposure.

4. Remove the cover plates from the source changer by breaking the seal wires and removing the bolts.

5. Connect one end of a guide tube extension to the projector and the other end to the fitting of the empty chamber in the source changer. Insure that the selector ring is in the unlock position.

6. At the projector controls, crank the source from the projector to the source changer.

7. Approach the projector with the survey meter. Survey the projector on all sides, survey the guide tube and survey the source

changer on all sides to ensure the source has been properly transferred. The maximum radiation level at the source changer shculd be less than 200 milliroentgens per hour at contact.

8, Rotate the selector ring to the LOCK position and depress the plunger lock. Disconnect the guide tube from the source changer. Disconnect the drive cable from the source assembly by moving the lock pin down and sliding the drive cable connector out through the keyway.

9. Couple the drive cable to the new source by depressing the lock pin, sliding the drive cable connector into the keyway, and releasing the lock pin. Test for proper engagement. Connect the guide tube to the fitting of the chamber. Unlock the key operated plunger lock and rotate the selector ring to the UNLOCK position.

10. At the projector controls, crank the source from the source changer to its storage position in the projector.

11. Approach the projector with the survey meter. Survey the projector on all sides, survey the guide tube, and survey the source changer on all sides to ensure the source has been properly transferred.

12. Lock the projector.

13. Disconnect the source guide tube from the source changer.

14. Affix the identification plate of the new source to the projector and attach the identification plate of the old source to the source changer chamber in which the source has been installed.

15. Again insure that the old source is secured in the source changer, the selector ring is the the LOCK position and the key operated plunger lock is engaged.

16. Bolt the source changer cover plates in place and seal wire.

17. Survey all exterior surfaces of the source changer to ensure that the radiation level does not exceed 200 milliroentgens per hour at contact.

18. Measure the radiation level three feet from all exterior surfaces of the source changer and ensure that the radiation level is less than 10 milliroentgens per hour. The maximum radiation level measured three feet from any exterior surface is the Transport Index. (Example: With a maximum radiation level of 2.2 milliroentgens per hour, the Transport Index is 2.2.)

19. Complete the appropriate "RADIOACTIVE" shipping labels. For contents, list the radioisotope contained Cobalt 60 or Iridium 192. Indicate the activity as the number of Curies. Record the Transport Index as determined above.

20. Apply the "RADIOACTIVE" shipping labels, properly completed, to two opposite sides of the container.

21. Return the container to Technical Operations, Inc.

CERTIFICATION

The following instrument, _____, Serial No. _____ has been calibrated with CO-60 Gamma Radiation. The dose rates were measured with a Victoreen Model 570, S. N. 532 condonser type R-Meter, which has been calibrated by the National Bureau of Standards.

Certified this date: _____

EBERLINE INSTRUMENT CORPORATION

Signed: _____

T/O-571 METER CALIBRATION KIT

OPERATING INSTRUCTIONS

The T/O-571 Meter Calibration unit is a compact directional source shield which contains a 12 millicurie Cobalt 60 source, at the bottom of a source rod. Lifting the source rod exposes the source through the port window, and dropping the source rod returns the source to the stored position. The source rod/capsule assembly may not be removed from the container. CAUTION! Seal wires are not to be broken!

1. The T/O-571 Meter Calibration kit consists of:

   1. No. 57100-1 directional source shield containing model Co-.012 Cobalt 60 source of approximately 12 millicuries
   2. 57100-8 Tape Measure
   3. Instruction Manual

WARNING

Do NOT unpack this device except in the presence of appropriate measuring instruments.

2. Receiving: As soon as you receive the T/O-571 kit, follow this procedure:

   A. Survey the package for excessive radiation. Radiation levels on the surface of the shipping crate should be less than 100 mr/hr.

   B. Inspect the exterior and interior contents for shipping damage, and inventory all contents in accordance with paragraph 1 above.

3. Preparation for use:

A. Place the source shield in a restricted area so that the directional port is aimed horizontally. To minimize the effects of scattered radiation, the unit should be at least 16 feet from any wall, in the direction of the primary beam.

B. Position a support 10' long horizontally from the T/O-571 directional shield, as shown on Drawing 57101.

C. Restrict access to an area 10' from the container as shown on Drawing 057102 attached.

4. Survey Meter Calibration:

A. On the bottom of the identification label is a dose/distance computer. The source size and date of calibration is stamped on the identification label. Follow these steps: (1) Set the age of the source shown on scale A opposite the original source size shown on scale B. (2) Tighten the screws holding the bottom scale. Desired dose rates are shown on scale C, and you may read the correct distance directly below the dose rate desired.

B. Turn on your survey instrument, let it warm up for about 10 minutes and zero the meter.

C. Turn the range switch to the low range, and place the meter at the appropriate distance (see dose/distance computer) for a 2.5 mr/hr reading. The survey meter should be located so that the center of the ion chamber, or detector, is at the correct distance, and centered on the center line of the radiation beam. The longest dimension of the ion chamber should be at right angles to the radiation beam. Depending on the physical size and configuration of your survey meter, it may be necessary to mount the 571 source shield somewhat higher than the bench surface. When the proper geometry for your meter has been established, use the same physical set-up consistently in future calibration operations.

A maximum dose rate of 1000 mr/hr can be obtained with certain survey meters in contact with the radiation port; however, the physical geometry of some survey meters may lead to incorrect readings at

such a close distance. Do not use less distance than the minimum distance which provides the correct maximum dose in accordance with the dose/distance computer.

CAUTION

The meter should be placed so that you can read it from a distance without exposing yourself to the primary beam.

D. Stand AWAY from the primary beam and open the source shutter. This may be done by lifting the source rod manually, or remotely with a string attached to the source rod. Check the reading on the instrument and then close the source shutter by allowing the source rod to drop to the stored position. If the reading does not agree within ~~± 20%~~ 10%, an adjustment is required.

E. In turn, check at least two points on all other scales using the correct distance indicated by your dose/distance computer.

F. On completion of the calibration, the source rod is to be dropped to the closed position, the locking bar inserted to prevent source movement, and the lock is to be locked and secured.

G. Survey meters which cannot be calibrated should be returned to the manufacturer for repair.

H. Fasten a label to your survey meter indicating the date of calibration.

5. Leak Testing:

The T/O-571 Meter Calibration kit contains a Cobalt 60 source which must be leak tested at 6 month intervals. This may be done by using the T/O-518 leak test kit as follows:

A. Place the T/O-571 directional shield in a restricted area.

B. Remove the lock and locking bar from the top of the source shield.

C. Wet the swab in the EDTA solution. Shake off the excess and wipe around the top of the source rod.

D. Raise the source rod to open position and wipe the exposed source rod thoroughly.

E. Place the swab in the plastic envelope.

F. The swab should now be monitored by turning the survey meter to its most sensitive range. Place the meter in a low background area and move the swab in its plastic envelope to the meter, not the meter to the swab.

