NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION

Amendment No. 15

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	In accordance with the letter dated May 1, 1998,
1. U.S. Army Communication-Electronics Command	3. License number 29-01022-14 is amended in its entirety to read as follows:
2. AMSEL-SF Fort Monmouth, New Jersey 07703-5024	4. Expiration date October 31, 2003
	5. Docket No. 030-29741 Reference No.

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Cobalt 60	A.	A.
B. Cobalt 60	B.	B.
C. Cobalt 60	C.	C.
D. Krypton 85	D.	D.
E. Strontium 90	E.	E.
F. Strontium 90	F. Sealed sources (ECOM Dwg. No. SM-B-509048)	F. Not to exceed 150 microcuries per source and 45 millicuries total

Information in this record was deleted in accordance with the Freedom of Information Act, exemptions 2
FOIA-2006-0238

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MATERIALS LICENSE
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6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
G. Strontium 90	G.	G.
H. Strontium 90	H. Sealed sources (3M Dwg. No. 12-1921-0474-8)	H. Not to exceed 36 microcuries per source and 18 millicuries total
I. Cesium 137	I.	I.
J. Cesium 137	J.	J.
K. Plutonium 239	K. Electroplated sources (Eberline Instrument Corp., Model 594-1)	K. Not to exceed 23 micrograms (1.4 microcuries) per set and 0.0115 grams total
L. Americium 241	L. Sealed sources (Amersham Radiochemical Center, Amersham Code 2084)	L. Not to exceed 10 millicuries per source and 50 millicuries total
M. Americium 241	M. Sealed sources (Amersham Model AMR 8122)	M. Not to exceed 1 microcurie per source and 100 microcuries total
N. Americium 241	N. Sealed sources (Amersham Model AMRB 8152)	N. Not to exceed 10 microcuries per source and 50 microcuries total
O. Americium 241	O. Sealed sources (Amersham Model AMRB 1659)	O. Not to exceed 20 microcuries per source and 100 microcuries total
P. Thorium 230	P. Electroplated source (Eberline Instrument Corp., Model No. CS-12)	P. Not to exceed 0.98 micrograms (20 nanocuries) per source and 1 milligram total
Q. Thorium 232	Q. Metal foils	Q. Not to exceed 2.7 grams (300 nanocuries) per source and 4.05 kilograms total

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6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
R. Plutonium 239	R. Electroplated sources (Eberline Instrument Corp., Model No. CS-1)	R. Not to exceed 163 nanograms (10 nanocuries) per source and 1 gram total
S. Thorium 232	S. Solid (Thorium Fluoride coating on optical systems)	S. Not to exceed 3 grams (0.330 microcuries) per optical system and 40 kilograms total
T. Cesium 137	T.	T.
U. Cesium 137	U.	U.

9. Authorized use:

A. through R. Calibration and operational checking of radiation detection instrumentation.
S. Optical coating on thermal imaging devices.
T. For use in FEMA Model CDV-790 calibrators for instrument calibrations.
U. For use in FEMA Model CDV-794 calibrators for instrument calibrations.

CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at Fort Monmouth, New Jersey, and at Department of Defense installations anywhere in the United States.

11. A. Licensed material shall only be used by, or under the supervision and in the physical presence of, individuals who have completed the training described in application dated July 20, 1992 and letter dated May 1, 1998, with enclosures.

B. The Radiation Safety Officer for this license is Joseph M. Santarsiero.

12. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

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MATERIALS LICENSE
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C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(I) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Director, Division of Nuclear Materials Safety, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.

G. The licensee is authorized to collect leak test samples for analysis by licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

13. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

14. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

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License Number
29-01022-14

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15. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.

16. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

17. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Memorandum of Understanding dated June 22, 1990
B. Application dated July 20, 1992
C. Letter dated June 15, 1993
D. Letter dated April 6, 1994
E. Letter dated February 28, 1997
F. Letter dated July 30, 1997
G. Letter dated August 27, 1997, with attachment
H. Letter dated May 1, 1998

For the U.S. Nuclear Regulatory Commission

Date May 19, 1998

By ***Original signed by John R. McGrath***

John R. McGrath
Nuclear Materials Safety Branch 3
Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

May 20, 1998

Docket No. 030-29741 License No. 29-01022-14
Control No. 125664

Steven A. Horne
Director, Safety Risk Management
Department of the Army
U.S. Army Communications-Electronics Command and Fort Monmouth
AMSEL-SF
Fort Monmouth, NJ 07703-5000

Dear Mr. Horne:

This refers to your license amendment request. Enclosed with this letter is the amended license.

Please review the enclosed document carefully and be sure that you understand and fully implement all the conditions incorporated into the amended license. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Thank you for your cooperation.

Sincerely,

Original signed by John R. McGrath

John R. McGrath
Senior Health Physicist
Nuclear Materials Safety Branch 3
Division of Nuclear Materials Safety

Enclosure:
Amendment No. 15

cc:
Joseph M. Santarsiero, Radiation Safety Officer

Commander, U.S. Army Materiel Command
ATTN: AMCSF-P
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

ML10

DOCUMENT NAME: G:\DNMS\DOCWORK\LICLTR\L2901022.14 15793166

To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	N	DNMS/RI					
NAME	JMcGrath							
DATE	05/20/98		05/ /98		05/ /98		05/ /98	

OFFICIAL RECORD COPY

This is to acknowledge the receipt of your letter/application dated

5/1/98, and to inform you that the initial processing which includes an administrative review has been performed.

AMEND. 29-01022-14

☑ There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card

_____.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 125664.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(6-96)

Sincerely,
Licensing Assistance Team Leader

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703-5000

REPLY TO
ATTENTION OF

May 1, 1998

Directorate of Safety Risk Management

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

Attention: Licensing Assistance Section

This refers to U.S. Nuclear Regulatory Commission (NRC) License Number 29-01022-14, Docket Number 030-29741.

We are requesting an amendment to this NRC license to authorize possession and use of radiation instrument calibrators originally designed for and used by the Federal Emergency Management Agency (FEMA) under NRC License Number 08-01297-06, Docket Number 030-07130, and its State emergency management counterparts. They are designated the FEMA Model CDV 790 and CDV-794 (Model 2) Calibrators, respectively. The calibrators are loaded with the following sealed sources:

a. CDV-790: Cesium 137, sealed sources (Nuclear Chicago Corporation Model OCD-S-104), not to exceed 16 millicuries per source and 320 millicuries (20 each calibrators) total.

[redacted]

These calibrators will be used under the supervision of U.S. Army military and/or civilian personnel at world-wide installations/activities.

Training:

a. Local Radiation Protection Officer (LRPO). A qualified LRPO will supervise all calibrations using the CDV-790 and CDV-794 Calibrators. To qualify as a LRPO a person must receive a minimum of 40 hours of formal training in radiation protection and the operation and use of the calibrators. Training includes principles and practices of radiation protection;

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radiological monitoring techniques; operation and calibration of portable or laboratory radiation detection instrumentation; mathematics and calculations basic to the measurement of radioactivity; and, biological effects of ionizing radiation.

NOTES

(1) Completion of the 40 hour Radiac Calibrator Custodian Course (Number 4J-F1/493-F3), or equivalent, given at the U.S. Army Chemical School, Fort McClellan, AL, meets these requirements.

(2) The Licensee may approve equivalent alternate training.

b. Operator or User. To qualify as a operator or user a person must receive a minimum of eight hours training under the guidance of a LRPO in the basic fundamentals of radiological operations, radiac instrumentation, survey techniques and on-the-job training in operation and care of the calibrator. Instructions shall include safe working practices and inherent hazards associated with the calibrator.

At the enclosure is a copy of the Operation and Maintenance Manual, Radiological Instrument Calibrator, OCD Item No. CDV-794, Model No. 2.

Your expeditious processing of this amendment request is appreciated.

Our Point of Contact is Mr. Joseph M. Santarsiero or the undersigned, Facsimile on (908) 532-6403 or (908) 542-7161; Voice on (908) 427-4427/3112.

Sincerely,

STEVEN A. HORNE
Director, Safety
Risk Management

Enclosures

Copy Furnished:

Commander, U.S. Army Materiel Command, ATTN: AMCSF-P, 5001 Eisenhower Avenue, Alexandria, Virginia 22333-0001

29-01022-14

Operation and Maintenance Manual
Radiological Instrument Calibrator

OCD Item No. CD V-794, Model No. 2

VOLUME 7

CALIBRATION

Office of Civil Defense

WASHINGTON, D. C.

PREPARED BY:

TECHNICAL OPERATIONS, INCORPORATED

Radiation Products Division

South Avenue, Burlington, Massachusetts 01803

WARNINGS

IS FULLY SHIELDED. THE PRESENCE OF THE SOURCE IN THE CALIBRATOR DICTATES STRICT ADHERENCE TO THE FOLLOWING PRECAUTIONS AND INSTRUCTIONS OF THIS MANUAL.

THIS EQUIPMENT SHALL BE OPERATED ONLY BY PERSONS LICENSED AND AUTHORIZED FOR THIS TYPE ACTIVITY BY THE ATOMIC ENERGY COMMISSION OR AN APPROPRIATE STATE LICENSING AGENCY.

UNDER NO CONDITIONS ARE OPERATING PERSONNEL TO ATTEMPT ANY INTERNAL ADJUSTMENTS OF, OR REPAIRS TO, THE CALIBRATOR OTHER THAN THE BASIC CORRECTIVE ACTIONS GIVEN BY SECTION V OF THIS MANUAL. MALFUNCTIONS OTHER THAN THOSE ENUMERATED BY SECTION V SHALL BE REPORTED IMMEDIATELY TO THE NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, PENTAGON, WASHINGTON, D.C. 20310.

IN THE EVENT OF A FIRE, PERSONNEL OVEREXPOSURE, RELEASE OF THE RADIOACTIVE MATERIAL, OR OTHER ACCIDENT DESCRIBED IN TITLE 10 OF THE CODE OF FEDERAL REGULATIONS (CFR) PART 20, PAR. 20.402, 20.403, AND 20.405, IMMEDIATELY NOTIFY THE FOLLOWING BY TELEPHONE OR TELEGRAPH:

1. DIRECTOR OF THE APPROPRIATE AEC REGIONAL COMPLIANCE OFFICE AS GIVEN IN APPENDIX D, 10 CFR 20, OR THE APPROPRIATE STATE LICENSING AGENCY.

2. NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, PENTAGON, WASHINGTON, D.C. 20310, PHONE: AREA CODE 202, 695-2519.

3. RADIOLOGICAL DEFENSE OFFICER OF THE APPROPRIATE OCD REGIONAL OFFICE.

WARNINGS

WHEN INSTALLED, THE CALIBRATOR SHALL BE WIPE-TESTED AT INTERVALS NOT TO EXCEED SIX (6) MONTHS IN ACCORDANCE WITH RADIOLOGICAL SAFETY INSTRUCTIONS GIVEN BY SECTION 2-4 OF THIS MANUAL.

WHEN IN STORAGE, THE CALIBRATOR SHALL BE INSPECTED AS FOLLOWS AT INTERVALS NOT TO EXCEED SIX (6) MONTHS:

1. SURVEY THE CRATED CALIBRATOR WITH A CD V-700 TYPE METER. IF EXPOSURE RATES AT THE SURFACE EXCEEDING 2 MR/HR ARE FOUND, TAKE IMMEDIATE CORRECTIVE ACTION IN ACCORDANCE WITH SECTION 2-3 OF THIS MANUAL.

2. A WIPE TEST SHALL BE MADE IN ACCORDANCE WITH SECTION 2-4 OF THIS MANUAL UNLESS SPECIFICALLY WAIVED BY THE LICENSE.

MAINTAIN A PERMANENT RECORD OF ALL RADIATION SURVEYS AND WIPE TESTS.

THE CALIBRATOR MAY OVERTURN IF TILTED BEYOND 25°. WHEN MOUNTED ON A VEHICLE OR ROLLING PLATFORM, THE CALIBRATOR SHOULD BE MOVED ONLY IN THE DIRECTION OF ITS LONG BASE DIMENSION.

THE CALIBRATOR CONTAINS A SAFETY INTERLOCK THAT PREVENTS OPENING THE EXPOSURE CHAMBER WHEN THE SOURCE IS NOT FULLY SHIELDED. STRICT ADHERENCE TO THE CAUTION AND WARNING INSTRUCTIONS ON THE EQUIPMENT AND IN THIS MANUAL IS MANDATORY.

THE CALIBRATOR SHALL BE LOCKED WHEN UNATTENDED.

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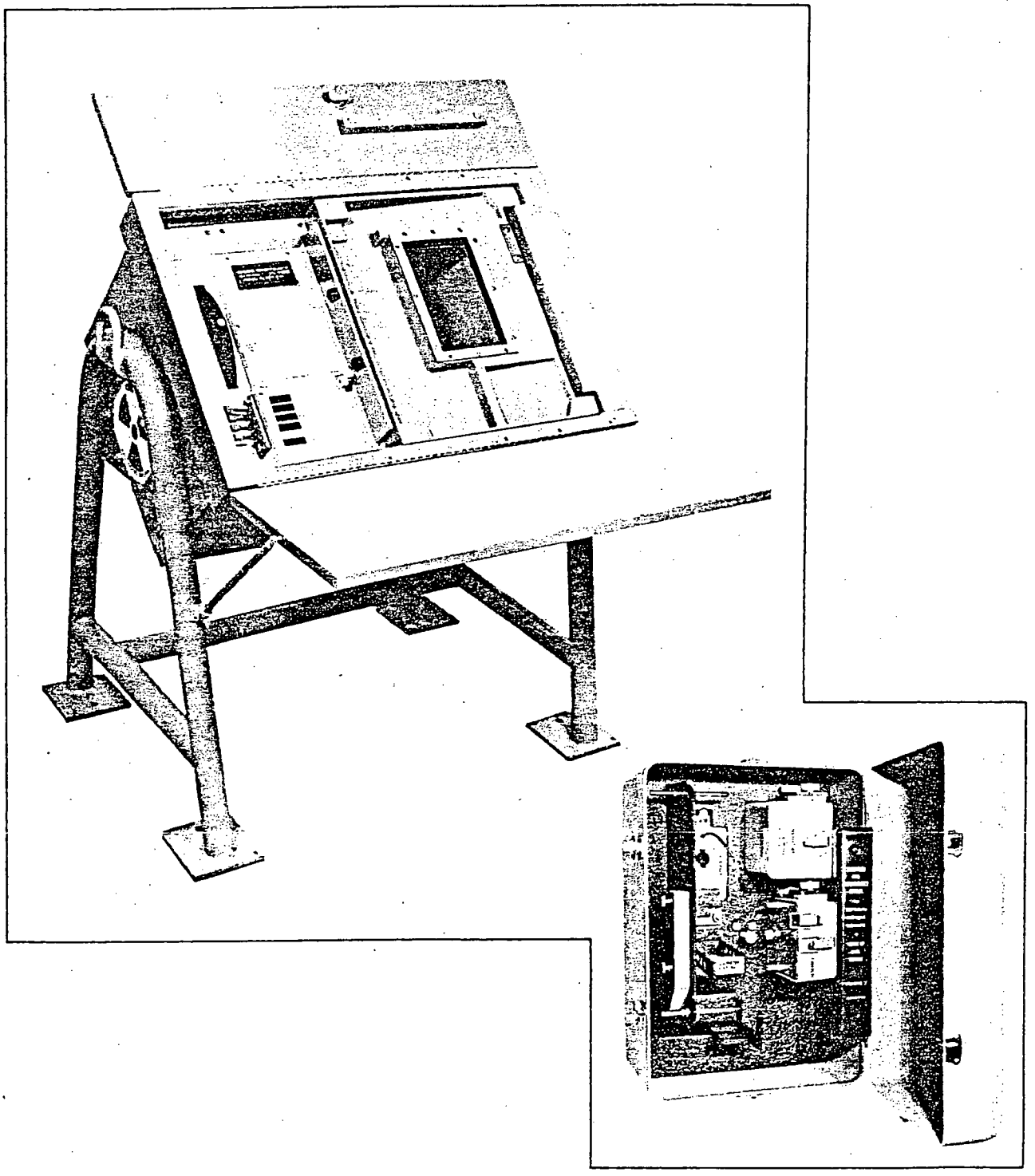


Figure 1-1. Radiological Instrument Calibrator, CD V-794, Model 2 and Accessories

section 1

equipment description

1-1. GENERAL DESCRIPTION

The CD V-794 Model No. 2 Calibrator, shown in figure 1-1, contains a gamma radiation source that provides four intensity levels for calibrating portable radiation survey instruments. Inside the calibrator, the radiation source has a fixed position relative to the survey meter* under test. The specific strength of the radiation field in the exposure chamber is controlled through a rotary attenuator. The instruments are properly positioned in the chamber with fixtures. While a survey meter is in the radiation field, it is calibrated via remote controls and meter readings observed directly through a lead-glass window in the exposure chamber door. All CD V-715 and CD V-717 survey meters are adjusted with the remote controls. Other type survey meters (see Table 4-I) are calibrated by the zero adjust method or by approximation.