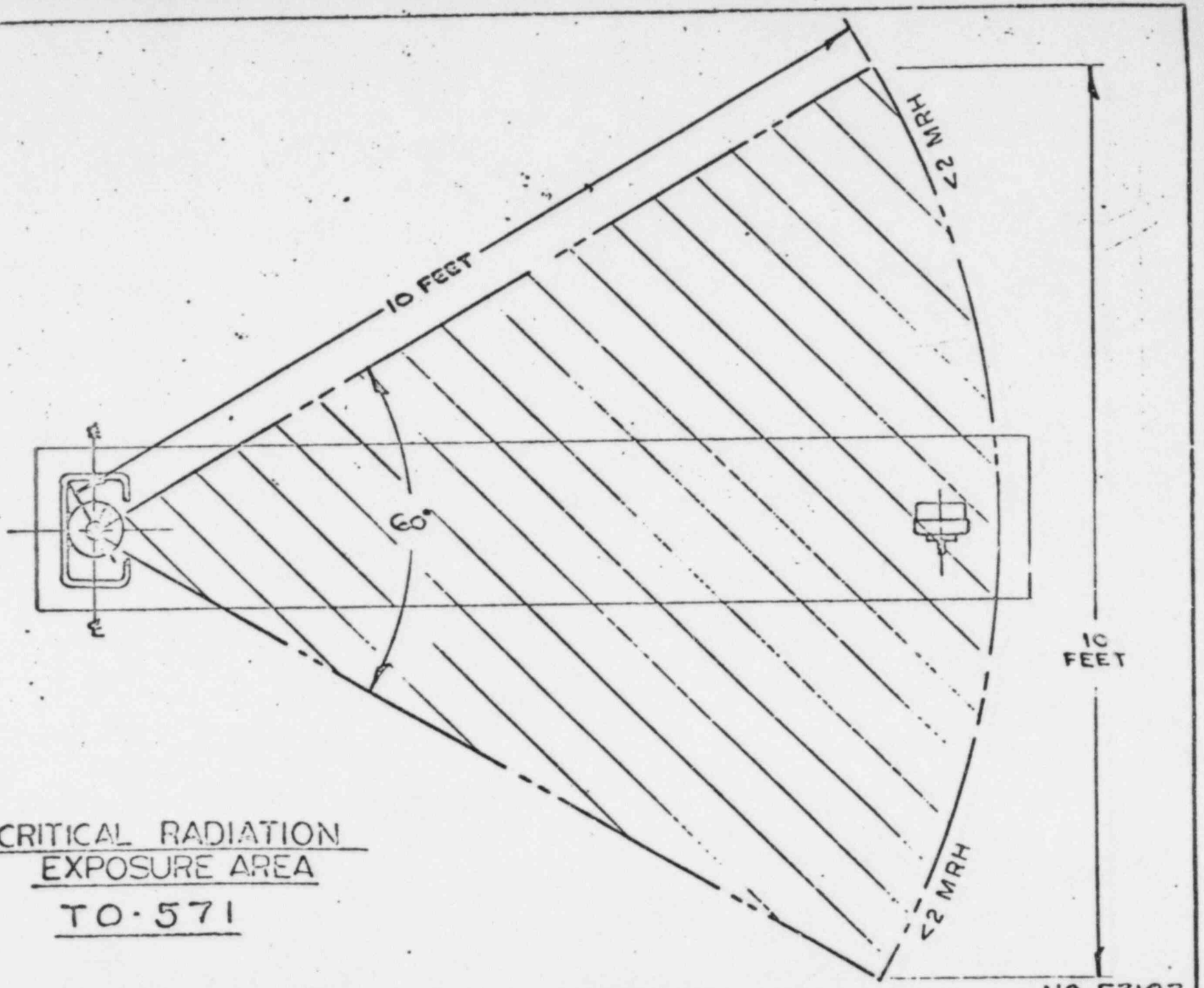
G. If there is no indication on the meter, or if the indication is no more than 0.2 MR per hour above background, put the plastic envelope with the swab in the mailing box and mail to Technical Operations, Incorporated, Burlington, Massachusetts. Be sure to fill out and return the identification sheet.

H. If the swab should show more than 0.2 MR per hour, do not mail. Contact Technical Operations, Inc., for specific instructions.

NOTE: If the survey meter available does not have the capability of detecting as little as 0.2 MR per hour, ship the wipe test swab to Technical Operations, Inc., via express. Do not ship if the radiation from the swab exceeds 2 MR per hour, and contact Technical Operations, Inc. for specific instructions. The wipe-test swab will be subjected to a precise radio assay when received by Technical Operations and a leak-test certificate will be mailed promptly. The AEC requires that this certificate be kept with your records and that it be available for inspection.

I. If other leak procedures are used, they must be specifically authorized by the AEC.

4.



CRITICAL RADIATION
EXPOSURE AREA

TO-571

foothope
BURLINGTON, MASS

Advanced Radiation Service

14 Winding Road □ Iselin, N.J. 08830 □ 283-3264

OPERATING & EMERGENCY PROCEDURES

IX. EMERGENCY PROCEDURES.

i. Plant Emergency. In the event of a plant emergency, in an area adjacent to a radiographic device, such as fire or an accident involving plant personnel, immediately do the following:

1. Return source to shielded position in device. Lock device.

2. Perform physical radiation survey of device to assure that source is in shielded position.

3. Remove source and control cables and insert safety plugs.

4. Remove device from danger area and if possible return to storage building.

5. Notify the Radiation Safety Officer.

6. If a radiographic device cannot be removed from a danger area, do the following:

a. Set up a Restricted Area, as specified in Section 6 of these Operating & Emergency Procedures, around the device, using survey instrument to determine area.

b. Notify the Radiation Safety Officer.

c. The R.S.O. shall notify plant guards or security, local police and/or fire department, if applicable.

d. The R.S.O. shall determine further course of action.

ii. Accidents Involving Source - In the event of an accident to the source or device, such as a falling object hitting the device, immediately do the following:

1. Return source to device, if possible, and lock device.

2. Notify your supervisor, who shall in turn notify the R.S.O., if your supervisor is other than the R.S.O.

continued...

OPERATING & EMERGENCY PROCEDURES

IX. EMERGENCY PROCEDURES (con't.)

ii. Accidents Involving Source (con't.)

3. Do not use the device again until Mr. Kurtz has made an inspection of the device and personnel monitoring equipment and grants approval for its use.

4. In the event the source cannot be returned to the device, the following action must be taken:

a. Set up and post a Restricted Area, as specified in Section 6 of these procedures, using a survey instrument to determine the perimeter of the area.

b. Prevent all personnel or others from entering the area.

c. Notify the Radiation Safety Officer, Mr. Kurtz.

d. Continue to restrict entry into the area.

e. Mr. Kurtz will in turn notify the following:

Technical Operations, Burlington, MA	(800) 225-1383 (617) 272-2000
NRC, King of Prussia, PA	(216) 337-1150
N.J. Dept. Environmental Protection, Bureau of Radiation Protection, Trenton, NJ	(609) 292-5586

iii. Exposure of Non-Monitored Personnel. In the event of an accident involving the exposure of non-monitored personnel to radiation, immediately do the following:

1. Use the survey instrument to determine the perimeters of a Restricted Area, post the area, and retain all names and numbers of the non-monitored personnel involved.

2. Post guards to prevent admittance to the Restricted Area.

3. Obtain all pertinent facts about the accident and report them immediately to Mr. Kurtz.

/continued.....

OPERATING & EMERGENCY PROCEDURES

IX. EMERGENCY PROCEDURES (con't.)

iii. Exposure of Non-Monitored Personnel.(con't.)

4. Mr. Kurtz will determine what course of action to take and will notify the NRC in accordance with Sections 20.403 and 20.405 of Part 20 as necessary.

iv. Loss of Source. In the event of a lost source, the following actions must be taken:

1. Notify Mr. Kurtz of the incident.

2. Mr. Kurtz, the Radiation Safety Officer, will perform the following immediately.

a. Check the area with a survey meter and rope off.

b. Obtain all information on the last known location.

c. If possible, locate the source using a survey meter and triangulation methods and replace the source in device or storage container as soon as possible.

d. Check non-monitored personnel as in iii. above.

e. Notify the NRC.

v. Vehicular Accident. In the event of a vehicular accident involving byproduct material while traveling to an exposure site, a Restricted Area must be established.

1. If the survey meter is operable, use it to establish the perimeter of the Restricted Area.

2. If the survey meter is inoperable, use calculations of the charts included in Section 6 to establish the perimeter of the Restricted Area, assuming that the source is in an exposed position inside the vehicle. (In case of a minor accident where it can be visually determined that the source is safely stored in its container, no Restricted Area is required.)

If the survey meter is operable and no radiation hazard exists, and the vehicle is movable, proceed.

/continued..

OPERATING & EMERGENCY PROCEDURES

IX. EMERGENCY PROCEDURES (con't.)

v. Vehicular Accident (con't.)

In any case, after establishing the Restricted Area if necessary, notify Mr. Kurtz and the local civil authorities.

vi. Notification and Reports of Incidents to NRC.

1. The Radiation Safety Officer will notify the NRC by telephone or telegraph in accordance with paragraphs 20.402 and 20.403 of Part 20.

2. The Radiation Safety Officer will notify the NRC by writing within thirty (30) days in accordance with paragraph 20.405 of Part 20.