The nominal accuracy of the calibrator is maintained by periodically adjusting a decay compensator. The initial radiation intensity of the source is adjusted at the manufacturer's facility.

---

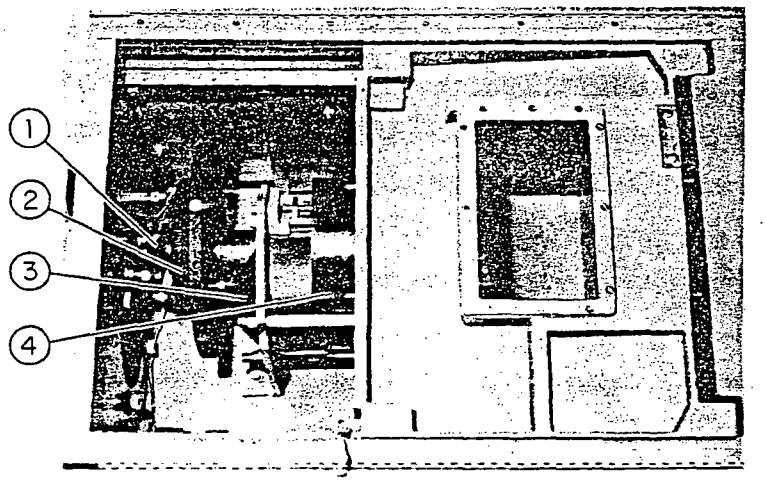
*" Portable radiation survey instruments" and " survey meter" will be used interchangeably in this manual.

1-2. FUNCTIONAL DESCRIPTION

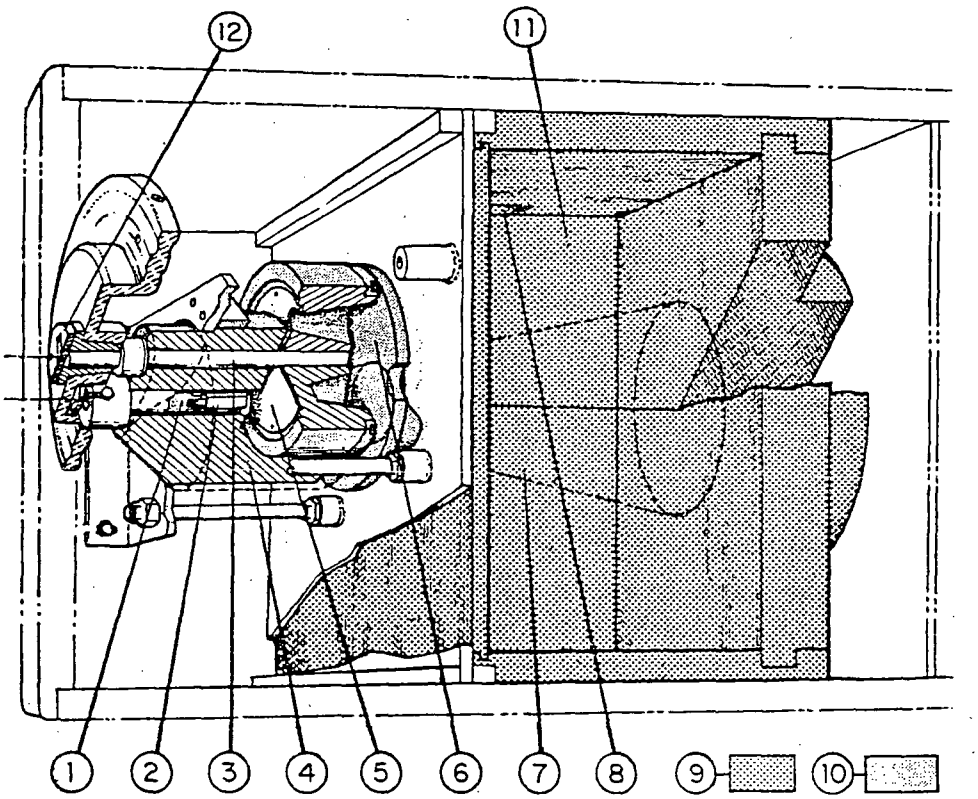
The main components of the calibrator are identified in figure 1-2. The primary shield assembly is the principal unit. It contains the source in a depleted uranium shield that attenuates radiation to a safe level when the source is unexposed, and supports the mechanical and electrical mechanisms for controlling the radiation of the source. The cesium-137 source emits radiation, beamed by the shielding design into the exposure chamber. Interposed in the radiation-beam path is the attenuator disc by means of which radiation levels of 0.4, 4, 40, and 400 R/hr are produced in the exposure chamber. When the radiation-level selector wheel is turned, it rotates the attenuator disc for a specific radiation level in the chamber, and completes the circuit to turn on the range-adjust lamp corresponding to the radiation level selected. When the wheel is in the SAFE position, the radiation-level SAFE indicator (green) is on. The radiation level in the chamber is then approximately 4 mR/hr. The decay compensator disc maintains the nominal radiation strength of the source within ±2.5% when adjusted every 2 years.

The exposure chamber is a special lead-shielded compartment for calibrating and testing OCD radiation survey meters. It is closed by a door with a lead-glass window that protects the operator from the radiation levels in the chamber and provides direct visual observation during instrument calibration. For access to the exposure chamber, the door is rolled to the left. A mechanical interlock prevents it from being moved unless the source is safely shielded.

Survey meters are calibrated via the control panel. The panel contains the radiation-level selector wheel, an indicator-lamp group, and the remote controls. When the selector wheel turns, the attenuator disc rotates and interposes in the radiation path an absorber that reduces the intensity of radiation to the selected level. While a survey meter is in the radiation beam, it can be adjusted by the remote controls, four of which vary the meter's potentiometers and one changes the meter's range. The indicator-lamp group lights to correspond with the radiation level beamed into the chamber.



1. Wiper and Contacts
2. Radiation Level Selector Wheel
3. Primary Shield Assembly
4. Attenuator Disc



1. Container Plug
2. Source
3. Attenuator Disc Shaft
4. Main Shield
5. Decay Compensator
6. Collimator
7. Conical Radiation Beam
8. Cable Port
9. Lead Shielding
10. Uranium Shielding
11. Exposure Chamber
12. Wiper

Figure 1-2. Main Components of Calibrator and Shielding Design

Electrical circuits incorporated in the calibrator provide signalling and illumination. On the left side of the cabinet, a pilot lamp glows (green) when 115 V ac power is turned on. At that time the exposure chamber is illuminated, and the green radiation-level indicator glows on the control panel if the radiation source is fully shielded (SAFE position on the selector wheel). The four other indicators glow red as the intensity is changed to 0.4, 4, 40, and 400 R/hr. Each lamp is correspondingly marked X0.1, X1, X10, and X100 and indicates which range-adjust remote control must be used to calibrate the instrument in the exposure chamber.

The alignment jig and fixtures aid calibration of various radiation survey meters. Before a survey meter is placed in the exposure chamber, the appropriate fixtures must be attached to it. The fixtures are devices for positioning the detecting volume of an instrument into the radiation reference plane, for remotely changing its range, and adjusting its potentiometers. The jig prealigns the 715 and 717 fixtures with the survey meter's potentiometers so that the remote-control screwdrivers will couple to them.

As shown in figure 1-2, adequate shielding is provided on all sides of the radioactive source and exposure chamber. The shielding reduces the exposure rate on external surfaces to a maximum of 2 mR/hr.

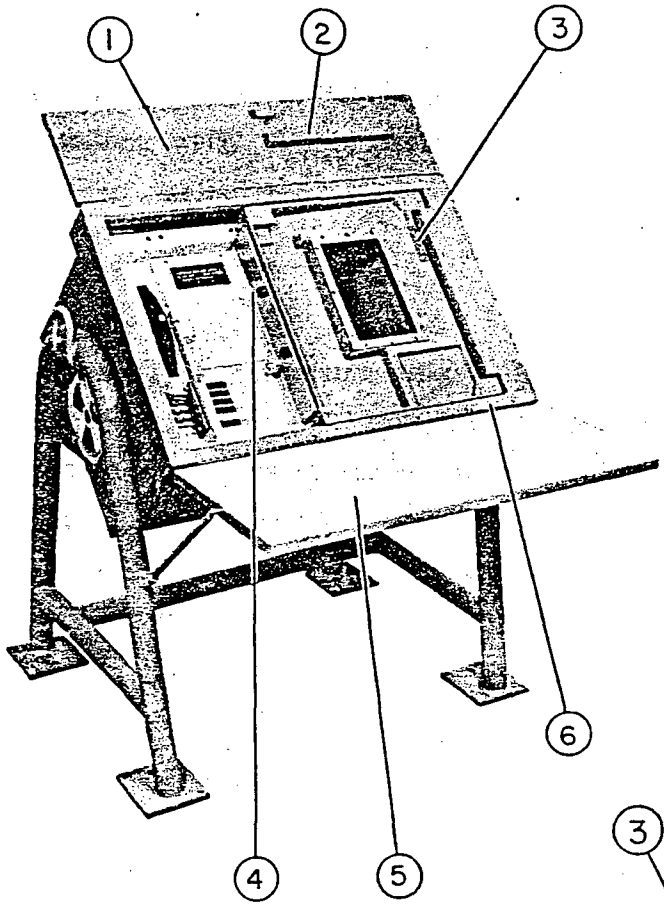
1-3. DESCRIPTION OF MAJOR COMPONENTS

1-3.1. STAND

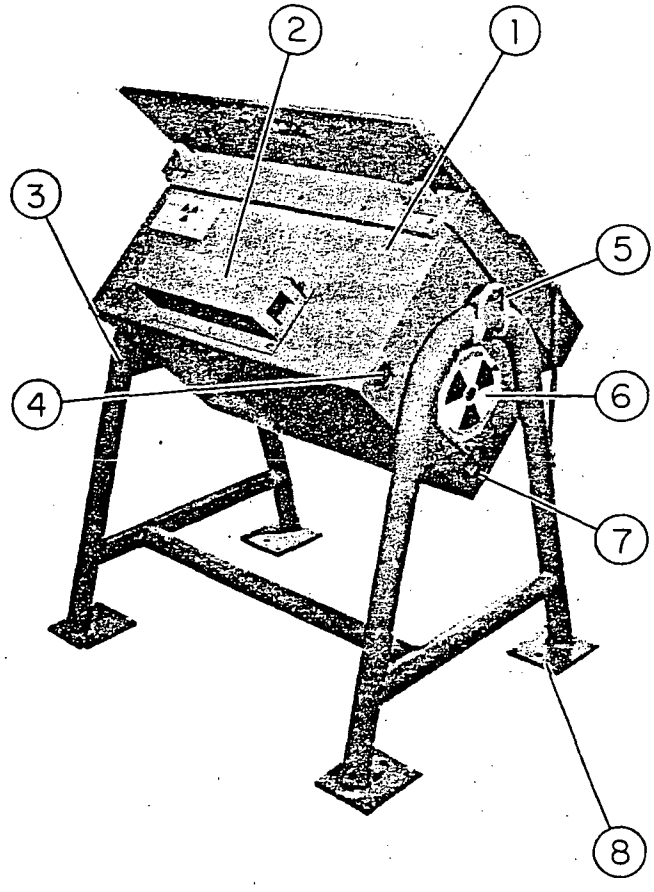
The stand (figure 1-3) consists of two tubular-steel, A-shaped frames joined by a tubular cross-member. The cabinet is bolted to a gusset on each A-frame to give stand rigidity. Leg spread stabilizes the calibrator, and leg pads distribute floor loading. The leg pads are drilled to accommodate casters.

1-3.2. CABINET

The cabinet (figure 1-3), a rectangular steel box, encloses all the calibrator's basic parts and is bolted to the stand. A steel plate divides the cabinet into two compartments. The right compartment contains the exposure chamber. The left compartment contains the primary shield housing, the mechanical



1. Upper Cover
2. Stay Bar
3. Lock Plate
4. Safe Secure Bolt Access
5. Lower Cover, Hinge, Writing Surface
6. Rail Assembly



1. Cabinet
2. Cable Port
3. Stand
4. Input Jack
5. Lifting Eye
6. Cabinet Access Cover
7. Main Switch
8. Leg Plate

Figure 1-3. Calibrator Parts

interlock, the remote controls, the electrical circuitry, and the control panel assembly. A rail assembly is fitted flush with the top of the cabinet and encases it. Two covers, hinged to the rail assembly, join when closed. They protect the controls and the window and door of the calibrator and, when locked, prevent unauthorized use.

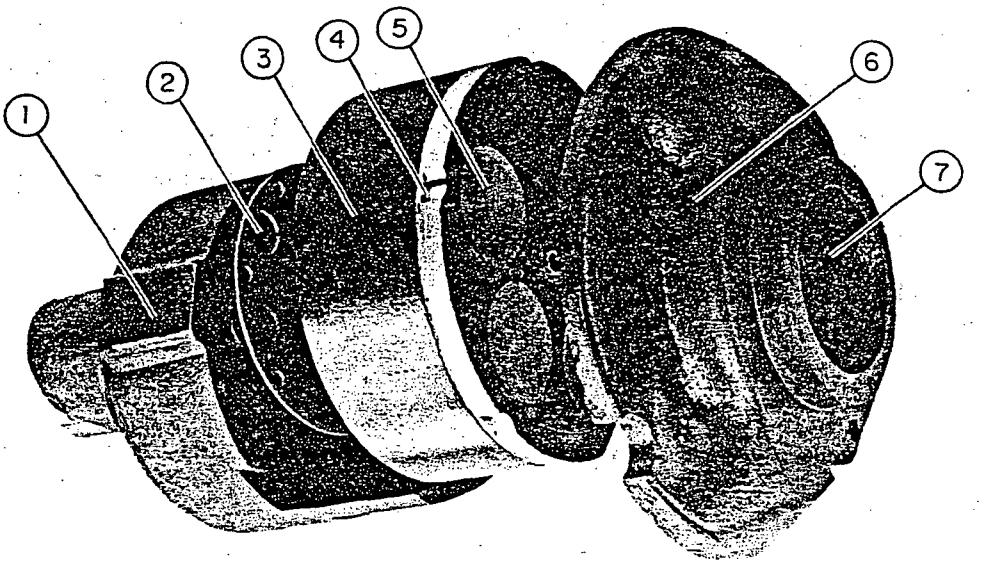
1-3.3. PRIMARY SHIELD ASSEMBLY

The primary shield assembly (figure 1-4) is depleted uranium metal cast in three parts: main shield, attenuator disc, collimator. The configuration of the housing attenuates radiation to 2 mR/hr at every normally accessible surface except the radiation path into the exposure chamber. Bored into the main shield are two parallel, cylindrical holes (figure 1-2). The attenuator-disc shaft is fitted into the upper hole and the source is confined in the lower hole.

The attenuator disc (figure 1-4) is a radiation shield set in the recess between the main shield and the collimator. The disc has five circular, equally-spaced absorption areas near its circumference. Each area is cast conically to a specific metal thickness that produces the required intensity level in the exposure chamber. The absorption areas have corresponding detents on an index ring at the circumference of the disc. The detents center the absorption areas in the radiation beam, control the exposure-chamber door lock, and actuate the attenuator switch in the indicator lamp-group circuit.

The collimator, mounted in front of the attenuator disc, has a cast conical hole that shapes the radiation beam entering the exposure chamber. The chamber side of the collimator hole has a shoulder around it that fits into a mating hole in the divider plate and in the adjacent lead shield of the exposure chamber.

The source is pelletized cesium chloride encapsulated in a double stainless steel jacket (figure 1-5). It is sealed in a cylinder-shaped tungsten plug that is inserted into a stainless steel tube within the main shield, and is then bolted and safety-wired. The source is thus rigidly positioned and is not subject to damage by outside forces.



1. Main Shield
2. Decay Compensator Disc
3. Attenuator Disc
4. Detent
5. Absorption Areas
6. Collimator
7. Beam Shaper

Figure 1-4. Shield Housing - Exploded View

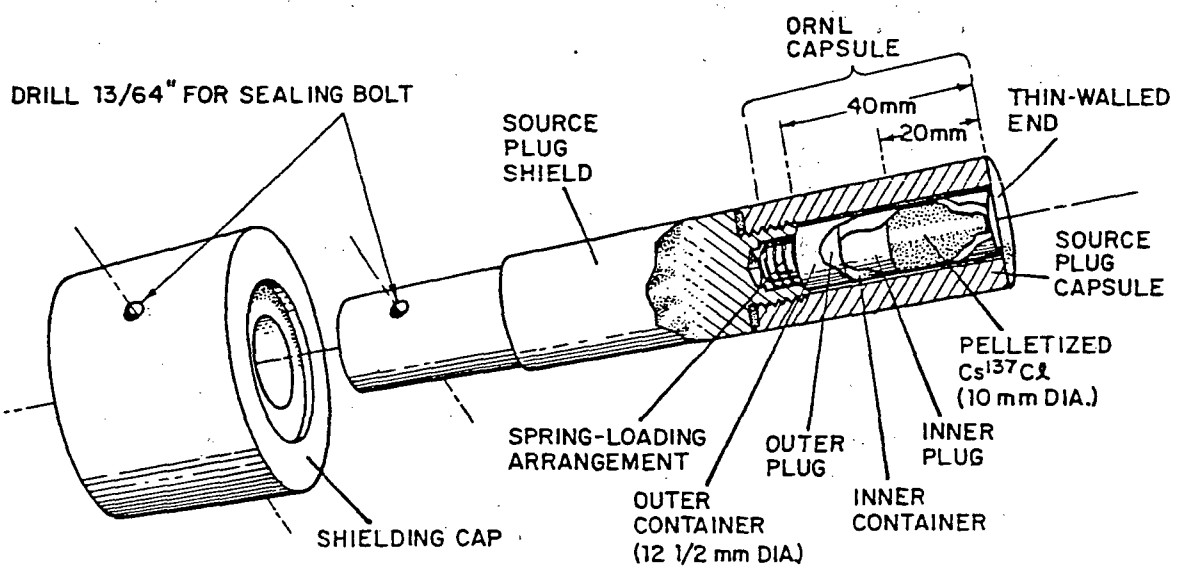
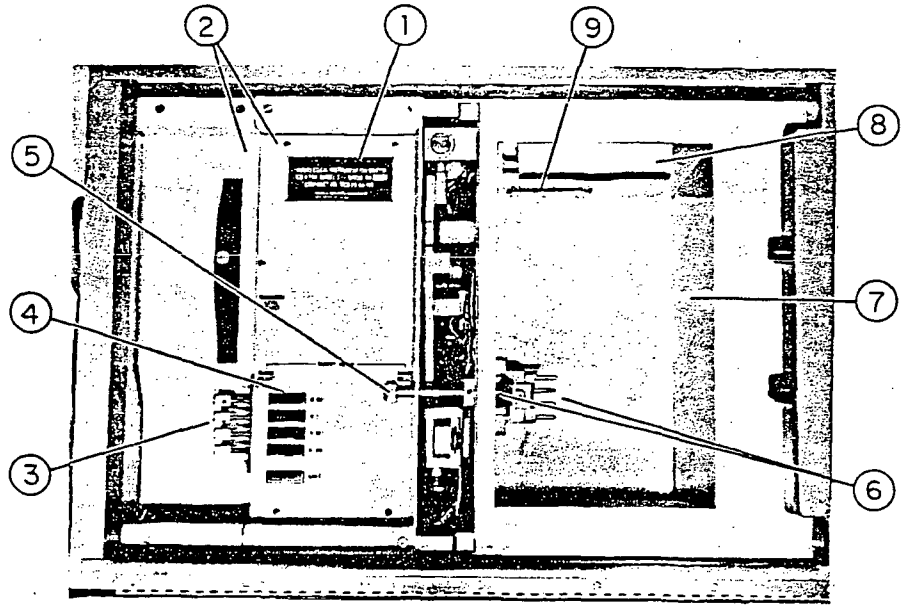


Figure 1-5. Pelletized Cs 137 Gamma Ray Source

The decay compensator (figure 1-4) is a tungsten disc with seven equally-spaced absorption areas and seven locking holes near its circumference. It is mounted on the attenuator-disc shaft between the attenuator and the source, and its absorption areas are coaxial to the radiation-beam path. The absorption areas are machined to successive diminishing thicknesses, each equivalent to source decay for consecutive 2-year intervals. The compensator is rotated one locking hole every 2 years and is retained in place by a spring-loaded lock pin.

1-3.4. EXPOSURE CHAMBER

The exposure chamber (figure 1-6) is the shielded area in which the survey meters are placed for exposure to the calibrated radiation beam. The beam enters the chamber from the left through the aluminum liner. The chamber, which is completely enclosed by lead shielding, is equipped with a cable port, a fixture adapter, a lamp and lamp guard, and remote-control stations for calibrating meters.



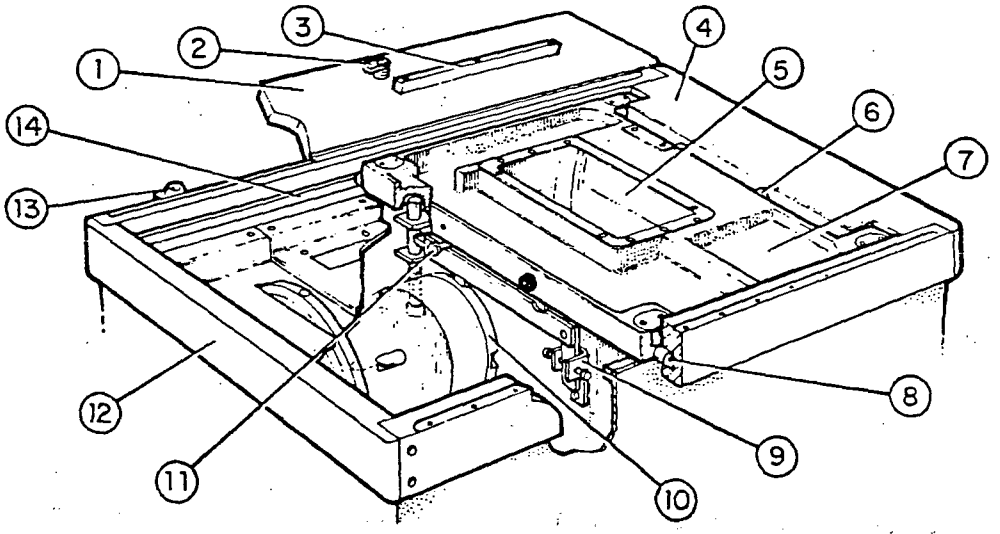
1. Nameplate
2. Control Panel Assembly
3. Range Adjust Controls
4. Indicator Lamp Group
5. Range Select Control
6. Remote Control Stations
7. Exposure Chamber Liner
8. Chamber Lamp and Guard
9. Cable Port

Figure 1-6. Detail of Exposure Chamber and Control Panel

The cable port, a lead-shielded passage, opens into the upper part of the chamber. Survey-meter cables may be routed through it for connection to instruments in the chamber. The chamber's fixture adapter is the range-adjust remote-control station, to which the 715 and 717 fixtures are clamped. Survey meters inserted into the special fixtures are anchored to it. The adapter houses the screwdrivers for adjusting survey-meter potentiometers. Recessed in the same left wall is the range-select remote-control station. It is a spline connector to which the flexible shaft of the range-changer fixture must be connected during calibration. A bayonet type, oblong lamp, protected by a plastic guard, is installed along the upper side of the chamber to illuminate the face of the survey meters evenly.

1-3.4.1. Door and Rail Assembly

The chamber door is cast bronze with lead shielding bonded to its panels. A 2-in. thick, lead-glass window, protected on the outer side by a plexiglass sheet, is framed in its sash. Two roller bearings at right angles at each corner (see figure 1-7) permit the door to roll in grooved, hard-coated aluminum rails



1. Upper Cover and Hinge
2. Cabinet Lock
3. Door Stay Bar
4. Rail End Bar
5. Lead-Glass Window
6. Rubber Bumpers
7. Chamber Door
8. Door Roller Bearings
9. Lever Bar and Arm Link
10. Index Ring
11. Safe-Secure Bolt
12. Rail End Bar
13. Cover Stop Bumper
14. Rail Groove

Figure 1-7. Detail of Rail, Door and Door Interlock

along the length of the cabinet top. A skirt on the control panel side of the door steps the door clearance to eliminate the effects of minor scatter from the chamber.

The door rails are bolted to the rail end-bars and to the cabinet, thereby encasing it. Two hinged covers for the cabinet are fastened to the rail bars. When opened, the lower cover provides a writing surface and the top cover has a card attached indicating when the decay compensator disc should be adjusted. To secure the calibrator, the top cover has a chamber-door stay bar that holds the chamber door in place over the control panel and a tumbler lock that engages a lock plate in the chamber door.

1-3.4.2. Chamber-Door Interlock

The interlock mechanism (figure 1-7) is a spring-loaded lock pin forced in and out of the door's locking hole by the lever bar as its cam roller tracks the index ring. The door is unlocked only when the cam rolls into the SAFE registration detent, the deepest notched position corresponding to maximum attenuation interposed in the beam path. The lock-pin spring constrains the cam roller in the notches. A barrier strip along the door's undersurface prevents the cam from rising out of the SAFE detent unless the door is fully closed.

Connected to the lever bar is an arm link by which the angular displacement of an absorber's center point is fine-adjusted to the axis of the radiation beam path. This is adjusted at assembly to assure proper alignment of the attenuator absorption surfaces with the radiation beam path.

1-3.5. CONTROL PANEL ASSEMBLY

The control panel assembly (figure 1-6) consists of two aluminum panel assemblies, each independently removable. The left panel is slotted for the radiation-level selector wheel. It has a recessed section for manipulating the range-adjust remote controls, and the range-adjust remote controls are attached to the panel. On the right panel are the nomenclature plate, the indicator-lamp group, the range-select control, and the access hole for the safe-secure bolt that fixes the interlock mechanism in the SAFE notch position (see figure 1-3). The control panel of the right control-panel assembly must be removed when the decay-compensator disc is adjusted.

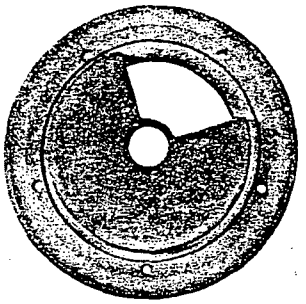


Figure 1-8. Radiation-Level Selector Wheel

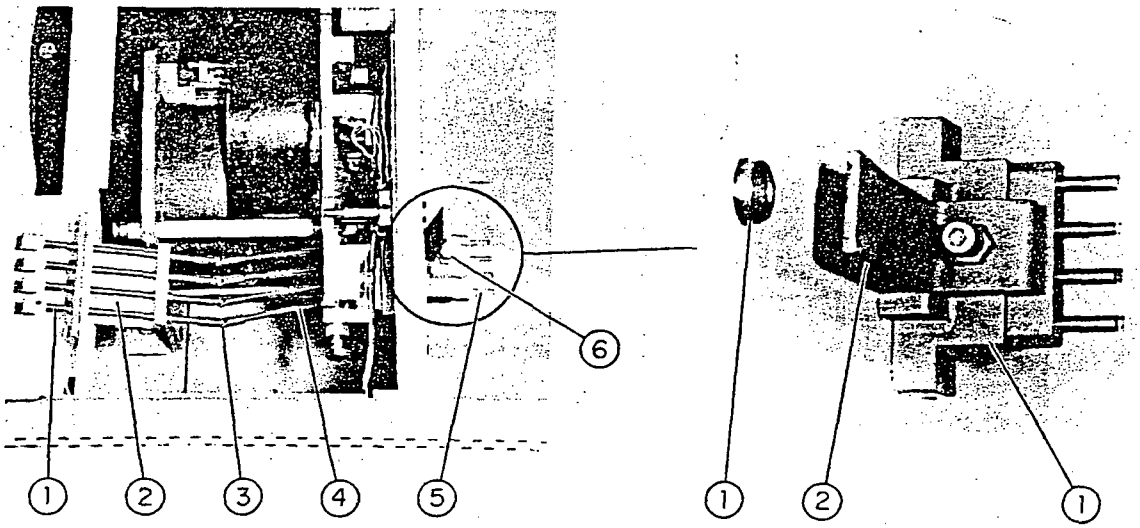
The radiation-level selector wheel (see figure 1-8) is cast aluminum and protrudes through the left control-panel surface. The wheel rim is recessed and coarse-finished for sure-grip manipulation and is marked to indicate the radiation level in the chamber. Holes in the radial surface of the wheel are situated flush with the panel to permit locking the wheel at a selected radiation level. The wheel is directly coupled to the attenuator disc via the attenuator-disc shaft. A triangular opening near the wheel hub provides direct access to the source tube in the main shield.

1-3.6. REMOTE CONTROLS

The remote controls are two assemblies, the range-adjust control and the range-select control. As mechanical links between the control panel and the exposure chamber, they set the calibration potentiometers and the range switch of the survey meters while the meters are attached to the remote stations in the calibrator's radiation field.

The range-adjust control (figure 1-9) is a set of four rigid-shaft screwdrivers incorporated within the fixture adapter. Each rigid shaft has three rods connected by universal joints that provide direct and sensitive potentiometer manipulation. Long sleeve bushings contain the drive and the screwdriver rods for smooth rotation, protrusion, and retraction of the device. A knurled knob is attached to each drive rod at the left control panel.

The range-select control (see figure 1-6) is a captive rod with a control knob at the right control panel and a spline within the chamber to which the range-changer's flexible cable is mated. The rod is held in a special sleeve bearing which recesses the spline within the exposure chamber wall.



1. Drive Rod
2. Drive Rod Housing
3. Universals
4. Transmission Rod
5. Screwdriver Rod
6. Fixture Adapter

1. Remote Control Stations
2. Fixture Adapter Clamp

Figure 1-9. Detail of Range-Adjust Remote Control

1-3.7. ELECTRICAL CIRCUITRY

The electrical circuit (figure 1-10) provides illumination in the exposure chamber and powers the signal lamps for monitoring the operating mode and status of the calibrator; 115 V ac power is connected to the calibrator via a 12-ft extension cord. It is fused at 1 ampere and then routed to the power switch. From the switch, 115 V are transmitted to the chamber lamp and to the 115/5 V stepdown transformer from which the other lamp circuits are operated, including the input-power pilot lamp. The indicator-lamp group illuminates to correspond with the selected radiation intensity in the chamber. The appropriate indicator lamp is selected by a wiper-contact system at the hub of the selector wheel, and it is turned on upon circuit completion by the attenuator switch when the lever-bar cam roller drops into one of the notches in the attenuator index ring. When any one of the four lamps in line with the range-adjust controls is lit, it indicates to the operator which range-adjust control must be used. The SAFE radiation-level indicator is set directly below the range-adjust indicators.

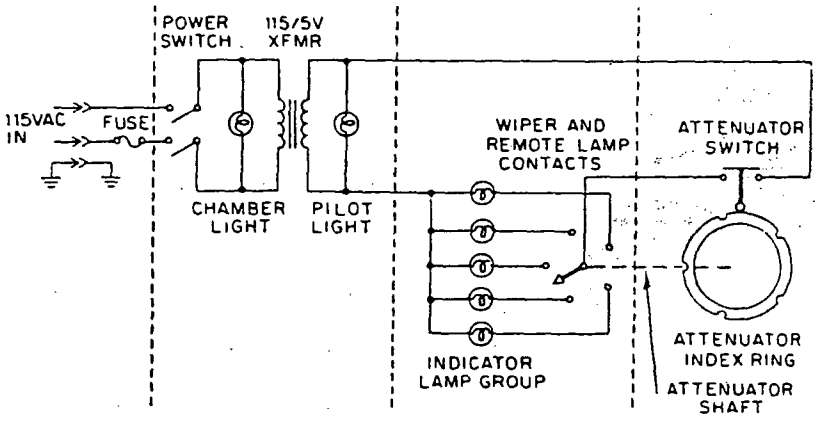


Figure 1-10. Electrical System Diagram

1-3.8. FIXTURES

The calibrator fixtures, except for the range changer and jig, are devices for positioning the detector volume of the different OCD radiation survey meters in the radiation-beam reference plane inside the calibrator exposure chamber. Fixtures 715 and 717 (figure 1-11) are designed for remote-control calibration of the 715 and 717 survey meters. Since the 715 and 717 fixtures are modified survey-instrument cases, the instrument mechanisms are transferred into the fixtures, which makes the potentiometers accessible by remote-control. Three 715 fixtures are supplied, one for each instrument manufacturer.