Advanced Radiation Service

14 Winding Road □ Isolin, Neb 99999 □ 283-3264

OPERATING & EMERGENCY PROCEDURES

X. TRANSPORTATION OF EXPOSURE DEVICES AND STORAGE CONTAINERS

i. The vehicle(s) used to transport exposure devices and storage containers from Advanced Radiation to worksites and back must be in operating condition and have the following safety equipment:

1) Two calibrated survey meters in good working order.
2) Radiation warning signs:
   a) At least 8 reading "CAUTION-RADIATION AREA"
   b) At least 4 reading "CAUTION-HIGH RADIATION AREA"
3) Warning rope or tape (minimum of 500 feet)
4) Fire extinguisher and spare tire
5) Set of vehicle tools and set of road flares
6) Pocket dosimeter charger in good working order
7) Length of utility rope
8) Flashlight
9) Spare "D" batteries
10) Copy of these Operating & Emergency Procedures
11) Copy of NRC License

ii. The vehicle must be accompanied by a qualified Radiographer and may also have an Assistant Radiographer.

iii. Insure that the shipping container is properly packaged, marked and labeled and the shipping papers are completed.

iv. Place the radioactive material container/exposure device in the vehicle and secure against movement within the vehicle.

v. Perform radiation surveys to insure that the radiation level inside the driver's compartment does not exceed 2 mr/hr and that the radiation level outside the vehicle does not exceed 1 mr/hr.

vi. In the event that the transporting vehicle is required to stay in an "Unrestricted Area", it must be secured against unauthorized removal from the place of storage

vii. All keys to the vehicle and the exposure device and/or shipping container must be in the possession of the Radiographer.

viii. If the vehicle is transporting a package bearing a "Radioactive Yellow III" label, the vehicle must be placarded on all four sides with a "RADIOACTIVE" placard.

ix. Complete the radioactive material transport checklist. Forward a completed copy to the Radiation Safety Officer upon

continued...

OPERATING & EMERGENCY PROCEDURES

X. TRANSPORTATION (con't.)

completion of the carriage.

x. If the vehicle becomes disabled on the road, or if any other emergency situation arises, see Section IX. of these procedures on emergencies.

xi. A radiographer must be in constant attendance during the transportation of devices.

xii. In case of an accident, make an immediate radiation survey if possible to see where radiation levels may be higher than permissible levels. Maximum permissible levels on shipping containers or exposure devices are 10 mr/hr three feet from any surface and 200 mr/hr at the surface. If necessary, rope off the area at the 2 mr/hr level, establishing a Restricted Area, and post warning signs (see Section VI.) Have someone contact the home office but do not leave the scene without the local police being present. Follow the Emergency Procedures outlined in Section IX.

xiii. In-plant transportation of devices shall be accomplished using handcarts or similar means. Hand carrying of exposure devices for long distances is extremely prohibited because of the relatively high radiation levels which exist at the surfaces of these devices.

xiv. Before transporting byproduct material, you must notify all appropriate personnel at Advanced Radiation Service as well as personnel at the destination worksite of the starting time, route, and estimated arrival time. You shall instruct them to notify the civil authorities and Advanced Radiation's Radiation Safety Officer if you do not arrive within two hours of your estimated arrival time. If you encounter any unexpected delays, be sure to notify these personnel,if possible, of your revised estimated arrival time.

Advanced Radiation Service

[redacted] □ [redacted] □ 283-3264

QUALITY ASSURANCE PROGRAM

ADVANCED RADIATION SERVICE

BYPRODUCT MATERIAL LICENSE

29-14171-01

RECORD OF REVISION

List of Effective Pages	Paragraph No.	Date of Revision	Revision No.
1		6/29/78	0
2		6/29/78	0
3		6/29/78	0
4		6/29/78	0
5		6/29/78	0
6		6/29/78	0

1. INTRODUCTION

1.1 This program has been prepared to assure that the quality assurance requirements of 10 CFR Part 71 are implemented. This program establishes the requirements which govern the preparation of packages for shipment and the maintenance of transportation packages.

1.2 The design and fabrication of radioactive material shipping packages shall not be conducted under this Quality Assurance Program.

1.3 The following Advanced Radiation documents shall form a part of this program.

1.3.1 Advanced Radiation Operating and Emergency Procedures.
1.3.2 Radiation Safety Manual Administrative Procedures.
1.3.3 Byproduct Material License No. 29-14171-01.

2. ORGANIZATION

2.1 The responsibility for this program for Part 71 requirements rests with Advanced Radiation Services.

2.2 The responsibility for administering this quality program by management is as follows:

2.2.1 The Radiation Safety Officer is responsible for the overall adminstration, implementation and auditing of this program. He is the only individual with authority to issue or change this program. Anton S. Kurtz, President is the Radiation Safety Officer.

2.2.2 The assistant Radiation Safety Officer reports directly to the RSO. He is responsible for implementing, auditing and enforcing the requirements outlined herein. His direct responsibility include training, testing and monitoring the performance of radiographic personnel, document control, investigating the cause of incidents, implementing preventive and disciplinary actions and reporting the results of such investigations and actions. Joseph Duton is the Assistance Radiation Safety Officer.

2.3 Either the RSO or Assistant RSO will assume control and institute corrective action in emergency situations.

2.4 The Radiographers are responsible for handling, storing, shipping, inspection, test, operating status, and recordkeeping.

3. QUALITY ASSURANCE PROGRAM

3.1 The management of Advanced Radiation establishes and implements this Quality Assurance Program. Training for all QA functions, prior to engagement in these functions, is required in accordance with written procedures.

3.2 QA Program revisions will be made in accordance with written procedures with management approval.

3.3 The QA Program will ensure that all defined QC procedures, engineering procedures, and specific provisions of the package design approval are satisfied. The QA Program shall emphasize control of the characteristics of the package which are critical to safety.

3.4 The Radiation Safety Officer shall assure that all radioactive material shipped packages are designed and manufactured under a Quality Assurance Program approved by the Nuclear Regulatory Commission for all packages designed and fabricated after July 1, 1978. This requirement shall be satisfied by obtaining a certificate of compliance to this effect from the manufacturer.

4. DOCUMENT CONTROL

4.1 All documents related to a specific shipping package will be controlled through the use of written procedures. All document changes will be performed in accordance with written procedures approved by management.

4.2 The Radiation Safety Officer shall ensure that all QA Functions are conducted in accordance with the latest applicable changes to these documents.

4.3 Records shall be maintained in accordance with Advanced Radiation's Radiation Safety Manual - Administrative Procedures.

5. HANDLING, STORAGE AND SHIPPING

5.1 Written safety procedures concerning the handling, storage and shipping packages for certain special form radioactive material will be followed. Shipments will not be made unless all tests, certifications, acceptances, and final inspections have been completed.

5. HANDLING, STORAGE AND SHIPPING (Cont'd)

5.2 Requirements for handling, storage and shipping operations are provied in Advanced Radiation's Operating and Emergency Procedures.

5.3 Radiopgrahy personnel shall perform the critical handling, storage and shipping operations.

6. INSPECTION, TEST, AND OPERATING STATUS

6.1 Inspection test, and operating status of packages for certain special form radioactive material will be indicated and controlled by written procedures. Status will be indicated by tag, label, marking or log entry. Status of nonconforming parts or packages shall be positively maintained by written procedures.

6.2 Radiograph personnel shall perform the regulatory required inspections and tests in accordance with written procedures contained in Advanced Radiation's Operating and Emergency Procedures. The Radiation Safety Officer shall ensure that these functions are performed.

7. QUALITY ASSURANCE RECORDS

7.1 Records of package approvals (including references and drawings), inspections, tests, operating logs, audit results, personnel training and qualification and records of shipments shall be maintained. Descriptions of equipment and written procedures shall also be maintained.

7.2 These records will be maintained in accordance with written procedures. The records shall be identifiable and retrievable. A list of these records, with their storage locations, will be maintained by the Radiation Safety Officer.

8. AUDITS

8.1 Established schedules of audits of the Quality Assurance Program will be performed using written checklists. Results of audits will be maintained and reported to management. Audit reports will be evaluated and deficient areas corrected. The audits will be dependent on the safety significance of the activity being audited, but each activity will be audited at least once per year.

8. AUDITS (Cont'd)

8.2 A record of the audit findings shall be documented in a written report and the checklist attached. This report shall indicate acceptable as well as any deficiencies. Audit reports and findings shall be maintained on file at the Advanced Radiation Home Office as part of the quality assurance records. Members of the audit team shall have no responsibility for the activity being audited.