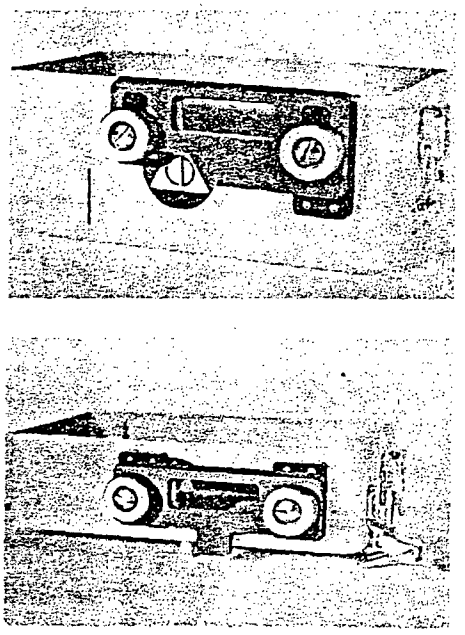


Figure 1-11. 715 and 717 Fixtures

The universal fixture (figure 1-12) is a metal stand consisting of a platform on three legs and an L-shaped bracket that holds the survey meters. Both parts are adjustable. Before the stand is inserted into the chamber, the height of the platform must be adjusted and

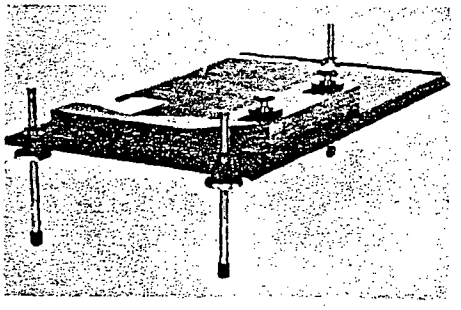


Figure 1-12. Universal Fixture

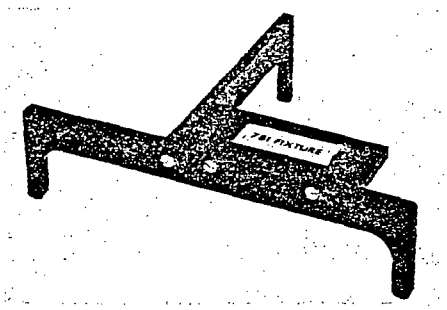


Figure 1-13. 781 Fixture

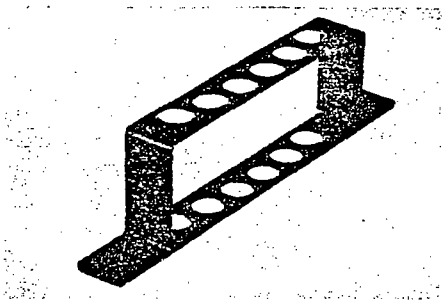


Figure 1-14. Dosimeter Fixture

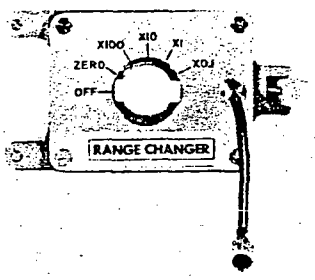


Figure 1-15. Range Changer Fixture

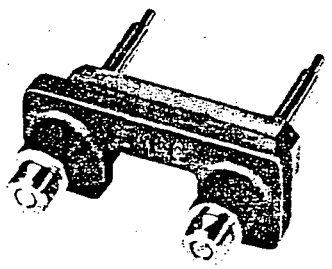


Figure 1-16. Alignment Jig

the meter-locator bracket set for the particular survey meter under test. The survey meters listed in Table 4-I are calibrated on the universal fixture.

The 781 fixture (figure 1-13) is a locating shoe onto which the detector unit of the aerial survey meter is placed.

The dosimeter fixture (figure 1-14) is a six-station U-shaped bracket welded to a similar, flat base that is then secured to the universal fixture. The six dosimeter stations are symmetrically spaced and radially equidistant from the source. Thus, each dosimeter receives an equal radiation dose.

The range-changer fixture (figure 1-15) is a geared device through which the range switch of the 715, 717, 720-3, and 720-3A survey meters can be turned remotely. A gearing mechanism is housed in the plate that fits on the survey meters and holds the range knob in a rotatable slot. Connecting the plate's flexible cable to the spline of the range-changer remote control completes the remote control path from the fixture to the calibrator control panel.

The jig (figure 1-16) fits into the 715 and 717 fixture-adapter socket. It is used to align the socket with the survey meter's potentiometers so that when the fixture is clamped onto the chamber fixture adapter via the socket, the potentiometers are positioned in line with the remote-control screwdrivers.

1-4. REFERENCE DATA

Contract Number and Date:	OCD-PS-66-149, June, 1966
Contractor:	Technical Operations, Inc., South Avenue Burlington, Massachusetts 01803
Cognizant Inspector:	Office of Civil Defense, Office of the Secretary of the Army, Washington, D.C.

Calibrator:

Nomenclature	- Radiological Instrument Calibrator OCD Item No. CD V-794, Model No. 2
Unit Size	27 1/2 in. wide x 34 1/2 in. long x 41 in. high (covers closed)
Unit Weight	- 1100 lb
Floor Loading	- 175 psf (approx.) 10 psi (approx.)

Source:

Nomenclature	- Cesium-137
Activity	- 130 curies ±10% as of date stamped on the calibrator regulation ID plate (10 CFR)
Type of Radiation	- Gamma rays
Half-life	- 29.68 years
Decay Adjustment	- Every 2 years as of date stamped on calibrator nameplate
Radiation Level	- Calibrated within ± 2-1/2%
Capsule	- Model ORNL-2339A

Shielding:

Type	- Depleted uranium
Weight	- 180 lb

Exposure Rate:

Inside Chamber	- < 4 mR/hr
	- 0.4 R/hr (X0.1 meter range)
	- 4 R/hr (X1 meter range)
	- 40 R/hr (X10 meter range)
	- 400 R/hr (X100 meter range)
Ext. Surface of Unit	- $\leq$ 2 mR/hr

Power Requirements:

Voltage	- 115 V ac
Current	- 1 ampere

Equipment Supplied:

Spare-parts Kit	- One (1)
Accessory Case	- One (1)

One (1) manual

One (1) extension cord

Three (3) Calibrator Wipe Tests and Radiation Survey Records

One (1) Alignment Jig

Six (6) fixtures
- Universal fixture
- Dosimeter fixture
- 715 fixture
- 717 fixture
- 781 fixture
- Range Changer fixture

section 2

safety and handling precautions

2-1. GENERAL

In providing a calibration and test chamber for CD portable radiation survey instruments, the CD V-794 presents two potential hazards to the operator: radiological and electrical.

NOTE

It is mandatory that the operator be familiar with the potential hazards and with the precautionary measures directed by this section.

The following subsections describe these hazards and the necessary operator actions. Precautions are also outlined regarding accidents (fire and transportation).

2-2. RADIOLOGICAL HAZARDS

2-2.1. DESCRIPTION OF THE HAZARDS

Two potential hazards arise from the 130-curie, cesium-137 source confined in the main shield. The principal hazard is external gamma radiation, which would be caused by partial or complete loss of the uranium or lead shielding. The second hazard is a radioactive contamination which would be caused by the

escape of cesium material from the source capsule or by uranium material from the shield housing.

2-2.2. PROTECTION

The calibrator is designed to reduce to a minimum the probability of either hazard occurring. The design safeguards are supplemented by personnel, area, and equipment monitoring procedures given in this section.

Personnel monitoring equipment (film badges and CD V-138 pocket dosimeters) must be supplied to each calibrator operator and utilized in accordance with procedures to be established by the cognizant Health Physicist or Radiation Protection Officer. The procedures must satisfy all the requirements of Title 10, Part 20 of the Code of Federal Regulations.

In accordance with procedures to be established by the cognizant Health Physicist or Radiation Protection Officer, the general working area where the calibrator is located must be periodically surveyed for external exposure-rate levels. A permanent record (Calibrator Wipe Test and Radiation Survey Record) of these data must be maintained. If exposure rates above 2 mR/hr at the surface of the calibrator are detected, the procedures given in par. 2-3 must be followed immediately.

The area where the calibrator is located must also be marked AT ALL TIMES by signs bearing the words CAUTION RADIOACTIVE MATERIAL, 130-CURIES CESIUM-137, and displaying the purple or magenta standard radiation symbol on a yellow background. Signs of this type are affixed to each calibrator.

2-3. RADIATION EXPOSURE-RATE CHECK PROCEDURE

The external radiation hazard is controlled by the system of shields and interlocks described in Section 1 of this manual. The following procedure for checking the exposure rates is to ascertain that the shielding is unimpaired. This check must be performed when shipping and receiving the calibrator (par. 3-1.1 and 3-3.1), after an incident that could affect shielding integrity (Fire, par. 2-6, and Transportation Accidents, par. 2-7), and when otherwise specified by

the Radiation Protection Officer. The check must be conducted by (or under the direction of) a Radiation Protection Officer or qualified Health Physicist. Proceed as follows:

a. Enter the calibrator area with a CD V-700 type survey meter and approach the calibrator.

b. IF EXPOSURE RATES ABOVE 2 MR/HR ARE DETECTED 1 FT OR MORE FROM THE CALIBRATOR, IMMEDIATELY TAKE THE FOLLOWING STEPS:

(1) CLEAR THE CALIBRATOR AREA OF PERSONNEL. MAKE A SURVEY OF THE AREA TO ESTABLISH THE 2 MR/HR ISODOSE RATE LINE. ISOLATE THE AREA WITH BARRIERS, ROPES, AND LOCKED DOORS AND POST RADIATION WARNING SIGNS IN ACCORDANCE WITH TITLE 10, PART 20 OF THE CODE OF FEDERAL REGULATIONS. IF NECESSARY POST GUARDS TO INSURE THAT NO ONE ENTERS THE AREA.

(2) IMMEDIATELY NOTIFY THE FOLLOWING BY TELEPHONE OR TELEGRAPH:

(a) NUCLEONICS DIVISION
TECHNICAL SERVICES
OFFICE OF CIVIL DEFENSE
DEPARTMENT OF THE ARMY
PENTAGON, WASHINGTON, D.C. 20310
Phone: Area Code - 202-695-2519

(b) RADIOLOGICAL DEFENSE OFFICER OF THE APPROPRIATE OCD REGIONAL OFFICE

c. If exposure rates at a distance 1 ft from the calibrator are not greater than 2 mR/hr, proceed with the check of the calibrator.

d. Place the detector of the CD V-700 on the external surface of the calibrator. The radiation exposure rate must not exceed 2 mR/hr at any point on the external surface for any position of the RADIATION-LEVEL SELECTOR wheel. If surface exposure rates of 2 mR/hr or above are detected, immediately notify (2) (a) and (b) above.

e. Record all data on the Calibrator Wipe Test and Radiation Survey Record.

2-4. WIPE TEST PROCEDURE

The contamination hazard is controlled by containing the cesium source within a system of sealed vessels as described by Section 1 of this manual. The following wipe test procedure is established to ascertain that sealing has not been impaired. Wipe test smears must be taken of the unsealed end of the source confinement cylinder at intervals of not more than 6 months. The test must be conducted by (or under the direction of) a Radiation Protection Officer or authorized Health Physicist. The following procedure must be performed:

a. Lock RADIATION-LEVEL SELECTOR wheel in SAFE position. Observe SAFE green indicator.

b. Remove extension power cord from power plug on left end of cabinet.

c. Remove cabinet access cover on the left side (figure 1-3).

d. Place detector of CD V-700 near open access port. PERFORM RADIATION EXPOSURE RATE CHECK AS DESCRIBED IN SECTION 2-3 ABOVE.

e. Using Whatman No. 50 (or equivalent) filter paper that has been moistened with isopropyl alcohol, smear the protruding portion of the source plug container (figure 1-2).

f. Check smear with CD V-700 for gross contamination. Let smear air-dry and evaluate the smear with an appropriate G-M counter or a gas-flow proportional counter at a known counting efficiency, E cpm/dpm (counts per minute/disintegrations per minute). Convert net count rate to units of microcuries using the appropriate E factor. Compare the results with the allowable limit of 0.005 microcurie activity. IF 0.005 MICROCURIE OR MORE OF GROSS BETA-GAMMA ACTIVITY IS DETECTED, IMMEDIATELY NOTIFY BY TELEPHONE AND TELEGRAPH THE NUCLEONICS DIVISION OF THE OFFICE OF CIVIL DEFENSE AND THE RADIOLOGICAL DEFENSE OFFICER OF THE APPROPRIATE OCD REGIONAL OFFICE. THE CALIBRATOR AREA MUST BE CLEARED OF PERSONNEL AND IMMEDIATELY CHECKED FOR CONTAMINATION. ALL CONTAMINATED AREAS MUST BE RESTRICTED FROM USE UNTIL CLEANED UNDER THE SUPERVISION OF A QUALIFIED HEALTH PHYSICIST AND ALL REQUIREMENTS OF TITLE 10, PART 20 OF THE CODE OF FEDERAL REGULATIONS ARE SATISFIED.

g. When it is necessary for personnel to enter the area prior to the institution of, and during, decontamination operations, protective clothing, gloves, and footwear should be worn. If airborne cesium-137 contamination above 1×10^{-8} microcurie per milliliter is present, dust respirators or air masks should also be worn. Contamination control procedures to prevent the spread of radioactive contamination should be utilized. Buffer zones should be established for the changing of contaminated protective clothing. To prevent spread of the contamination, the radioactive contaminated area should not be ventilated without control of the effluent air. All operations must be carried out under the direct supervision of an authorized Health Physicist or the Radiation Protection Officer.

h. The disposition of a calibrator with a leaking radioactive source must be handled directly by the Office of Civil Defense. No attempt to stop the leakage or to dispose of the source shall be made without the written approval of the Radiation Protection Officer of the Office of Civil Defense.

i. Record all wipe test results in units of microcuries in the permanent Calibrator Wipe Test and Radiation Survey Record of the calibrator. Replace the access cover and tighten the four bolts. The wire seal need not be replaced.

2-5. ELECTRICAL HAZARDS

2-5.1. DESCRIPTION OF THE HAZARD

Since the calibrator is connected to 115 V ac power, it presents the shock and burn hazards common to all electrically-powered equipment. The hazards have been controlled by grounding the calibrator frame to the ground wire in the extension cord and by fusing one side of the power at the cabinet main switch.

2-5.2. PROTECTION

When maintenance is performed inside the cabinet, the following procedures should be observed:

a. If maintenance is related to the radiation source or to a mechanical difficulty, remove the power cord from the input power plug at the left end of the cabinet.

b. If maintenance requires troubleshooting the electrical circuit, keep power ON only as required. When power is ON, precautions for safe electrical-troubleshooting procedures should be followed.

2-6. FIRE ACCIDENTS

2-6.1. DESCRIPTION OF THE HAZARD

Fires in buildings ordinarily do not produce sufficient temperatures to melt or ignite the uranium shield. However, a calibrator exposed to a prolonged fire may be damaged mechanically and electrically.

2-6.2. PROTECTION

Adequate fire protection should be planned during site selection and calibrator installation. The calibrator itself is not constructed of flammable materials and, with the exception of its painted surfaces, will not support combustion. Local fire prevention personnel should be informed of the radiological hazards.

Since it is difficult to determine how damage to the steel structure or other mechanisms will diminish source shielding, the instructions below should be followed in the event of fire or exposure to elevated temperatures:

a. KEEP THE CALIBRATOR AS COOL AS POSSIBLE DURING EXPOSURE.

b. THE CALIBRATOR AREA MAY BE RADIOLOGICALLY HAZARDOUS DURING AND AFTER FIRE OR HEAT EXPOSURE.

c. RE-ENTER THE AREA WITH EXTREME CAUTION ONLY AFTER AN EXPOSURE-RATE CHECK AND CONTAMINATION CHECK IN ACCORDANCE WITH PAR. 2-3 AND 2-4.

d. IMMEDIATELY NOTIFY THE FOLLOWING BY TELEPHONE AND TELEGRAPH:

(1) NUCLEONICS DIVISION
TECHNICAL SERVICES
OFFICE OF CIVIL DEFENSE
DEPARTMENT OF THE ARMY
PENTAGON, WASHINGTON, D.C. 20310
Phone: Area Code: 202-695-2519

(2) RADIOLOGICAL DEFENSE OFFICER OF THE APPROPRIATE OCD REGIONAL OFFICE

(3) APPROPRIATE AEC REGIONAL COMPLIANCE OFFICE OR STATE LICENSING AGENCY

e. WITHIN 30 DAYS OF ACCIDENT, SUBMIT A WRITTEN REPORT TO EACH OF THE ABOVE. LICENSEES LOCATED IN NONAGREEMENT STATES SHOULD ALSO REPORT TO:

THE DIRECTOR
DIVISION OF COMPLIANCE
U. S. ATOMIC ENERGY COMMISSION
WASHINGTON, D. C. 20545 (ALSO SEE DIRECTIONS PAR. 2-8)

2-7. TRANSPORTATION ACCIDENTS

2-7.1. DESCRIPTION OF THE HAZARD

During shipment and installation, a calibrator might be severely jolted and dropped. IMMEDIATELY CLEAR THE AREA OF PERSONNEL AND CHECK EXPOSURE RATES IN ACCORDANCE WITH THE INSTRUCTIONS OF PAR. 2-3. This check will determine whether faults have occurred in the shielding through which significant amounts of gamma radiation might be emitted.