Tech/Ops

Radiation Products Division
40 South Avenue
Burlington, Massachusetts 01803
Telephone (617) 272-2000

Sample Transportation Instruction

PART 1 RECEIVING RADIOACTIVE MATERIAL

NOTES: 1. A package of radioactive material must be accepted from the carrier at the time it is delivered. [10CFR20.205(a)(1)]

2. If a package of radioactive material is to be held at the carrier's terminal, it must be picked up expeditiously upon receipt of notification from the carrier of its arrival. [10CFR20.205(a)(2)]

1. Upon receipt of a package of radioactive material, survey the exterior surfaces of the package to insure that the radiation levels do not exceed 200 milliroentgens per hour. [10CFR20.205(c)]

2. Survey three feet from the exterior surfaces of the package to insure that radiation levels do not exceed 10 milliroentgens per hour. [10CFR20.205(c)]

3. For packages containing radioactive material in normal form (i.e. not in special form), make contamination wipe tests of the exterior surfaces of the package. Count these wipes to insure that contamination levels do not exceed 0.01 microcuries per 100 square centimeters. [10CFR20.205(b)]

4. Record the results of these surveys on the Receiving Report. If any of the above limits are exceeded, notify the Radiation Safety Officer. [10CFR20.401(b)]

5. Record on the Receiving Report the source, model number, serial number, isotope, activity, shipping container model number and serial number.

6. Inspect the package for any evidence of physical damage. Record the result of this inspection on the Receiving Report.

7. Forward a copy of the Receiving Report to the Radiation Safety Officer.

PART II SHIPPING RADIOACTIVE MATERIAL

SUBPART A SHIPMENT OF RADIOGRAPHIC SOURCES

1. Insure that the source is secured in the proper shielded storage position in the shipping container.

2. Attach a security seal with an identification mark to the package closure. [49CFR173.393(b)]

3. If the shipping container is to be packaged inside a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transport. Place the shipping container in the outer package with sufficient blocking to prevent shifting during transportation. [49CFR173.25]

4. Survey the package at the surface and at three feet from the surface to determine the proper radioactive shipping labels to be applied to the package. Use the criteria of Table II.1. [49CFR172.403]

	Surface	3 Feet
RADIOACTIVE-WHITE I 	0.5mR/hr	None
RADIOACTIVE-YELLOW II 	50mR/hr	1.0mR/hr
RADIOACTIVE-YELLOW III 	200mR/hr	10mR/hr

PART II (continued)

SUBPART A

5. Properly complete two shipping labels indicating the contents (^{192}Iridium, ^{60}Cobalt, etc.), the number of curies and the Transport Index (maximum radiation level measured at three feet from the surface of the package; used on Yellow II and Yellow III labels only). [49CFR172.403(g)]

6. Insure that any old shipping labels have been removed from the package. Apply the two properly completed radioactive shipping labels to two opposite sides of the package. [49CFR172.403(f)]

7. Mark the outside of the package with the proper shipping name (Radioactive Material, Special Form, n.o.s.) if not already marked. [49CFR172.300]

8. If a shipping container is packaged inside a crate or other packaging mark the outside package "Inside Container in Accordance with _____". (Fill in the blank space with the appropriate DOT Specification Number of Type B Certificate Number) and the words "TYPE B" or "TYPE A" if applicable. [49CFR172.310; 49CFR173.393a]

9. Perform a radioactive contamination wipe test of the shipping package and insure that the wipe test does not exceed 0.001 microcuries per 100 square centimeters. [49CFR173.397; 49CFR173.393(n)(9)]

10. Properly complete the shipping papers indicating:

    a. Proper shipping name (i.e. Radioactive Material, Special Form, n.o.s.)

    b. Name of Radionuclide (i.e. ^{192}Iridium, ^{60}Cobalt)

    c. Physical or chemical form (or Special Form)

    d. Activity of Source (expressed in curies or millicuries)

    e. Category of Label applied (i.e. Radioactive Yellow III)

    f. Transport Index

    g. USNRC Identification Number or DOT Specification Number (i.e. USNRC: USA/9032/B or DOT-7A)

    h. For export shipments, IAEA Identification Number (i.e. IAEA: USA/9032/B) [49CFR172.203(d)]

PART II (continued)

SUBPART A

1. Shipper's Certification:

"This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation." [49CFR172.204(a)]

Notes: 1. For air shipments, the following shipper's certification may be used:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in proper condition for carriage by air according to applicable national governmental regulations". [49CFR172.204(c)]

2. For air shipments, the package must be labeled with a "CARGO AIRCRAFT ONLY" label and the shipping papers must state: [49CFR172.402(b)]

"THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR CARGO-ONLY AIRCRAFT" [49CFR172.204(c)]

PART II SHIPMENT OF RADIOACTIVE MATERIAL

SUBPART B SHIPMENT OF EMPTY DEPLETED URANIUM SHIELDED CONTAINERS AND COLLIMATORS

1. If the container is to be packaged inside a crate or other outer packaging, the outer packaging must be strong enough to withstand the normal conditions of transportation. Place the container in the outer package with sufficient blocking to prevent shifting during transportation.

2. Mark the outside of the outer shipping package: "RADIOACTIVE - MATERIAL - LSA, n.o.s." [49CFR173.392(c)(8); 49CFR172.30]

3. Perform a radioactive contamination wipe test of the shipping package and insure that the wipe test does not exceed 0.001 microcuries per 100 square centimeters. [49CFR173.397; 49CFR173.393 (n)(9)]

4. Survey the package at the surface and at three feet from the surface to determine the proper radioactive shipping labels to be applied to the package.

   a. If the surface radiation level is less than 0.5 milliroentgens per hour and there is no measurable radiation level at three feet from the surface, no label is required. Mark the outside of the package with the statement: "Exempt from specification packaging, marking and labeling, and exempt from the provisions of 49CFR173.393 per 49CFR173.391(c). Exempt from the requirements of 49CFR Part 175 per 49CFR175.10(a)(6)." [49CFR173.391(c) & 49CFR175.10(a)(6)]

   Properly complete the shipping papers indicating:

   (1) Proper shipping name (Radioactive Material LSA, n.o.s.)

   (2) Name of Radionuclide (Depleted Uranium)

   (3) Physical or Chemical Form (Solid Metal)

   (4) Activity (in curies or millicuries)

   (5) The Statement "Exempt from specification packaging marking and labeling, and exempt from the provisions of 49CFR173.393 per 49CFR173.391(c). Exempt from the requirements of 49CFR Part 175 per 49CFR175.10(a)(6)." [49CFR172.203(d)]

PART II (continued)

SUBPART B

(6) Shipper's Certification:

"This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation." [49CFR172.204(a)]

NOTES: 1. For Air Shipments, the following shipper's certification may be used:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in proper condition for carriage by air according to applicable national governmental regulations." [49CFR172.204(c)]

2. For Air Shipments, the following statement must appear:

"This shipment is within the limitations prescribed for passenger aircraft in accordance with 49CFR175.10(a)(6). [49CFR172.204(c)]

b. If the surface radiation level exceeds 0.5 millircentgens per hour, or if there is a measurable radiation level at three feet from the surface, use the criteria of Table II.1 to determine the proper radioactive shipping labels to be applied to the package.

Properly complete the shipping papers indicating:

(1) Proper shipping name (radioactive material, LSA,n.o.s.)

(2) Name of Radionuclide (Depleted Uranium)

(3) Physical or Chemical Form (Solid Metal)

(4) Activity (in curies or millicuries)

(5) Category of Label Applied (i.e. Radioactive Yellow II)

(6) Transport Index

(7) USNRC Identification Number or DOT Specification Number (i.e. USNRC USA/9032/B or DOT-7A)

PART II (continued)

SUBPART B

(8) For Export Shipments, IAEA Identification Number (i.e. IAEA USA/9032/B) [49CFR172.203(d)]

(9) Shipper's Certification

"This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation." [49CFR173.204(a)]

NOTES: 1. For Air Shipments, the following shipper's certification may be used:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in proper condition for carriage by air according to applicable national governmental regulations." [49CFR172.204(c)]

2. For Air Shipments, the package must be labeled with a "CARGO AIRCRAFT ONLY" label and the shipping papers must state: [49CFR172.402(b)]

"This shipment is within the limitations prescribed for cargo-only aircraft." [49CFR173.204(c)]

PART II

SUBPART C SHIPMENT OF EMPTY LEAD SHIELDED CONTAINERS

1. Insure that the container does not contain a radioactive source.

2. Insure that the container interals are securely closed or containe no radioactive contamination. [49CFR173.29(c)]

3. Perform a radioactive contamination wipe test of the outside of the container and insure that the wipe test does not exceed 0.001 microcuries per 100 square centimeters. [49CFR173.397]

4. Survey the external surface of the container to insure that the radiation levels do not exceed 0.5 milliroentgens per hour. [49CFR173.29(e)]

5. Insure that any old shipping labels have been removed from the package. Attach an "EMPTY" label to the package. [49CFR173.29(e)]

PART III CARRYING RADIOACTIVE MATERIAL

1. Insure that the vehicle used is in good condition and carries the normal complement of safety equipment including radiation area signs, a length of rope, spare tire, fire extinguisher, a set of vehicle tools and a set of flares. The glove compartment shall contain the registration certificate and an operating flashlight. Additionally, the operator must have a calibrated and operable survey meter and be wearing a film badge and dosimeter.