2-7.2. PROTECTION

The calibrator is designed and constructed to withstand shock and vibration. Normal in-transit shock and vibration would not be expected to cause shielding or structural failure. Precautionary exposure rate checks must be conducted, however, in accordance with the instructions of par. 2-3 after shipment or other shock and vibration exposure. No attempt should be made to service the instrument until authorized by the Radiological Defense Officer of the appropriate OCD Regional Office.

2-8. ADDITIONAL REPORTING REQUIREMENTS

In addition to the reports required by par. 2-3 and 2-6 above, notification by telephone and telegraph as specified in par. 20.402 and 20.403, Title 10,

Part 20 of the Code of Federal Regulations, must be made immediately after a major incident, loss, or other theft of the radioactive material, or for minor incidents within 24 hours, to: (1) The Director of the appropriate AEC Regional Compliance Office or the appropriate State Licensing Agency, (2) Nucleonics Division, Technical Services, Office of Civil Defense, Washington, D. C. 20310, Phone: Area Code 202-695-2519, and (3) The Radiological Defense Officer of the appropriate OCD Regional Office.

Also, a written report must be made within 30 days of any reportable incident (see par. 20.403 and 20.405 of 10-CFR-20) to (1) the Director, Division of Compliance, U. S. Atomic Energy Commission, Washington, D. C. 20545, with a copy to the Director of the appropriate AEC Regional Compliance Office or (2) the appropriate State Licensing Agency. Additionally, if a wipe test on the calibrator indicates the presence of 0.005 microcurie or more of removable gross beta-gamma activity, in accordance with the condition of each licensee, written notification must be made within the specified time period to either (1) the Division of Materials Licensing with a copy to the appropriate AEC Regional Compliance Office or (2) the appropriate State Licensing Agency.

section 3

shipment and installation

3-1. SHIPMENT

When the calibrator must be moved, reshipped, or relocated, the Radiological Defense Officer of the appropriate OCD Regional Office must be notified in writing immediately. In addition to instructions for shipment and special handling at destination, the paragraphs below outline steps to be followed when preparing the calibrator for shipment.

3-1.1. CALIBRATOR PREPARATION

When preparing the calibrator for shipment, follow the steps of this procedure:

a. Perform a wipe test and record the data. Refer to the procedure outlined in par. 2-4.

b. Remove the interlock-mechanism safe-secure bolt from the accessory case.

c. Fix the interlock mechanism in the SAFE position with the safe-secure bolt (see figure 1-7). Check that the RADIATION-LEVEL SELECTOR wheel can be oscillated but not rotated. Safety-wire the safe-secure bolt to the RANGE SELECT knob.

d. Roll the chamber door leftward and place it over the control panel. Block door in place. See figure 3-1 (B).

e. Close the lower cabinet cover.

f. Close the upper cabinet cover and lock. Mail keys to consignee separately by registered mail with return receipt required.

g. Check that the cabinet access cover is safety-wired.

h. Check that the accessory case contains one manual, one or more Calibrator Wipe Test and Radiation Survey Record sheets, an extension power cord, the calibrator fixtures (6), and one alignment jig.

3-1.2. PACKAGING PREPARATION

The shipping container for transporting the calibrator must be a sturdy wooden frame. The following procedure is recommended:

NOTE

Services of professional movers/riggers should be obtained for crating and moving the calibrator.

a. Prepare platform and crate enclosure. Refer to figure 3-1(A).

b. Place calibrator on platform and bolt stand legs to platform.

c. Secure accessory case and spare parts kit to platform.

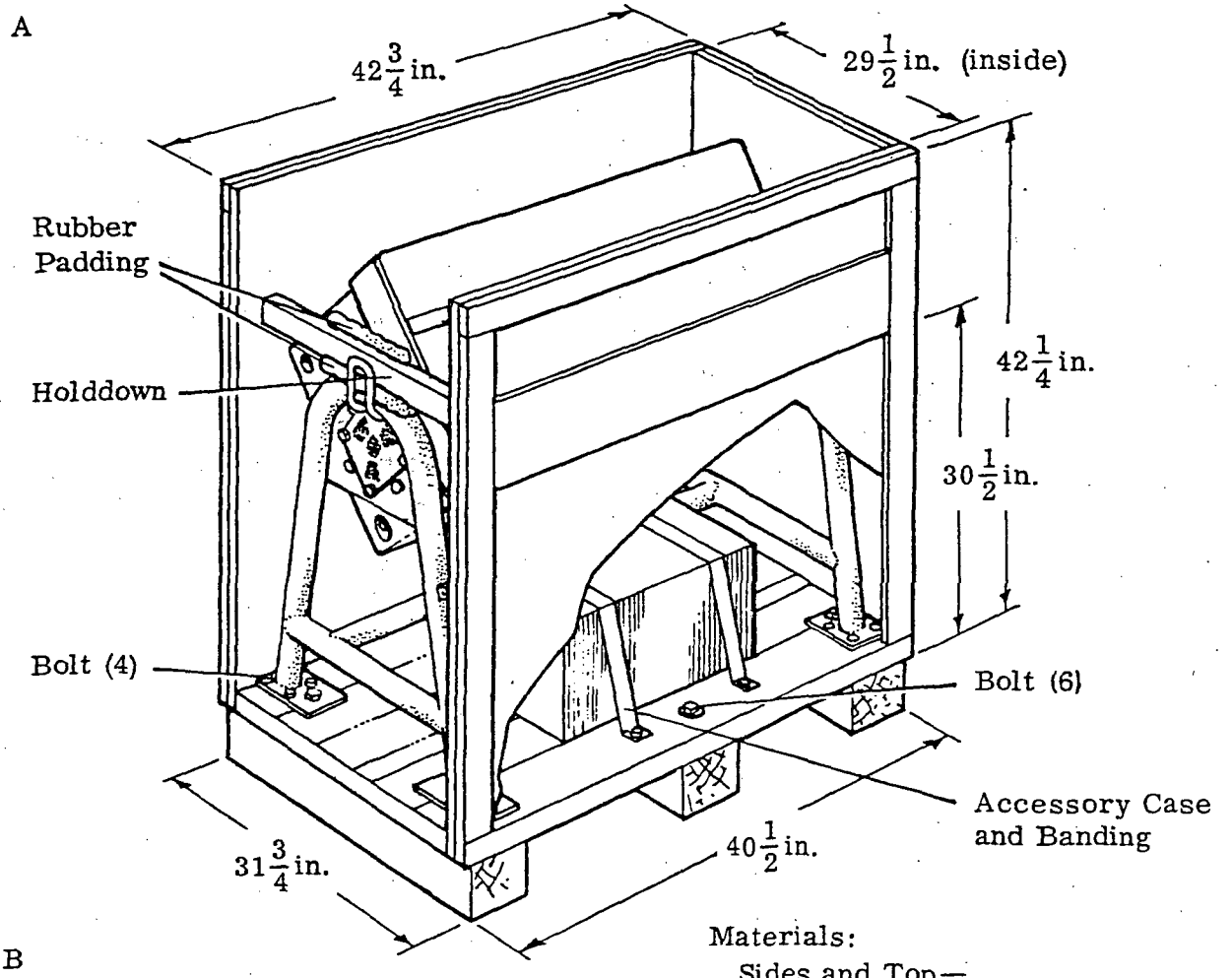
d. Cover calibrator and its accessory case and spare parts kit with a waterproof paper.

e. Block the calibrator within the crate as depicted in figure 3-1(A).

3-1.3. SHIPPING INSTRUCTION

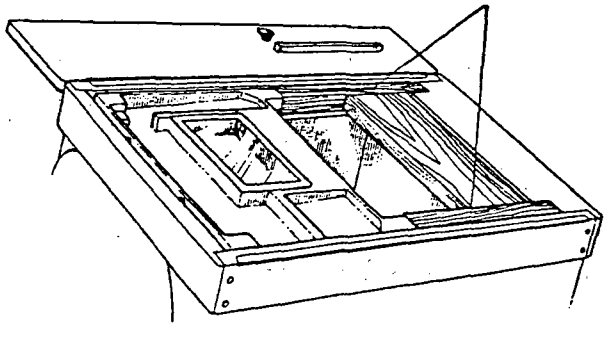
When shipping the calibrator, observe the following procedures:

a. The consignor should utilize only carriers licensed and insured to ship the radioactive materials.



B

Wood Wedge (2)
2 1/4 in. x 1 7/16 in. x 10 in. Timber



Securing the Calibrator Interior.

Materials:

Sides and Top—
3/8 in. Plywood
Strapping —
1 in. x 3 in. (Edges)
Holddown —
2 in. x 4 in. Timber
1 in. x 6 in. (2 Sides Only)
Platform —
2 in. x 8 in. Timber
Skids —
4 in. x 4 in. Timber
Carriage Bolt 3/8 in. x 6 in.
Calibrator —
Carriage Bolt 1/2 in. x 4 in.

Figure 3-1. Construction Data-Calibrator Shipping Container

CAUTION

EXTREME CARE MUST BE TAKEN WHEN MOVING OR MOUNTING THE UNIT ON A MOVING VEHICLE. ALWAYS SECURELY BLOCK AND STRAP THE UNIT ON A MOVING VEHICLE.

b. SHIPMENT OF THIS ITEM MUST BE IN ACCORDANCE WITH DOT REQUIREMENTS. DOT regulations applying to the shipment of this calibrator are published by the U. S. Government Printing Office, Washington, D. C. as Code of Federal Regulations, Title 49, Transportation, Parts 71 to 90. These regulations are also reprinted as tariffs for transportation of hazardous materials by the American Trucking Association (1616 P Street NW, Washington, D. C. 20036) and by the Association of American Railroads (Bureau of Explosives) (30 Church Street, New York, New York 10007). Labels must conform to figure 3-2 in size and data content (49 CFR 73.414). Samples may be obtained from the American Trucking Association and from the Association of American Railroads.

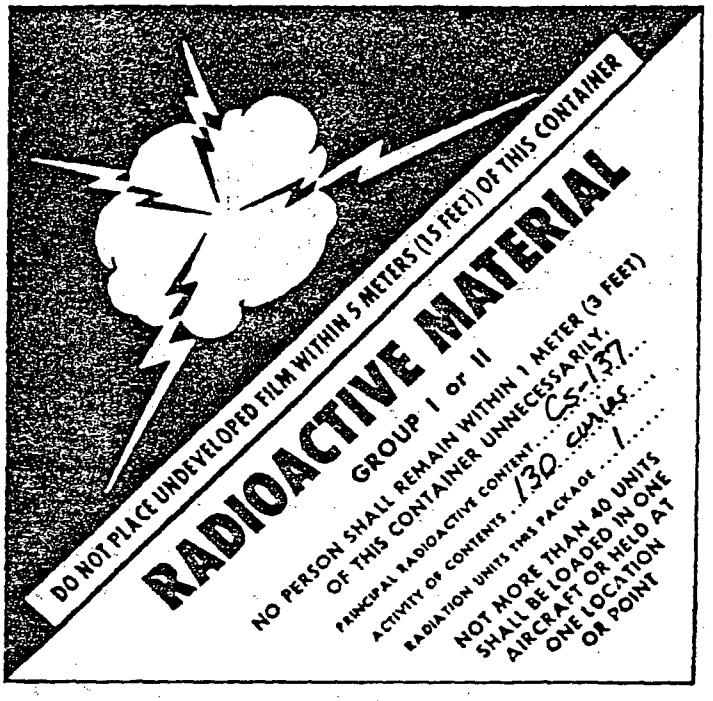
c. The consignor should also assure himself that the consignee is appropriately licensed to receive the calibrator (receipt of requested copy of consignee's license prior to release of shipment).

3-2. UNPACKING AND HANDLING PROCEDURES

At destination, the calibrator should be unpacked, checked, and moved only in the presence of the Radiation Protection Officer or an authorized Health Physicist. The instructions and procedures of the following paragraphs assure safe handling.

NOTE

An authorized Health Physicist or Radiation Protection Officer should receive shipment of the equipment and check it as though the entire unit were a consignment of radioactive materials.



NOTE

These labels will be replaced by those described in 49 CFR 173.414 when it is adopted.

Shipper's name required here for surface transportation.

Figure 3-2. Shipping Label

WARNING

IMMEDIATELY UPON ARRIVAL, THE EXPOSURE RATES AT CONTACT WITH THE CRATE MUST BE MEASURED. A CD V-700 METER MAY BE USED. THE EXPOSURE RATE AT CONTACT WITH THE CRATE MUST NOT EXCEED 2 MR/HR. IF FOUND TO BE HIGHER, IMMEDIATELY NOTIFY THE APPROPRIATE OCD PERSONNEL AS REQUIRED BY PAR. 2-3.

a. Uncrate the unit but do not remove it from its platform. Store shipping crate – it can be reused.

b. Visually check the calibrator for damage and if received direct from the manufacturer check that the wire-seals are intact. Investigate any discrepancies immediately and report these to the Radiological Defense Officer of the Appropriate OCD Regional Office.

c. Calibrator may be moved by inserting the tines of a forklift under the wooden platform. Exercise greater caution when moving the calibrator in the direction of its short base dimension.

d. Do not transport calibrator to installation site until incoming inspection is completed.

3-3. INCOMING INSPECTION

3-3.1. RADIATION INSPECTION

The following inspection should be performed:

a. Conduct a complete exposure rate survey in accordance with par. 2-3.

b. Unlock and open the cabinet covers.

c. Remove wood shipping blocks wedging chamber door.

d. Roll chamber door rightward and place it over exposure chamber. Repeat step a. above. Record the maximum dose rate measured on Calibrator Wipe Test and Radiation Survey Record shipped in the accessory case.

e. If received direct from the manufacturer, break wire-seal of access cover on left side of cabinet. Remove cover and perform a wipe test on end of source plug container. Refer to procedure outlined in par. 2-4. Record amount of removable contamination in units of microcuries on Calibrator Wipe Test and Radiation Survey Record in accessory case.

If the results of d and e are acceptable, proceed to mechanical and electrical inspection (par. 3-3.2). After completion of that section, repeat step d with a survey meter in the chamber and the SELECTOR wheel rotated to the 400 R/hr position. External dose rates should still not exceed 2 mR/hr.

3-3.2. MECHANICAL AND ELECTRICAL INSPECTION

Perform the following inspection:

a. Check cover lock and handle. Check top cover bumper stops.

b. Open and close covers. Covers should swing smoothly on the hinge. All hinge screws should be tight.

c. Roll chamber door on its rails. A slight force should move it. No binding should be evident. Even contact should be made on both rubber bumpers without any metal portion of the door first making contact with the right rail end bar.

d. Check cabinet, control panel, and exposure chamber for loose parts.

e. Check each of the RANGE-ADJUST controls for free 360° rotation as well as ease of movement to each extreme from all the way pulled out to all the way pushed in. No binding should be present. Rotate the RANGE SELECT control knob; this should turn freely.

f. If a mechanical defect is indicated, refer to Section 5 for corrective action.

CAUTION

CALIBRATOR MUST BE GROUNDED. CONNECT CALIBRATOR TO A 115 VAC, GROUNDED, 3-CONDUCTOR POWER OUTLET ONLY. THE CALIBRATOR IS EQUIPPED WITH A POWER CORD.

g. Turn ON power at cabinet main switch. Check that main-power pilot lamp (green), SAFE radiation-level indicator (green), and chamber lamp are ON.

h. Remove safe-secure bolt and place it in the accessory case.

i. With chamber door in position over exposure chamber, rotate SELECTOR wheel downward to first radiation level indicated (400 R/hr). Check for binding or rubbing. Check that the X100 RANGE ADJUST indicator glows.

j. Standing well to the control panel side of the calibrator, try to roll chamber door toward the control panel. It should not move.

WARNING

IF THE DOOR ROLLS OPEN, THE SAFETY-INTERLOCK MECHANISM IS DEFECTIVE. PLACE THE DOOR OVER THE EXPOSURE CHAMBER. TURN THE SELECTOR WHEEL TO THE SAFE POSITION. POST A "DO NOT OPERATE" SIGN ON THE EQUIPMENT AND FOLLOW THE CORRECTIVE MAINTENANCE PROCEDURES OF SECTION 5.

k. Repeat steps j. and k. for the 40, 4, and 0.4 R/hr positions of the SELECTOR wheel. The SELECTOR wheel should rotate freely without binding and, at each dose rate position, the detent mechanism should provide a positive feel that it has stopped in the detent at the correct location.

l. Resecure calibrator.

3-4. INSTALLATION

No special facilities are required for this calibrator. Follow this procedure when installing it:

a. The calibrator should be placed in the maintenance shop in a location most convenient for the calibration of the instruments – uncalibrated instruments should flow easily to the calibrator and calibrated instruments away from the calibrator.

b. The most important consideration in locating the calibrator is to eliminate glare from overhead lights and to make sure the operator can clearly see the instrument's meter when the instrument is in the exposure chamber. Overhead lighting may need to be adjusted.

c. The calibrator is designed so that the integrity of the shield will not be destroyed even though the calibrator might be involved in a fire. However, after the calibrator has been installed, it is recommended that the fire department providing service to the building in which the calibrator is located be notified.

d. The weight of the calibrator is approximately 1100 pounds. The floor construction must be capable of sustaining this weight. If desired, four casters may be used under the leg pads, but since the calibrator has a relatively high center of gravity, caution should be exercised if it is moved on casters. The specification for stability up to 25° of tilt is not applicable when the calibrator is mounted on casters.

e. Source of 115 V ac, grounded power is required.

3-5. PREPARATION FOR USE

To use the calibrator, proceed as follows:

a. Unbolt the calibrator from the platform.

b. Remove the calibrator from the platform and locate it in the selected area.

c. Check that the calibrator cannot be rocked; if necessary apply small shims under the appropriate leg pad to stabilize the calibrator.

d. Connect the extension power cord to the cabinet input jack and also to the building power outlet. With an ohmmeter, check for continuity between the cabinet and building electrical ground.

section 4

operating instructions

4-1. GENERAL

The CD V-794 Model 2 calibrator provides four radiation intensity levels for calibrating standard OCD ion-chamber survey meters. These intensities are sufficient to calibrate CD V-710, V-715, V-717, and V-720 instruments in each of their ranges at approximately 80% of full scale. The CD V-781, having a different scale, can be checked at approximately 40% of its full scale for the two highest ranges. No intensity is available to check the response on the lowest range of the CD V-781 survey meter.

4-2. PREPARATION OF CALIBRATOR AND INSTRUMENTS

4-2. 1. CALIBRATOR

Before proceeding, refer to Section 5-2. Calibrator preparation and maintenance should be performed concurrently.

NOTE

Before using the calibrator, verify that the inspection procedures in par. 3-3 have been complied with, and that the equipment has been properly serviced.

a. Unlock the calibrator and open cabinet covers. See figure 4-1.

b. Close the exposure chamber door by sliding it to the right until it completely covers the exposure chamber. See figure 4-2.

c. Connect the extension cord to the cabinet input jack and to a 115 V ac grounded power outlet.

d. Turn ON power at calibrator power switch. Check that power lamp, radiation-level SAFE lamp, and chamber lamp are ON.

e. Check the operation of each RANGE ADJUST indicator lamp by rotating the RADIATION-LEVEL SELECTOR wheel to the 400, 40, 4, and 0.4 R/hr positions. See figure 4-3.

f. Remove required fixtures from accessory case.

g. Check that Operator Maintenance (refer to par. 5-2) has been completed.

4-2.2. RADIATION SURVEY INSTRUMENTS

To permit rapid processing, instruments of the same make and model should be handled in groups of twenty five to fifty. Observe the following procedure:

a. Set groups of instruments on a table adjacent to the calibrator.

b. Place fresh batteries in each instrument.

c. After sufficient warmup, perform an operability check.

d. Set the range switch of operable instruments to the zero position.

e. For non-operable instruments, refer to the REPAIR AND MAINTENANCE MANUAL FOR CIVIL DEFENSE RADIOLOGICAL INSTRUMENTS for repair procedures.

4-2.3. UNIVERSAL FIXTURE

The universal fixture is used to center the ion-chamber volume in the chamber radiation beam when the platform legs have been adjusted to the proper height and the platform is set against the left wall. Follow these steps:

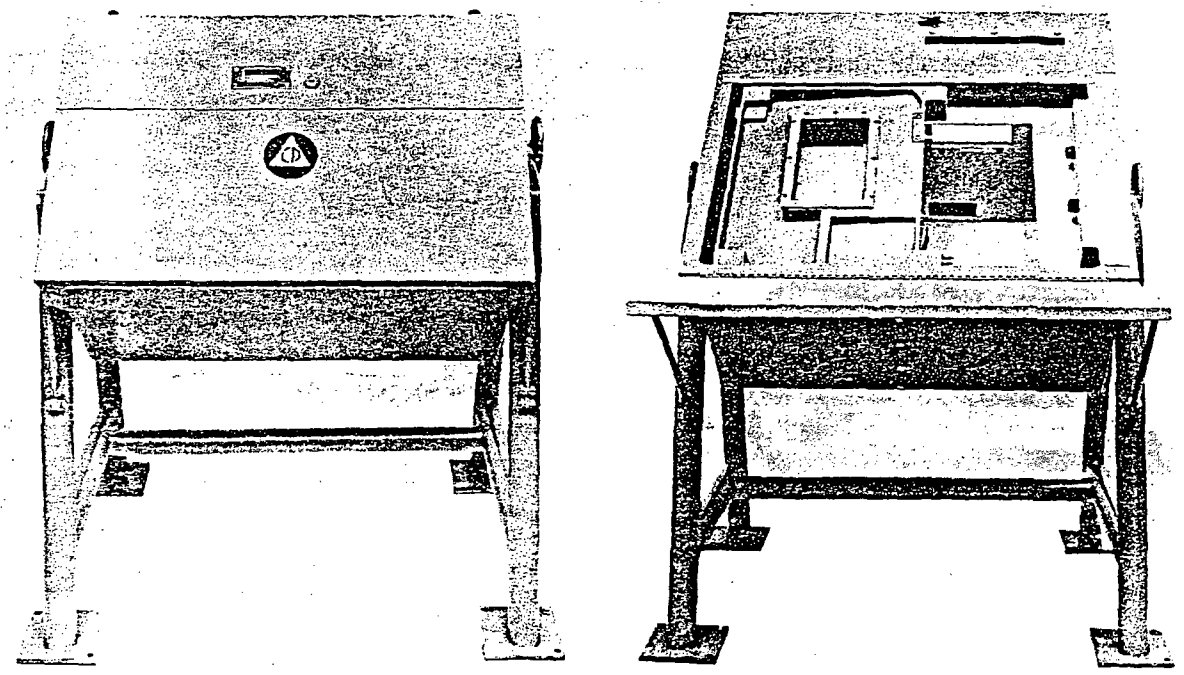


Figure 4-1. Calibrator Locked and Open

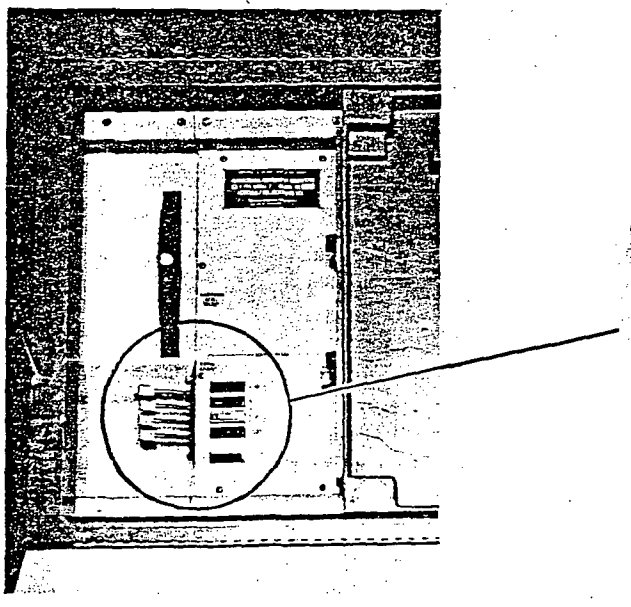


Figure 4-2. Calibrator with Exposure Chamber Door Closed

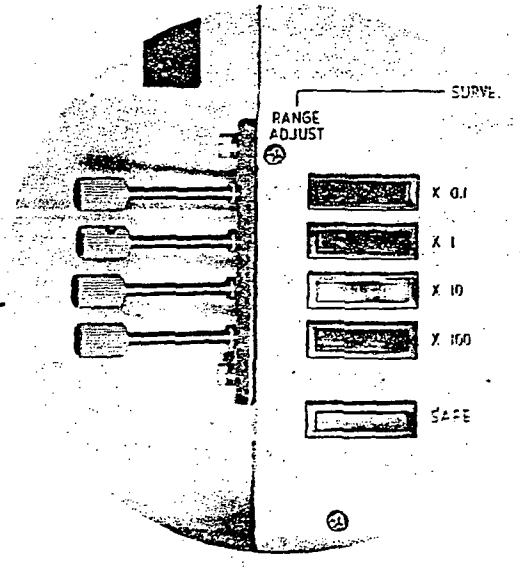
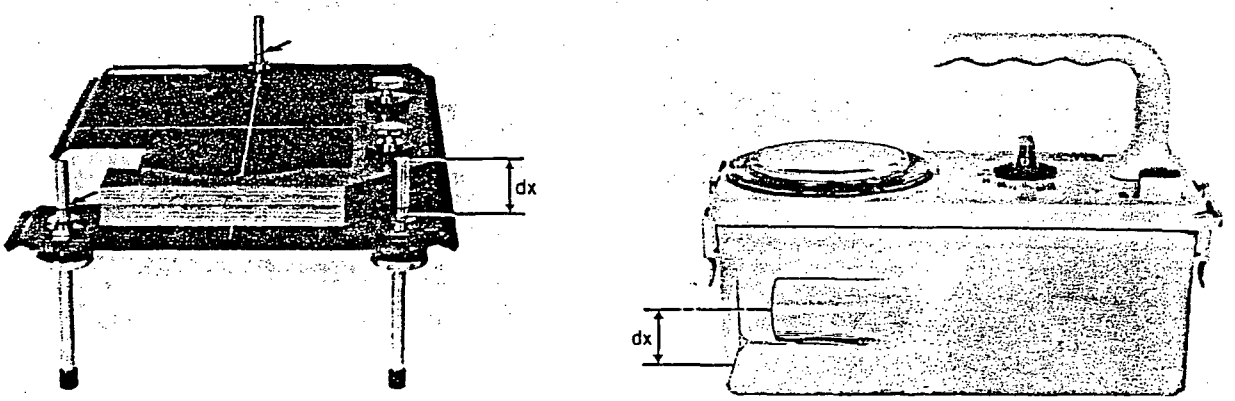


Figure 4-3. Indicator-Lamp Group Checkout

a. To adjust the platform height:

1. For all instruments listen in Table 4-I, adjust each leg so that the red ring on the fixture leg is even with the top of the leg bushing. Tighten in this position.



A B

Figure 4-4. Setting Leg Height on Universal Fixture

2. To prepare the platform for unlisted meters, refer to figure 4-4 (B); dx is the distance from the outside of the bottom of the instrument case to the center of the detector volume; and also from the top of each leg to the top of each leg bushing.

TABLE 4-I. INSTRUMENTS CALIBRATED ON THE UNIVERSAL FIXTURE

CD V-710 M3	Victoreen	CD V-720 M2	Victoreen
CD V-710 M4	Jordan	CD V-720 M3	Victoreen
CD V-710 M5	Victoreen	CD V-720 M3	Landers
CD V-720 M1	Chatham	CD V-720 M3A	Victoreen
CD V-717 M1 Victoreen (Remote Mode Only)			
Dosimeters			
CD V-138	CD V-736	CD V-742	
CD V-730	CD V-740	CD V-746	
Other Radiation Survey Meters (Refer to par. 4-5.)			

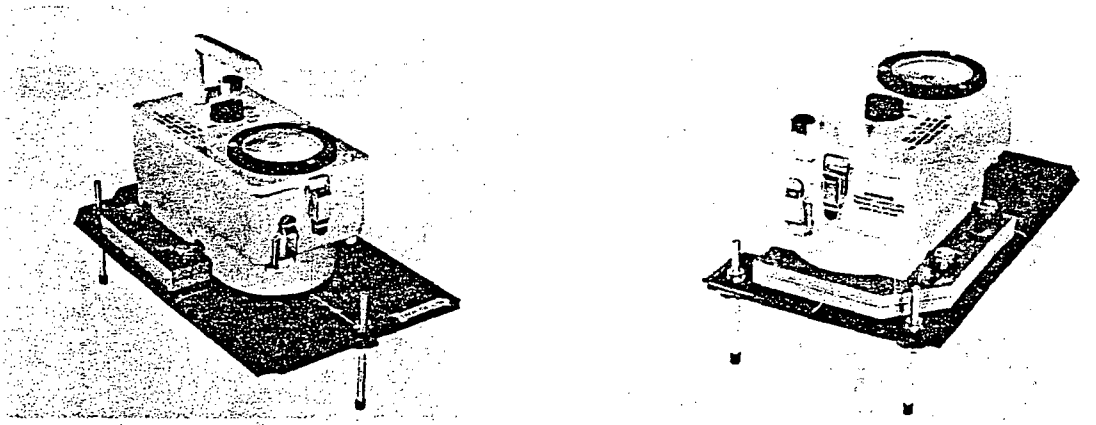
b. To calibrate survey meters:

1. Stand fixture on table and loosen nuts on Bakelite bracket.

2. Place instrument on platform and center its detector volume with the platform's beam and center lines. See figure 4-5(A).

3. Move the Bakelite bracket against the instrument and tighten the nuts. See figure 4-5(B).

4. Remove instrument and place the universal fixture into the exposure chamber. Slide fixture against left wall of chamber as far as it will go. See figure 4-6.



A B

Figure 4-5. Centering Instrument Chamber on Universal Fixture

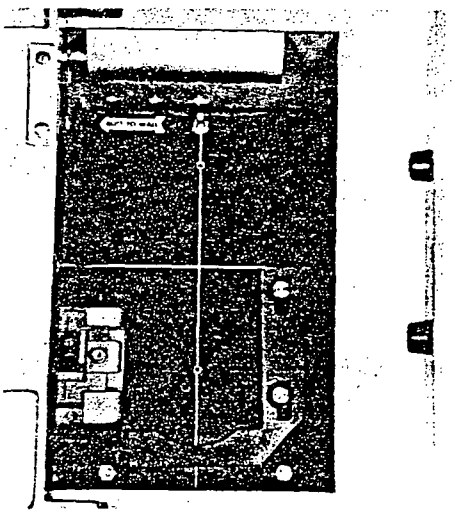
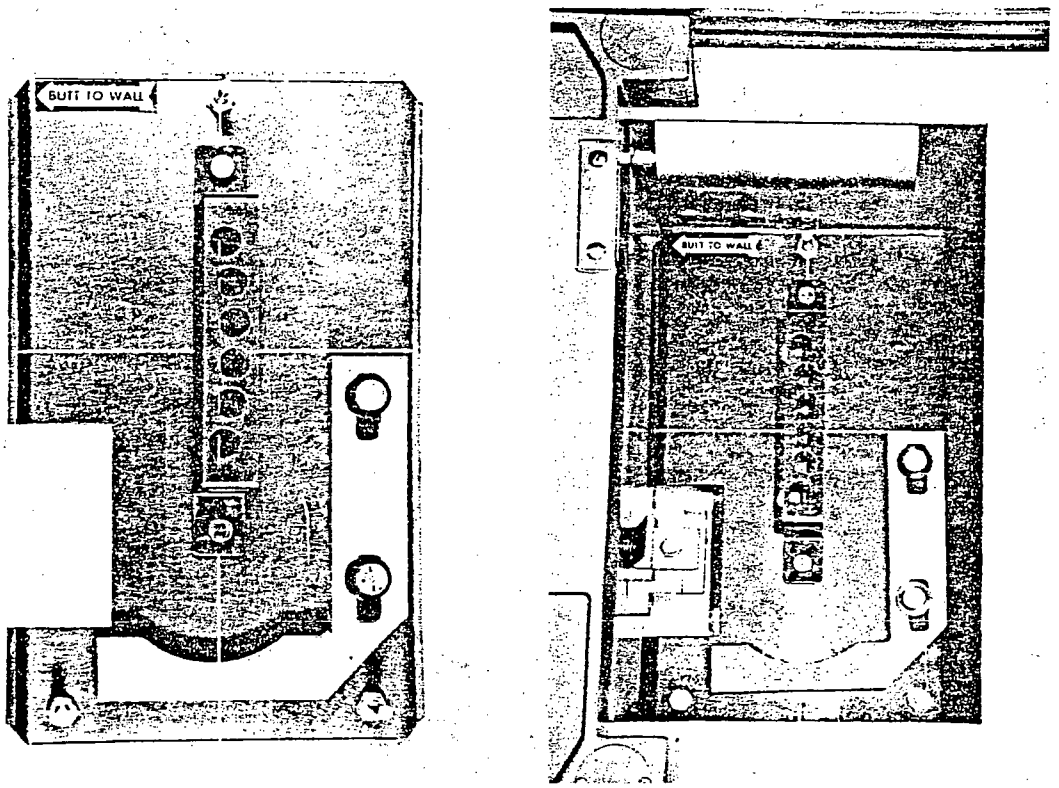


Figure 4-6. Universal Fixture Set in Exposure Chamber

c. To calibrate dosimeters:

1. Stand universal fixture on table and fasten dosimeter fixture to it. See figure 4-7(A).

2. Place universal fixture into the exposure chamber. See figure 4-7(B). Universal fixture platform should be pushed against left wall of chamber as far as it will go.