2. Insure that the container is properly packaged, marked and labeled and the proper shipping papers are completed in accordance with the instructions of Part II.

3. Place the radioactive material container in the vehicle. Secure the container against movement in the vehicle. [49CFR177.834]

4. Survey the driver's compartment to insure that the radiation level does not exceed 2 milliroentgens per hour. [49CFR173.393(j)(4)]

5. If the vehicle is transporting a package bearing a "RADIOACTIVE YELLOW III" label, the vehicle must be placarded on all four sides with a "RADIOACTIVE" placard. [49CFR172.504]

   Note: Operation of a vehicle which is required to be placarded requires compliance with the Federal Motor Carrier Safety Regulations [(49CFR390-397)]

6. Complete the radioactive material transport checklist. Forward a completed copy to the Radiation Safety Officer upon completion of the carriage.

7. If the vehicle becomes disabled on the road, do not leave the vehicle unguarded when going for help. A message for help may be sent by a passing motorist or the police be enlisted to guard the vehicle.

8. Should any kind of accident occur, make an immediate radiation survey to see where, if at all, the radiation levels are higher than normal. If any abnormal radiation areas exist, keep all persons out of them and get police assistance, if possible. If radioactive sources have escaped from their containers, notify the Radiation Safety Officer. Do not leave the scene without assuring that someone responsible (such as police) will keep people away from radiation areas.

PART III (continued)

9. Collect information pertinent to the accident, such as names of witnesses, names of people involved, names of police, license numbers, circumstances of the accident. Call the Radiation Safety Officer promptly giving him as much information as possible about the condition of the radioactive sources.

10. If a source should escape from its container, the vehicle operator should make no attempt to restore the source by himself, but he should wait for assistance from the Radiation Safety Officer.

Advanced Radiation Service

[redacted] □ [redacted] □ 283-3264

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES

i. DAILY INSPECTIONS BY RADIOGRAPHER. Each workday the radiographer will inspect the radiographic devices prior to their use. The results of this inspection will be reported on the form titled "Daily Maintenance and Inspection Report" (see Appendix). The following order shall be used by the radiographer to perform the daily inspection at the worksite:

1) Unwind the crank mechanism.

2) Feel outside surface of cable for cuts, bruises, excessive roundness or flat configurations.

3) Check outside surface of crank mechanism for loose bolts and the position of the Odometer. Check nuts on ends of guide tubes of drive cable to be sure they are tight.

4) Remove end protector of drive cable. Take Tech/Ops 550 connector gage and check cable for excessive wear. Wind approximately two feet of drive cable out of its protective casing and inspect for dirt and frays.

5) Take survey of camera to check for any sign of abnormal radiation leakage. Readings over 200 mr/hr for a new source (maximum capacity) at the surface of the camera are abnormal.

6) Unlock locking mechanism on back of camera. Turn connector selector ring to "connect" position. Take Tech/Ops 550 connector gage and check female connector on back of camera.

7) Leave safety plug in device and connect control cable to source. Feel tension on the spring loaded locking pin. Be sure that there is no dirt buildup and that locking pin has tension on it. Look at connector for chipped edges. Tug lightly at connection to be sure connectors are properly mated.

8) Take control cable collar and hold flush against projector connector and rotate selector ring from the "connect" position to the "lock" position.

9) Turn selector ring to "operate" and then turn back to "lock" and "connect". Make sure the selector ring turns easily and

continued....

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

the control cable connector springs back when selector ring comes to the "connect" position.

10) Disconnect control cable from back of camera.

11) Replace protective cover on control cable.

12) Replace protective cover on back of device and turn selector ring to "lock". Lock the device.

13) Remove the safety plug and look at threads for any possible dirt buildup. Do not look directly into front of camera or stand in front of camera with safety plug removed. Replace safety plug.

14) Take survey of camera at surface of camera and log it in the Radiographic Equipment Exposure Log (FORM 1-Appendix).

15) Check all tags and markings on device.

16) Take source guide tubes and check all mating ends for metal burrs and stripped threads or dirt buildup.

17) Run hands on the outside surface of the guide tubes to check them for flat sports, out of round, or twists and cuts in the outer casings.

18) Pull slightly on the swedged fittings to make sure they are secure.

19) Fill out the "Maintenance Inspection Report" (FORM 2).

ii. QUARTERLY MAINTENANCE. The Radiographer will perform quarterly maintenance on all radiographic devices. The results and the repairs required to pass inspection must be logged on the "Quarterly Maintenance & Inspection Report" (see appendix). The following procedures shall be used to carry out quarterly maintenance:

1) Unwind control cable and revolve end protector. Check male end connector of drive cable with Tech/Opera model 550 connector gage.

/continued....

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

ii. QUARTERLY MAINTENANCE (con't.)

2) Take the isotope projector from storage and make the applicable radiation survey.

3) Hook up the projector (IRI^{192} units only) as specified in the Source Changing Procedures, Section 8.

4) Crank the source into the source changer. Take the radiation survey and disconnect the source from control cable.

5) Retract the source drive cable.

6) Check projector with survey meter.

7) Check source changer with survey meter.

8) Disconnect control cable from back of isotope projector.

9) Crank control cable out of control cable housing into a bucket, with about a quart of solvent in it, by turning the control handle in the exposed direction. Wind the cable in a circular motion so it forms a circle on the bottom of the bucket.

10) When the cable releases itself from the crank, putt it out of the control cable housing by hand. Maintain the circular motion on the cable so the control cable still forms a circle on the bottom of the bucket.

11) Let the cable soak in bucket of degreasing solvent until all the foreign matter which may have accumulated on it is removed.

12) Remove the control cable housing from the crank and control cable cover by loosening the fittings. Take some degreasing solvent and pour through cable housing until the fluid coming through the opposite end is free of impurities.

13) Dry cable inside and out by using compressed air or an air stream from a vacuum cleaner. Under no circumstances should the air pressure exceed 15 pounds per square inch.

continued.....

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

ii. QUARTERLY MAINTENANCE (con't.)

14) Pour off solvent from control cable and replace it with fresh solvent. Make sure cable is clean. Remove all solvent from bucket and let cable air dry for approximately fifteen minutes.

15) Remove cover from gear mechanism on crank, remove gear and check it for chipped or excessively worn gear teeth. Remove all grease from inside of housing. While doing this, check for metal chips which may be part of the gear or drive cable; also check for score marks on the inside of the housing.

16) Wipe the inside of housing clean with solvent and dry it off.

17) Check housing for any dirt and grime. When you are satisfied the housing is clean, take some Texaco Unitemp grease or equivalent and put a light coat on the gear teeth and a small amount of the inside surface of the gear housing, on the edge that the drive cable will pass over.

18) Reassemble gear mechanism.

19) Reassemble drive cable housing mechanism.

20) Take terminated end of drive cable and start feeding the cable into the drive cable housing. While doing this, take a small amount of Texaco Unitemp grease or equivalent and apply it to the cable. Give cable a careful visual inspection while feeding the drive cable into the housing.

21) When the drive cable reaches the gear mechanism, have the assistant radiographer turn the crank slowly in the retract direction while you continue the greasing and inspection of the drive cable.

22) With the cable in the fully retracted position, reset the odometer to the "zero" position.

23) Replace the end protector.

24) Log all necessary repairs and maintenance performed on the "Quarterly Maintenance and Inspection Report".(FORM 3).

continued...

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

ii. QUARTERLY MAINTENANCE (con't.)

25) Look into the exit port and check for alignment of shield source tube with female connector on front end of the projector. CAUTION: Do not look into or stand in front of the projector with a source in it. If the tube is misaligned, notify the R.S.O. immediately, in order to make arrangements with Tech/Ops to have the necessary adjustments made.

26) Check locking mechanism for any dirt buildup and clean it if necessary.

27) Pour a small amount of solvent through front of the projector. Do this over a clean pan. Check solvent coming out for any metallic pieces. If any are found, do not touch with your hands. Notify R.S.O. immediately, who will make the necessary checks and evaluations to determine whether they are radioactive, i.e. part of the shield assembly. Pour solvent through tube until it is clean.

28) Dry out the mechanism with forced warm air.