A B

Figure 4-7. Dosimeter Fixture Attached to Universal Fixture and Placed into Exposure Chamber

4-3. CALIBRATION OF FIXTURE-ADAPTER GROUP

4-3.1. SURVEY METER CD V-715

To calibrate survey meter CD V-715, perform the following operations:

a. Perform operability check and zero the meter.

b. Prepare instrument calibration card, as required. See sample, figure 4-8.

GENERAL DATA

State Shop

CD V- _____ Model No.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 5 6 7 8 9

☐ ☐ ☐
A B C

— — — — — — — — — —
Serial Number

Date
— — — (Mo.) — — — (Yr.)

INSTRUMENT RECEIVED FROM
Federal Agency ☐
State/Local Agency ☐
Depot Stock ☐

Manufacturer
☐ Anton
☐ Bendix
☐ Chatham
☐ ENI
☐ IEH
☐ Jordan
☐ LFC
☐ LTV
☐ Landsverk
☐ Lionel
☐ Nuclear Chicago
☐ NC of A
☐ Victoreen
☐

DEPARTMENT OF THE ARMY
OFFICE OF THE SECRETARY OF THE ARMY
OFFICE OF CIVIL DEFENSE
WASHINGTON, D.C. 20310

CALIBRATION AND REPAIR DATA CARD

CALIBRATION DATA

Range	R/hr Applied	Meter Reading (R/hr)	
		Before Cal.	After Cal.
X-100			
X-10			
X-1			
X-.01			

Date Last Calibrated ____ ____ (Mo.) (Yr.)

Calibration Time in Minutes — — —

Name of Technician

REMARKS:

OCD Form No.

Figure 4-8. Sample Data Card

c. Remove the instrument from its case.

d. Secure the instrument into the appropriate 715 fixture. A separate fixture is provided for each manufacturer of the CD V-715.

NOTE

The 715 fixture positions the detection chamber of the CD V-715 within the radiation beam. Its design offsets the chamber from the beam reference plane by 3/8 inch.

e. Use the alignment jig to align the fixture-adapter socket with the instrument's sensitivity potentiometers. See figure 4-9. Careful alignment is necessary to permit remote adjustment of all sensitivity potentiometers.

f. Set range changer fixture in place. See figure 4-10.

g. Place the instrument in the exposure chamber and attach the fixture-adapter socket to the fixture adapter. See figure 4-11.

h. Check meter zero reading. If necessary, re-zero.

i. Connect flex cable of range changer fixture to remote-control station. See figure 4-12.

j. Close the chamber door.

k. With the RANGE SELECT control, change the instrument range to X100.

l. Rotate the RADIATION-LEVEL SELECTOR wheel to the 400 R/hr position (X100 RANGE ADJUST indicator, ON).

m. Record observed meter reading on the calibration card.

n. Push in and rotate the RANGE ADJUST knob opposite the lighted indicator to adjust the meter reading to the nominal 400 R/hr or to the most precise exposure rate that may be specified. Record this value on the calibration card.

NOTE

It is important that the RANGE ADJUST knob be pulled out immediately after each use to prevent (1) further movement of the calibration potentiometer when the instrument is removed and (2) bending the screwdriver rod portion of the RANGE ADJUST mechanism, which would result in binding of the mechanism.

o. Rotate the RADIATION-LEVEL SELECTOR wheel to 40 R/hr position (X10 RANGE ADJUST indicator, ON).

p. Change the instrument range to X10 with the RANGE SELECT control.

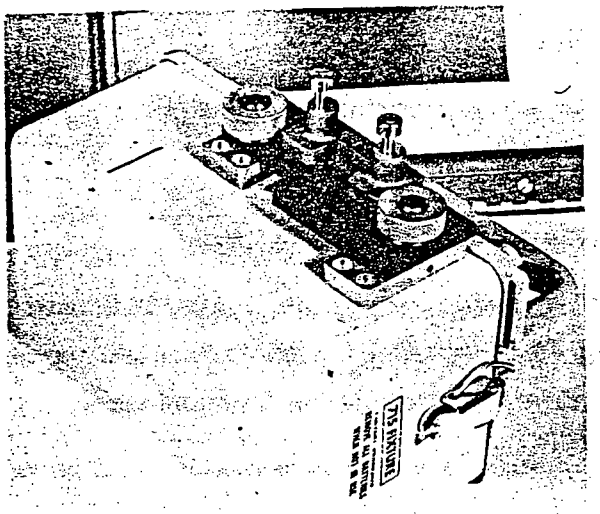


Figure 4-9. Using Jig to Align 715 Fixture Socket

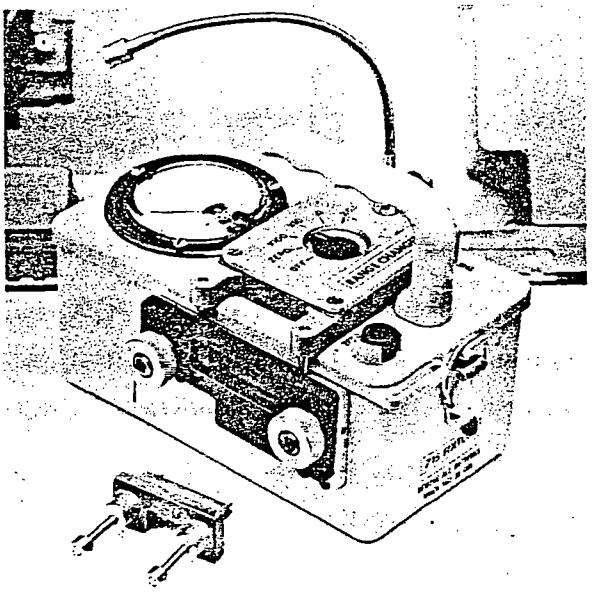


Figure 4-10. Survey Meter Range Control in Place Over Range Switch Knob

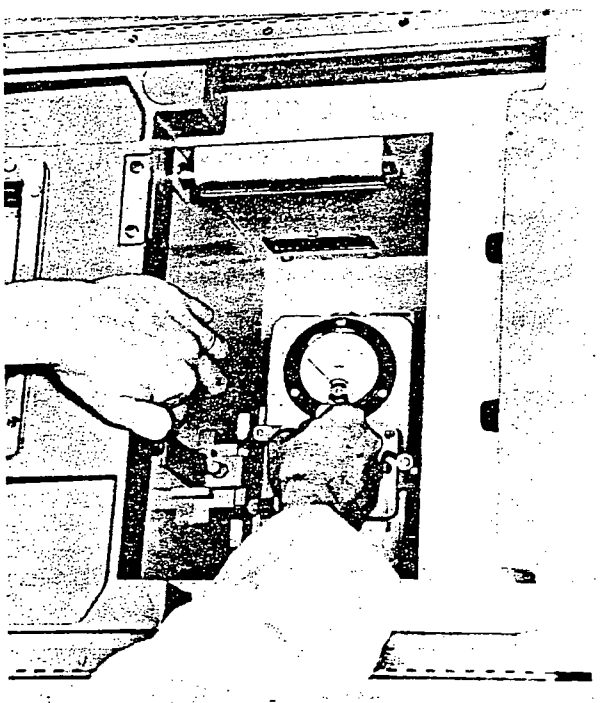


Figure 4-11. Attaching CD V-715 to the Fixture Adapter

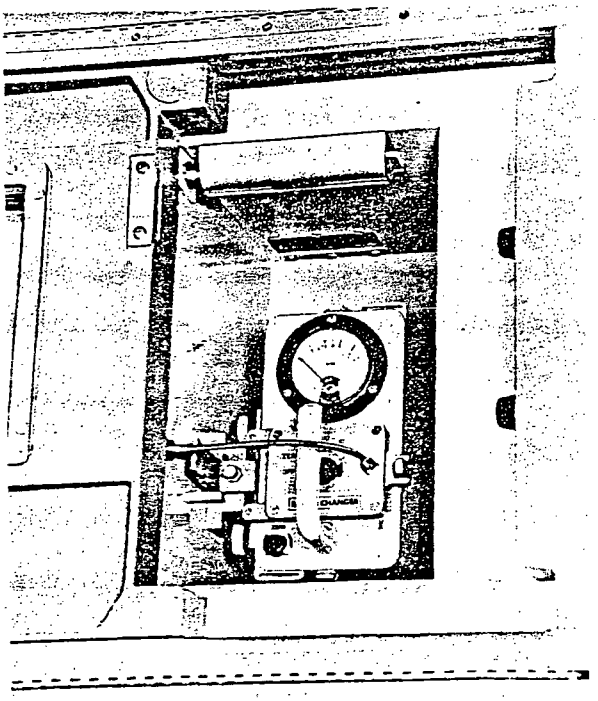


Figure 4-12. Attaching Flex Cable of Range Changer Fixture to Remote Control Station

NOTE

The sequence of steps o and p is important to prevent pinning the needle.

q. Record the observed meter reading on the calibration card.

r. Push in and rotate RANGE ADJUST knob opposite the lighted indicator to adjust the meter reading to the nominal 40 R/hr or to the most precise exposure rate that may be specified. Record this value on the calibration card.

s. Repeat steps o through r to adjust X1 and X0.1 ranges for radiation levels of 4 R/hr and 0.4 R/hr.

NOTE

If the instrument cannot be adjusted to within ±1 scale division of the desired value at any scale range, it should be considered inoperable and set aside for repair.

t. Rotate the SELECTOR wheel to SAFE position (SAFE indicator, ON). Make sure that the RANGE ADJUST control knobs are all fully retracted.

u. Open the chamber door.

v. Disconnect the flex cable from the remote station and depress the fixture-adapter lever to release the instrument. Remove the instrument from the chamber.

w. Detach the range changer fixture; remove the instrument from the 715 fixture.

x. Remove the battery and store it with the calibrated instrument.

y. At the end of calibration, secure the calibrator if it is left unattended. Refer to par. 4-8.

On a small percentage of Victoreen CDV-715 Model 1A instruments, the chassis post prevents the RANGE ADJUST control from making proper contact with the instrument X1 potentiometer. If this occurs, the scale can be adjusted by approximation or by the zero adjust method described in the calibration procedures

of the CD V-710 and CD V-720 instruments. When these methods are used to adjust the potentiometer, it is desirable to return the instrument to the exposure chamber and verify the calibration.

4-3.2. SURVEY METER CD V-717

4-3.2.1. Calibration by Remote Range Adjustment

To calibrate the CD V-717 instrument, perform the following operations:

a. Perform operability check.

b. Prepare instrument calibration card, as required. See sample (figure 4-8).

c. Replace center case section of instrument with special 717 fixture.

NOTE

The 717 fixture positions the detection chamber of the CD V-717 within the radiation beam. Its design offsets the chamber from the beam reference plane by 3/8 inch.

d. Follow the procedures outlined in steps d through v of CD V-715 calibration.

NOTE

For this instrument it is particularly important that the order of calibration be from the least sensitive range to the most sensitive range.

e. Remove the range changer fixture; turn instrument to OFF position, and replace the 717 fixture with the instrument's own center case section.

f. If the instrument can be adjusted to within ±1 scale division of desired value at all ranges, proceed to par. 4-3.2.2. If not, consider the instrument inoperable and set aside for repair.

4-3.2.2. Operability of Instrument Center Case Section

To check the center case section, perform the following operations:

a. Prepare the universal fixture as described in par. 4-2.3.

b. Place the instrument on the universal fixture.

c. Zero the meter.

d. Change the instrument range to the X100.

e. Close the chamber door.

f. Rotate the RADIATION-LEVEL SELECTOR wheel to the 400 R/hr position.

g. Check the meter reading. This reading should be within ±1 scale division of the adjusted reading obtained above.

h. Rotate the SELECTOR wheel to SAFE position.

i. Open the chamber door. Remove the instrument from the chamber and turn it off.

j. If the instrument does respond properly, proceed to par. 4-3.2.3. If not not, refer to steps k. and l. below.

k. If the meter does not respond to radiation, the instrument center feed-through connector may not be making contact, or it may be defective. Set the instrument aside for further check and possible repair.

l. If the instrument is not within ±1 scale division of its adjusted reading, check the meter zero and the universal fixture alignment. Rezero the instrument and/or realign the fixture and repeat check as necessary. If the instrument reading is low, it is probably due to leakage across the center feed through connector. Cleaning should correct this situation.

4-3.2.3. Operability and Reliability of Remote Operation

To check remote operation, perform the following operations:

a. Remove case bottom and take out the detector cable assembly.

b. Carefully unwind the cable from the spool to avoid kinking and insert it through the port on the calibrator back. See figure 4-13.

c. Feed the cable up through the cut-out portion of the universal fixture. See figure 4-14.

d. Connect the threaded cable plug to the ion chamber and position the bottom case section on the universal fixture. See figure 4-15.

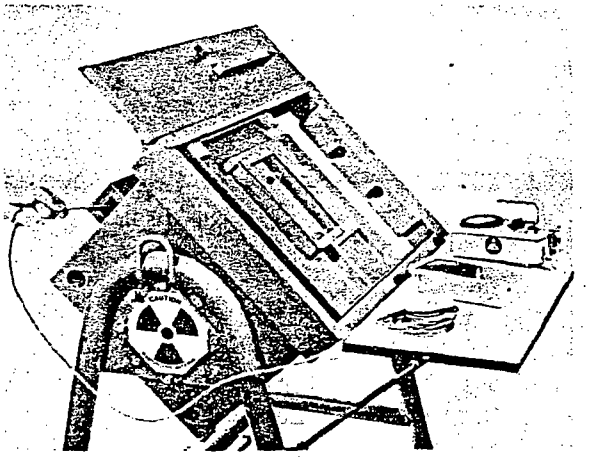


Figure 4-13. Feeding CD V-717 Cable Through Port on Calibrator

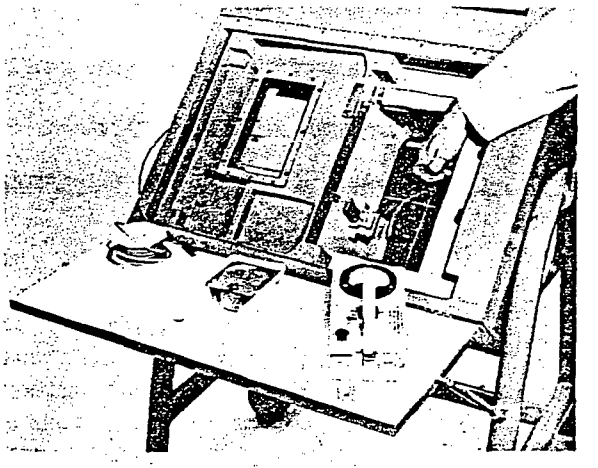


Figure 4-14. Bringing Cable Through Cutout Portion of Universal Fixture

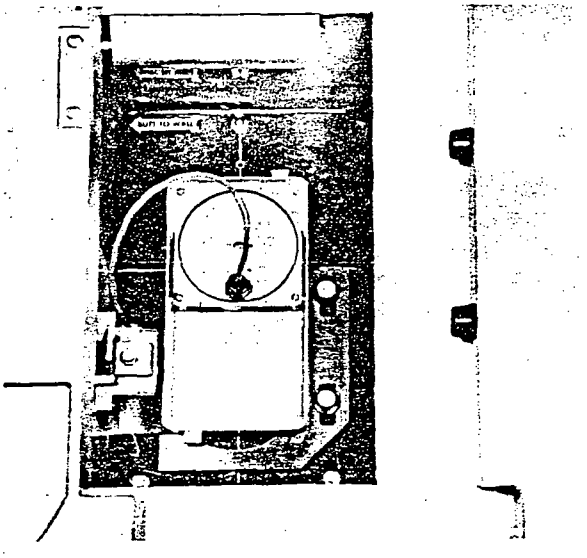


Figure 4-15. Ion Chamber Connected to Cable and Positioned on Fixture

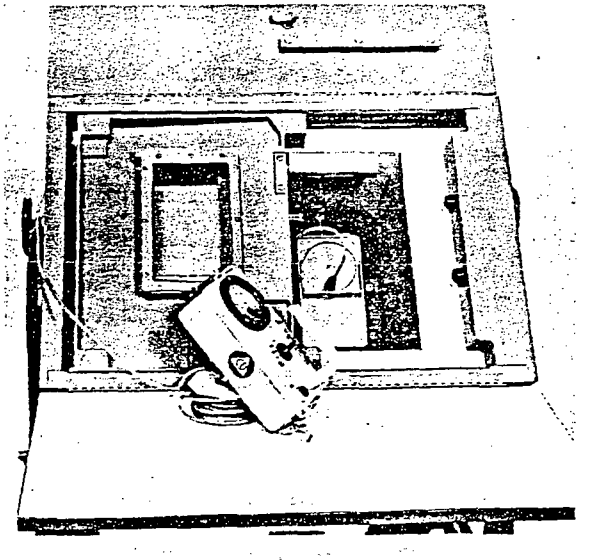


Figure 4-16. Meter Connected to Cable and Positioned for Easy Viewing

e. Slide the push-fit cable plug onto the feed-through connector on the center case section. Use cable spool to position meter for easy viewing. See figure 4-16.

f. Zero the instrument.

g. Set the instrument range to X100.

h. Close the chamber door.

i. Rotate the RADIATION-LEVEL SELECTOR wheel to the 400 R/hr position.