29) Hook up cranking mechanism.

30) Hook up dummy source in the device.

31) Put on maximum length of cleaned out source guide tubes (21 feet or 3 tubes) with the blank end.

32) Expose dummy source and retract it several times to make sure the machine feels mechanically proper.

33) Check to be sure the odometer is working properly.

34) Check the labeling on machine.

35) Check for loose screws.

36) Remove dummy source from device.

37) Reload the projector with live source. Take survey for radiation levels. Disconnect source guide tubes and replace the safety plug.

continued...

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

ii. QUARTERLY MAINTENANCE (con't.)

38) Disconnect crank mechanism.

39) Check male end of source drive cable and female end of source connector using Tech/Ops 550 connector gage.

40) Replace the end protector on the drive cable and return to storage.

41) Replace end protector on the projector and lock device.

42) Take radiation survey and put projector into storage.

43) Log necessary repairs that were made on ARS's "Quarterly Maintenance & Inspection Report". (FORM 3).

44) Inspect source guide tube ends for burrs and crushed threads.

45) Feel cables for flat spots, twists and deep cuts.

46) Place small amount of solvent into cables and shake them, empty cable of solvent. Repeat this process until solvent comes out clean.

47) Blow clean warm dry air through source guide tubes until they are dry.

48) Connect male and female end of each individual hose together and return them to storage area.

iii. CORRECTIVE ACTIONS - Any component critical to the safe operation of the radiography equipment which is found to be defective, excessively worn, or in poor or erratic operating condition, shall be removed immediately from service for repair or replacement.

/continued.....

OPERATING & EMERGENCY PROCEDURES

XI. INSPECTION & MAINTENANCE PROCEDURES (con't.)

iv. RECORDS. All inspections and maintenance measures must be entered in the log and must include a description of each check, the results, the date and the name of the radiographer performing the work.

If repairs or replacements are made to any component or assembly, the radiographer must also note in the log a description of each repair or replacement, including the date of servicing, the nature of the problem, the nature of the corrective action taken, and the name of the person and/or company who performed the work.

See Appendix for sample forms.

Advanced Radiation Service

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OPERATING AND EMERGENCY PROCEDURES

XII. LEAK TESTING PROCEDURES

Advanced Radiation Service will use Leak Testing Kit Model 518, manufactured by Technical Operations, and will follow its instructions, which are attached to Section XII.

Mr. Kurtz will perform the wipe test and send it to Technical Operations in Burlington, Mass. for the assay. The NRC requires leak tests be performed at least every six months.

TECHNICAL OPERATIONS, INCORPORATED
LEAK TEST KIT MODEL 518

INSTRUCTIONS FOR USE

This kit is designed for use on Technical Operations Gamma Ray Projectors It provides a convenient and safe method of performing leak tests of radiographic sources in accordance with NRC regulations, which require such tests at intervals of not more than 6 months.

CONTENTS

Flexible swab holder with swab
Vial of EDTA solution
Plastic Envelope
Mailing Box
Identification Sheet

PROCEED IN THIS MANNER:

1. Be sure source is fully retracted into projector. (Use a survey meter to be sure that radiation levels are normal.)
2. Remove source tube from face of shield or remove shipping plug.
3. Wet the swab with EDTA solution. Shake off excess and insert the swab into the hole in the shield. Wipe the interior of the hole thoroughly by rotating swab holder.
4. Withdraw swab and place in plastic envelope.
5. The swab should now be monitored by turning the survey meter to its most sensitive range. Place the meter in a low background area and move the swab in its plastic envelope to the meter, not the meter to the swab.

6. If there is no indication on the meter, or if the indication is no more than 0.2 MR per hour above background, put the plastic envelope with the swab in the mailing box and mail to Technical Operations, Incorporated, Burlington, Massachusetts. Be sure to fill out and return the identification sheet.

7. If the swab should show more than 0.2 MR per hour, do not mail. Contact Technical Operations, Inc., for specific instructions.

NOTE: If the survey meter available does not have the capability of detecting as little as 0.2 MR per hour, ship the wipe-test swab to Technical Operations, Inc., via express. Do not ship if the radiation from the swab exceeds 2 MR per hour and contact Technical Operations, Inc., for specific instructions. The wipe-test swab will be subjected to a precise radio assay when received by Technical Operations, and a leak-test certificate will be mailed promptly. The NRC requires that this certificate be kept with your records and that it be available for inspection.

TECHNICAL OPERATIONS
INCORPORATED
BURLINGTON·MASSACHUSETTS · TELEPHONE 272·2000
RADIATION PRODUCTS DIVISION

Gentlemen:

Our records indicate that we performed a radio-assay of your leak test about five months ago.

Since the N.R.C. requires that leak tests be performed at six month intervals, another leak test kit is enclosed for your use.

Sincerely,

TECHNICAL OPERATIONS, INC.

N O T I C E

"Use of this Model 518 Leak Test Kit requires specific Nuclear Regulatory Comm. authorization. If your license does not have specific authorization you should submit an application for authorization. See Paragraph 6 of Section 30.24(g) of 10 CFR.

Use of this kit without specific authorization constitutes a violation of Nuclear Regulatory Commission regulations."

TECHNICAL OPERATIONS, INC.
BURLINGTON, MASSACHUSETTS

10-30-80

LEAK TEST

FIRM NAME_____

ADDRESS_____

PURCHASE ORDER NO._____ NRC LIC. NO._____

Tech/Ops Gamma Ray Projector

MODEL NO._____ SERIAL NO._____

SOURCE MODEL NO._____ SERIAL NO._____

CURIES_____

Isotope
(Check Which)

Cobalt 60_____
IR 192_____
Tm 170_____
Other_____

DATE_____ BY_____

RETAIN THIS PORTION FOR YOUR RECORDS

.....

LEAK TEST

IDENTIFICATION SHEET

FIRM NAME_____

ADDRESS_____

_____

PURCHASE ORDER NO._____ NRC LIC. NO._____

Tech/Ops Gamma Ray Projector

MODEL NO._____ SERIAL NO._____

SOURCE MODEL NO._____ SERIAL NO._____

CURIES_____

Isotope
(Check Which)

Cobalt 60_____
IR 192_____
Tm 170_____
Other_____

DATE_____ BY_____

PLEASE FILL OUT AND RETURN THIS SHEET
TO TECH/OPS WITH TEST KIT FOR RADIO ASSAY

RADIOASSAY, MICROCURIES_____

RAD 36 Rev. 1-10-66

Advanced Radiation Service

[redacted] □ [redacted] □ 283-3264

OPERATING & EMERGENCY PROCEDURES

XIII. SECURITY AND STORAGE

i. Radiographic devices and storage containers must be locked at all times when not in use so that the source cannot be accidently exposed.

ii. Radiographic devices and storage containers must be stored within a locked storage area.

iii. Temporary storage areas should be selected so that any point accessible to unauthorized personnel will not exceed a 2 mr/hr radiation dose rate.

iv. Storage areas must be posted with warning signs containing the words, "Caution-Radioactive Material", bearing the yellow and magenta radiation symbol.

v. At field sites, sources must be locked within a shielded container and stored inside a locked and labeled vehicle when not in use. When this is not feasible, the source must be locked within its shielded container and stored in a locked room. If neither of the foregoing storage arrangements are possible, the Radiographer must maintain constant surveillance of the locked storage container.

vi. Keys to storage containers, vehicles and access doors to the storage room shall only be issued to the Radiographer in charge and are his responsibility until the sources are stored and secured, at which time the keys must be returned to the office and kept under the supervision of Mr. Kurtz.

See attached drawing of storage facilities for Advanced Radiation Service.

Advanced Radiation Service

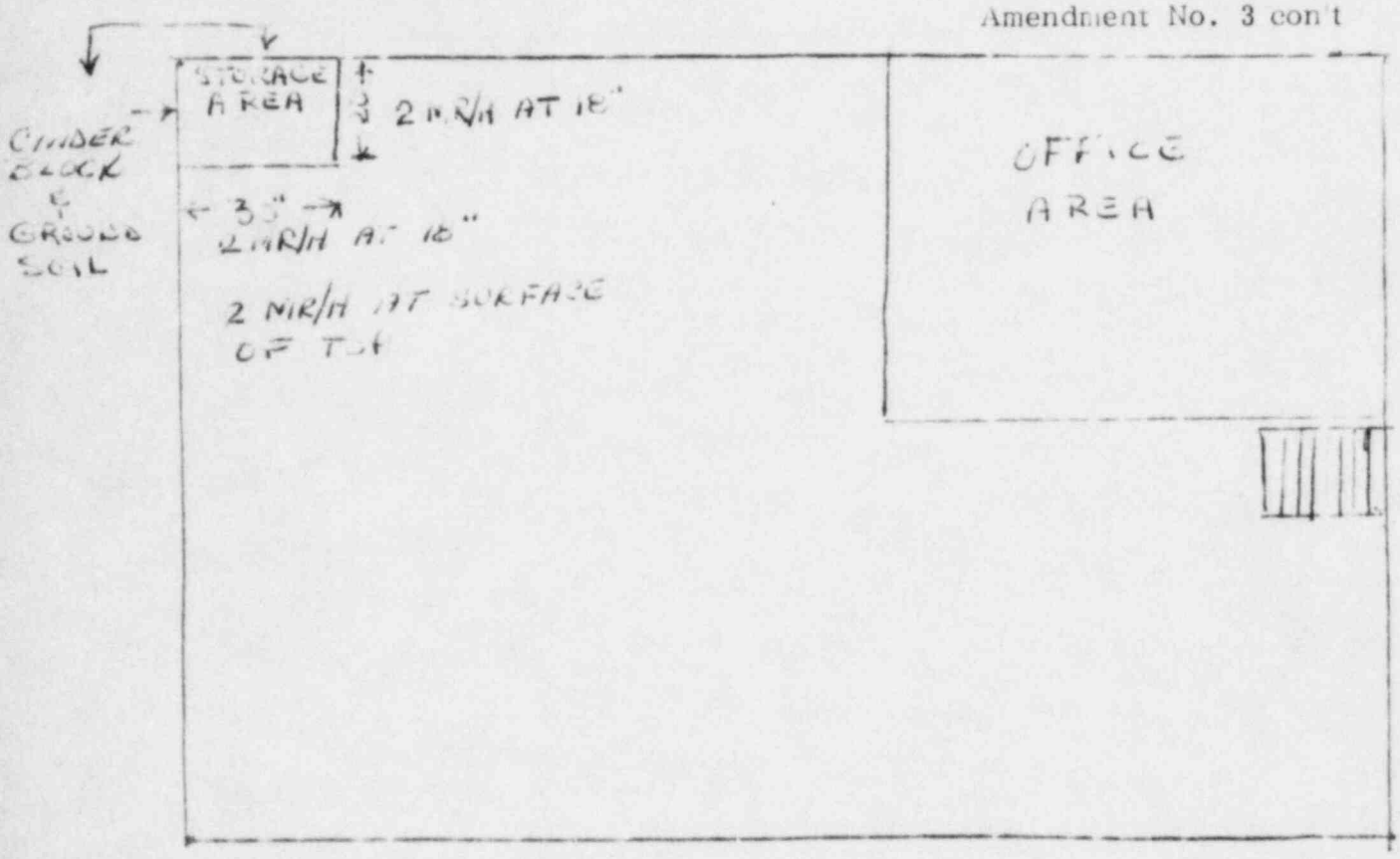
271 PLAINFIELD ROAD

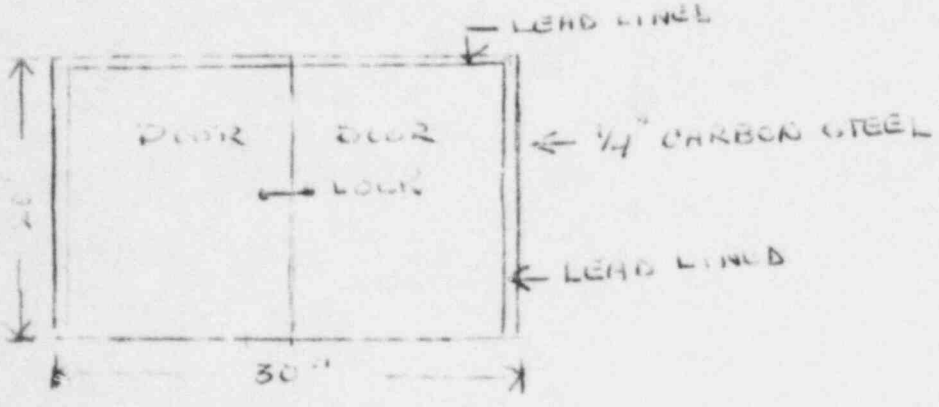
EDISON, NEW JERSEY 08820

ITEM 3, Sketch of Storage Facility.

July 15, 1981

Amendment No. 3 con't





Note; Thickness of lead as a liner cannot be determined until a survey can be made with sealed sources in storage box.

Advanced Radiation Service

[redacted] □ [redacted] □ 283-3264

OPERATING & EMERGENCY PROCEDURES

XIV. RECORDKEEPING REQUIREMENTS

The following records must be maintained in the Radiography Department Log at Advanced Radiation Service. All entries must be dated and initialed by the individual responsible for the entry.

1. Utilization Log (Form 1)
   a) Date and location of use.
   b) Model and serial # of device being used.
   c) Type of source and serial #
   d) No. of exposures
   e) Maximum exposure time
   f) Radiation levels at perimeter of area
   g) Radiation level at surface of device when securing prior to storage
   h) Serial number of survey meter used
   i) Dosimeter reading in mr/hr
   j) Truck survey report
   k) Daily checklist of gamma ray projector used

2. Daily Maintenance & Inspection Report (Form 2)

3. Quarterly Inspection (Periodic) and Maintenance Report (Form 3)

4. Radiation Safety Internal Inspection Report (Form 4)

5. Dosimeter Calibration Records (Form 5)

6. Radiation Survey Data (Form 6)
   a) Source Changer Survey Report
   b) Radiation Survey Meter Data
   c) Radiation Levels at Certain Areas

7. Survey Meter Calibration Certificate (Form 6a)

8. Inventory/Source Record Sheet (Form 7-Administrative Manual only)

9. Film Badge Reports

/con't.

OPERATING & EMERGENCY PROCEDURES

XIV. RECORDKEEPING REQUIREMENTS (con't.)

10. Leak Test Results - records of wipe performed by the Radiation Safety Officer with Tech Ops Kit 518, and records of the assay performed by Tech Ops.

11. Qualification records and training examination records of all personnel involved in radiography.

Advanced Radiation Service

271 Plainfield Road Edison, N.J. 08820

OPERATING & EMERGENCY PROCEDURES

UTILIZATION LOG

RADIOGRAPHER _____

DATE	LOCATION	CAMERA #	SOURCE #	# EXPOSURES	MAXIMUM EXPOSURE TIME	BARRIER READING IN MR/H	FINAL CAMERA READING IN MR	SURVEY METER #	DOSIMETER READING IN MR

SIGNATURE _____

TO BE SENT IN WITH WEEKLY REPORTS.

TOTAL _____

Advanced Radiation Service

14 Winding Road ☐ Iselin, N.J. 08830 ☐ 283-3264

OPERATING & EMERGENCY PROCEDURES

RADIOGRAPHIC DEVICE - DAILY MAINTENANCE & INSPECTION REPORT

EXPOSURE DEVICE S/N _____ CRANK S/N _____

ISOTOPE S/N _____ ISOTOPE ACTIVITY(Curies) _____

ISOTOPE TYPE _____

DATE _____ INSPECTED BY _____

INSPECTION	COMMENTS
1) Changes in operating characteristics of the device	
2) Proper operation of crank mechanism	
3) Proper operation of source position indicator	
4) Proper operation of locking mechanism	
5) Source and drive cable and guide tube damage	
6) Connector wear or damage of all mating components	
7) Rust, dirt or sludge build-up in the source guide tubes	
8) Shifting of shield and/or source in exposure device housing	
9) Cable drive gearbox damage or wear	
10) Proper labeling	
11) Miscellaneous (loose screws, safety caps, etc.)	

Any damage to the radiographic device which may impair its safe operation will be reported immediately to the Radiation Safety Officer.

FORM 3

ADVANCED RADIATION SERVICE

Periodic Inspection and Maintenance

Operating & Emergency Procedures

Date Inspected _____ Next Inspection Due _____

Manufacturer _____ Model No. _____ Serial No. _____

Type of Isotope _____ Source S/N _____ Curie Strength _____

CHECK EACH ITEM BELOW

ITEM	ACCEPTABLE	CORRECTIVE ACTION TAKEN
PROJECTOR		
Safety Caps		
Lock Box		
Lock		
Handle		
Labels		
'S' Tube		
Outlet Nipple or Threads		
SOURCE CONNECTOR		
Snug Fit		
Straightness		
Excessive Wear		
SOURCE POSITIONER		
Handle		
Drive Gear		
Shaft Bushings		
Gear Box		
Screws		
Conduit Connections		
Cable Flexibility		
Straightness		
SOURCE TUBE		
Physical Damage		
End Cap		
Foreign Material		
Connections		
Kinks or Crimps		

REMARKS _____

EXPOSURE DEVICE INSPECTED AND REPAIRED AS NOTED AND IS ACCEPTABLE FOR USE

_____

Inspected By

Advanced Radiation Service

RADIATION SAFETY INTERNAL INSPECTION REPORT FOR _____ DIVISION

NOTE: This form is not to be filed before approvals from Division and Corporate

Division approval: _____ Corporate approval: _____

Date of Inspection: _____ By: _____ Location _____

Radiographer _____ Dosimeter No. _____ Film Badge No. _____

Assistant _____ Dosimeter No. _____ Film Badge No. _____

Assistant _____ Dosimeter No. _____ Film Badge No. _____

Isotope _____ Source No. _____ Curies _____ Camera Model _____ Ser. No. _____

Survey Meter Model _____ Serial No. _____ Void Date _____

1. Is area restricted in accordance with (A.R.S.) (O&E) _____
2. Radiation Levels—At Controls _____ At Restricted Area _____
3. Exposure minutes for this date at time of inspection _____
4. Is continuous surveillance maintained of the restricted area? _____
5. Date of latest radiation report in Radiographer's book _____
6. Date last radiation reports mailed to Division Office _____
7. Dosimeter readings at time of inspection for Radiographer _____ Ass't _____ Ass't _____
8. Are dosimeter readings being logged? _____ Available at jobsite _____
9. Proper Labels—On Truck _____ On Storage Compartment _____
10. Is equipment operating properly? _____
11. Is lock on storage compartment and operating properly? _____
12. Does Radiographer have the following documents on the Unit? O & E _____ AEC License _____
    Parts 19 and 30 _____
    Parts 20 and 34 _____ AEC-3 _____ State License _____
13. Overnight security of source Good _____ Negligent _____ Corrected _____

Corrective action taken _____

R.S.O. signature: _____ Radiographer signature: _____

CORPORATE COPY

Advanced Radiation Service

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

OPERATING & EMERGENCY PROCEDURES

DOSIMETER CALIBRATION: 10 CFR 34.33(c)

DOSIMETER CALIBRATOR: MODEL 3060

RADIOISOTOPE: CESIUM 137

SERIAL No. 267

MFG: ______________________ CALIBRATION DATE: __________

MODEL No. ______________________ SCALE: 0 TO 200 MR. __________

SERIAL No. ______________________ SCALE: 0 TO 500 MR __________

SIX (6) HOUR EXPOSURE: __________ ± ______________________

TWENTY-FOUR (24) HOUR EXPOSURE ________ ± ______________________

NEXT CALIBRATION DUE: ______________

CALIBRATED BY: ______________________ R.P.O.

RADIOGRAPHER OR ASSISTANT: ______________________________

SOURCE CHANGER SURVEY REPORT

Date Ordered_____ By_____

Date Received_____ By_____

Source changer Model_____ S/N._____ Source S/N._____

Type Source Model_____ S/N._____ Curies_____

RADIATION SURVEY METER DATA

Survey Meter Model_____ Survey Meter S/N._____

Date Calibrated_____ By_____ Due Date_____

Projector Model_____ Projector S/N._____

Note: Technician must follow Operating Instructions Provided by shipper.

RADIATION LEVELS AT THE FOLLOWING AREAS

1). Contact of changer._____ New Source.
2). At 1 Meter._____ New Source.

3). Source Guide Tube._____
4). Contact of changer._____ Old Source.
5). At 1 Meter._____ Old Source.
6). Source Guide Tube._____

Carrier: Company Name_____

Carrier: Company Location_____

Technician Conducting Operation & Survey.

Name_____ Level_____ Date:_____

201 - 283-3264

Advanced Radiation Service

271 PLAINFIELD ROAD

EDISON, NEW JERSEY 08820

OPERATING & EMERGENCY PROCEDURES

METER CALIBRATION CERTIFICATE

CUSTOMER _____

ADDRESS _____

_____

TELEPHONE NO. _____ CALIBRATION DATE _____

MODEL NO. _____ SERIAL NO. _____

	TRUE FIELD	RESPONSE	% ERROR
RANGE X1	2.0 mr/hr	_____	_____
	8.5 mr/hr	_____	_____
RANGE X10	20.0 mr/hr	_____	_____
	80.0 mr/hr	_____	_____
RANGE X100	200.0 mr/hr	_____	_____
	850.0 mr/hr	_____	_____

The above instrument was calibrated with a Cesium 137 source. NRC regulations require that it be recalibrated within three months.

By _____

Advanced Radiation Service

271 PLAINFIELD ROAD

EDISON, NEW JERSEY 08820

OPERATING & EMERGENCY PROCEDURES

RADIATION SAFETY OFFICER: MR. ANTON S. KURTZ
271 Plainfield Road
Edison, NJ 08820
(201) 283-3264

EDUCATION
High School Graduate

Completed 24 classroom hours in Magnetic Particle, Conam Inspection, Inc. Graduated from combined formal course in Magnetic and Liquid Penetrant from Automation Industries, Danbury, CT.

Completed 20 hours in Liquid Penetrant, Conam Inspection, Inc. Classroom training and formal course in Liquid Penetrant at Automation Industries, Danbury, CT.

Completed 40 hours formal course in Ultrasonics, Automation Industries. Completed 24 classroom hours in Ultrasonics at Conam Inspection.

Completed 120 classroom hours in Radiography and Radiation Safety at Conam Inspection.
Completed 80 classroom hours in Radiography and Radiation Safety at Eastern Inspection.
Completed 80 classroom hours in Radiography and Radiation Safety at Advanced Radiation Service

PRODUCT EXPERIENCE:

Refineries, Fossil Fuel Power Plants, Nuclear Power Plants, Pressure Vessels and Pressure Piping; Missile Components and related systems; Castings and Forgings; Welded structures.

RESPONSIBILITIES:

Testing Technician and Inspector; Supervisor of NDT; Radiation Safety Officer; Radiation Safety Monitor; Training and Manager of NDT; Procedure Consultant.

Advanced Radiation Service

271 PLAINFIELD ROAD

EDISON, NEW JERSEY 08820

OPERATING & EMERGENCY PROCEDURES

RADIATION SAFETY OFFICER: MR. ANTON S. KURTZ

ACCOMPLISHMENTS:

Manager of NDT, Eastern Inspection/Woodbridge Division.
Radiation and Training Officer, Eastern Inspection
Supervisor of NDT, Eastern Inspection.
NDT Technician and Inspector, Conam Inspection, Woodbridge, NJ
Radiation Protection Officer, Manager and Training Officer,
Advanced Radiation Service, Edison, NJ.

EXPERIENCE AND TRAINING

Magnetic Particle Inspection:

Conam Inspection (Experience)	9 years
Eastern Inspection (Experience)	2 years
Advanced Radiation Service(Experience)	11 years
Conam Inspection (Training)	24 classroom hours
Automation Industries	40 classroom hours

Penetrant Inspection:

Conam Inspection (Experience)	9 years
Eastern Inspection (Experience)	2 years
Advanced Radiation Service (Experience)	11 years
Conam Inspection (Training)	20 classroom hours
Automation Industries	40 classroom hours

Radiographic Inspection:

Conam Inspection (Experience)	9 years
Eastern Inspection (Experience)	2 years
Advanced Radiation Service (Experience)	11 years
Conam Inspection (Training)	120 classroom hours
Eastern Inspection (Training)	80 classroom hours
Advanced Radiation Service (Training)	80 classroom hours

Ultrasonic Inspection:

Conam Inspection (Training)	24 classroom hours
Automation Industries (Training)	40 classroom hours

Advanced Radiation Service

271 PLAINFIELD ROAD

EDISON, NEW JERSEY 08820

OPERATING & EMERGENCY PROCEDURES

RADIOGRAPHER

GERALD MUCHANIC, SR.
73 Remsen Avenue
Avenel, New Jersey

Ten years with Advanced Radiation Service.

Eighty hours of classroom training in radiation safety.

Has been employed as a Radiographer for the past year. Is familiar with radiation safety in handling by-product material and transportation procedures of this by-product material.