NOTE

To obtain satisfactory dose rate indication with the remote detector, allow at least 4 min for the meter to reach a steady value when using the X0.1 range, 50 sec for the X1 range, and 10 sec on the other two ranges. All remote readings should be within ±2 scale divisions (±5%) of the readings obtained with remote sensitivity adjustment. Therefore, this method will not normally be used to calibrate the CD V-717.

j. Record the meter reading.

k. Rotate the SELECTOR wheel to the 40 R/hr position.

l. Change instrument range to X10.

NOTE

The check for operability of the center section of the CD V-717 can be combined with the check for operability with the remoting cable. Also, only one of the higher ranges of the instrument need be checked for accuracy to confirm the operability of the cable.

m. Record meter reading.

n. Repeat steps j, k, and l for the X1 and X0.1 ranges.

o. Rotate SELECTOR wheel to the SAFE position.

p. Open the chamber door.

q. Remove the battery and reassemble the instrument to its original condition.

r. At the end of calibration, secure the calibrator if it is left unattended. Refer to par. 4-8.

4-4. CALIBRATION OF UNIVERSAL-FIXTURE GROUP

4-4.1. SURVEY METER CD V-710

To calibrate survey meter CD V-710, perform the following operations:

a. Prepare the universal fixture as described in par. 4-2.3.

b. Check instrument operability.

c. Prepare instrument calibration card. See sample, figure 4-8.

d. Place the instrument on the universal fixture and check meter zero reading. If necessary, rezero.

e. Set the instrument range to X100. See figure 4-17.

f. Close the chamber door.

g. Rotate the RADIATION-LEVEL SELECTOR wheel to the 40 R/hr position (X10 RANGE ADJUST indicator, ON). See figure 4-18.

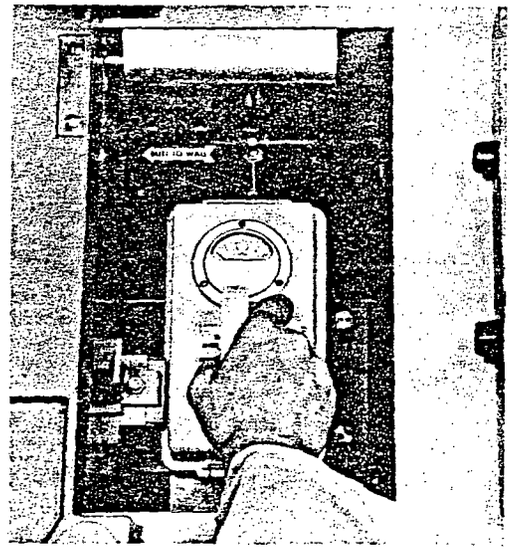


Figure 4-17. Setting Survey Meter Range to X100

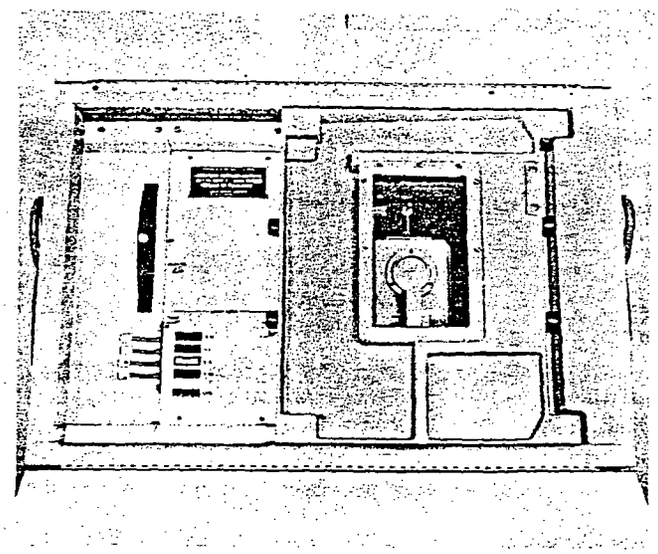


Figure 4-18. Radiation Level Selector Wheel at 40 R/hr (Meter Range at X100)

h. Read the meter and record this value on the calibration card. See figure 4-19.

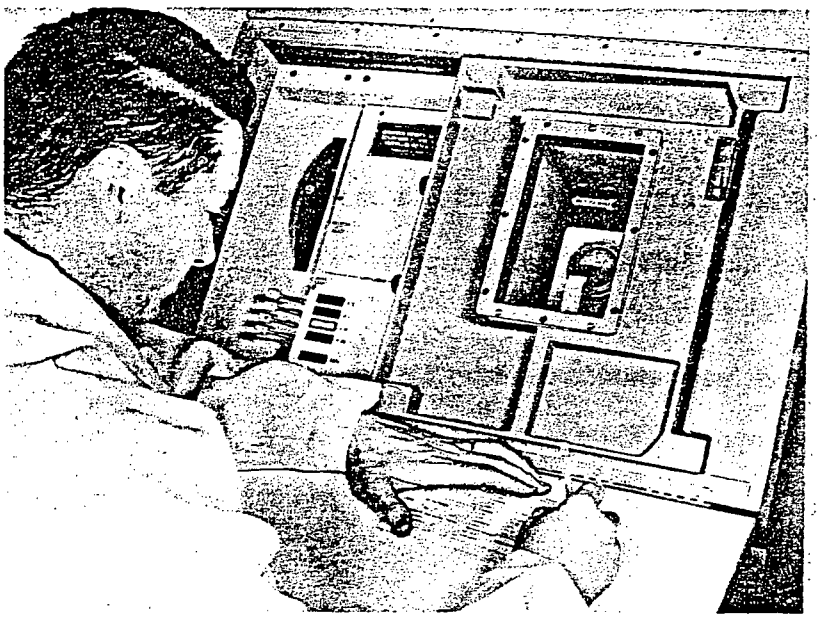


Figure 4-19. Observing and Recording Meter Reading

i. Rotate the SELECTOR wheel to the SAFE position.

j. Open the chamber door.

k. Repeat steps e through j for the X10 range with the SELECTOR wheel at 4 R/hr. Meter reading in figure 4-20A will be used in step n below.

l. Repeat steps e through j for the X1 range with SELECTOR wheel at 0.4 R/hr.

m. Remove the survey instrument from the chamber and detach the case bottom.

n. Set range switch to X10 position.

o. Rotate ZERO control until meter indicates the scale value recorded for exposure at the 4 R/hr intensity level. See figure 4-20B.

p. Adjust sensitivity potentiometer until meter reading is nominal 4 R/hr, or the most precise exposure rate that may be specified. See figure 4-21.

Figure 4-20A. Observe and Record Reading at X10 Range

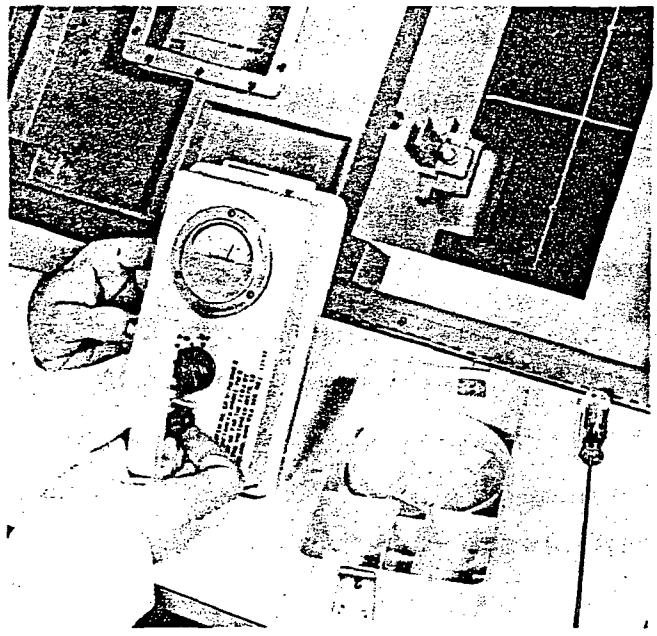


Figure 4-20B. With Zero Control, Adjust Meter Reading to Value Recorded for X10 Range

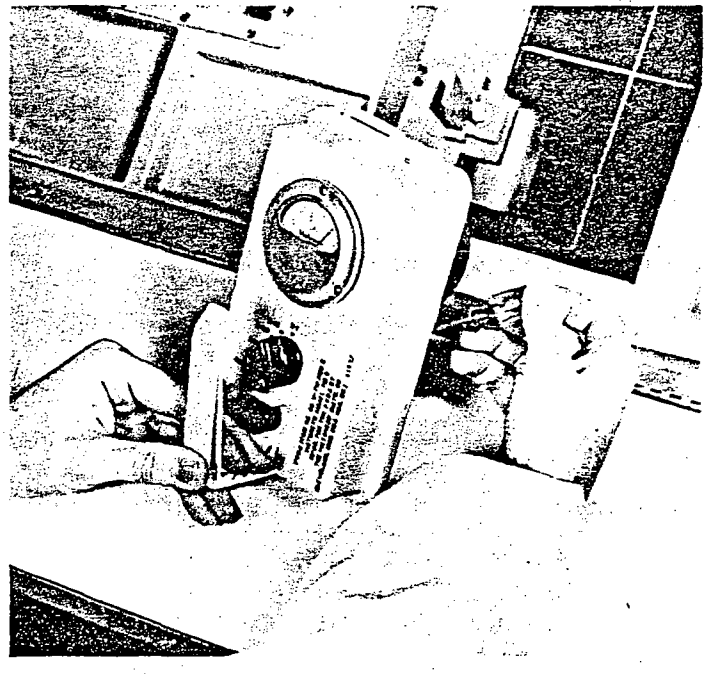


Figure 4-21. Adjust Sensitivity Potentiometer to Make Instrument Read True Dose Rate (4 R/hr)

q. Replace case bottom of the instrument.

r. Switch to the ZERO position and adjust ZERO control so the meter reading is zero.

s. Repeat steps d through k; record all information on the calibration card.

t. If the instrument on its X10 range does not read within 1 scale division of 4 R/hr, repeat steps m through r.

u. When the meter reading is within ± 1 scale division of 4 R/hr on the X10 range, the X1 and X100 ranges should be within ± 20% of the true dose rate. If either range is not within ± 20%, the instrument should be repaired.

v. If the X10 range is within ± 1 scale division of 4 R/hr and the X1 and X100 ranges are within ± 20% of the true dose rate, calibration is complete for this instrument. Remove batteries and store with instrument.

w. At the end of calibration, secure the calibrator if it is to be left unattended. Refer to par. 4-8.

4-4.2. SURVEY METER CD V-720

To calibrate survey meter CD V-720, perform the following operations:

a. Prepare universal fixture as described in par. 4-2.3.

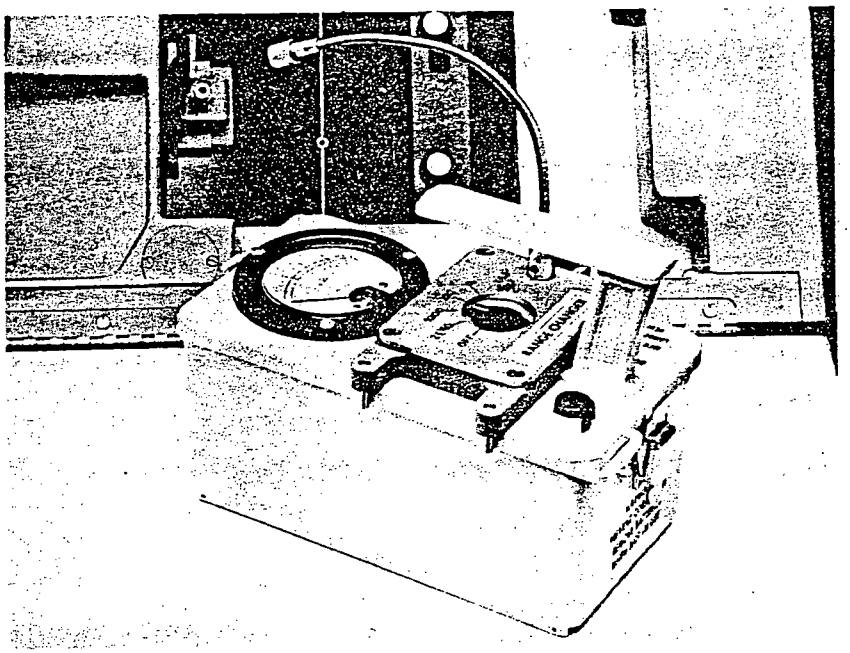
b. Perform instrument operability checks.

c. Prepare instrument calibration card, as required. See sample, figure 4-8.

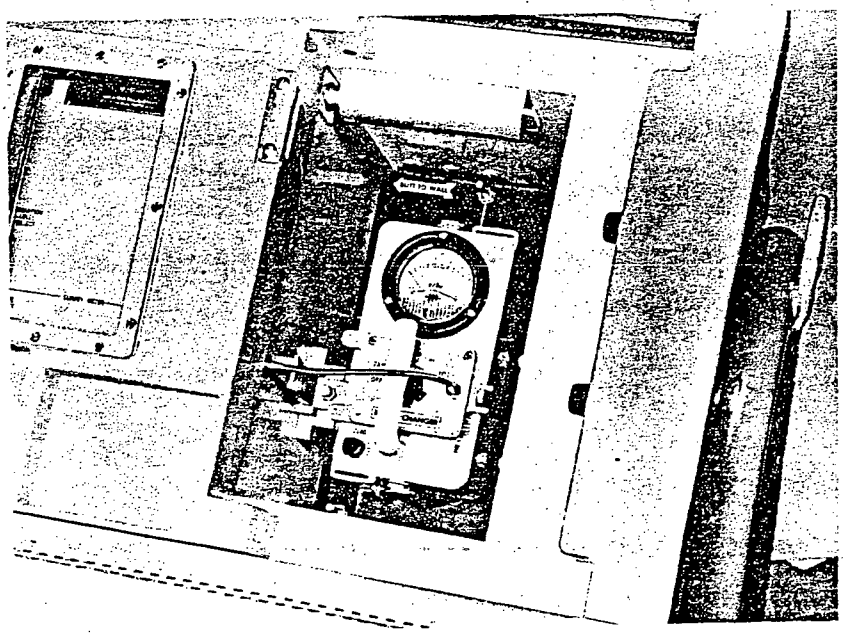
d. Set range changer fixture in place. See figure 4-22(A).

e. Place the instrument on the universal fixture and check that the meter reading is zero. If necessary, rezero the instrument.

f. Connect the flex cable of the range changer fixture to the remote control station in the exposure chamber. See figure 4-22(B).



A



B

Figure 4-22. Range Changer Remote Control Setup

g. Close the chamber door.

h. Turn the RANGE SELECT control to set the instrument on the X100 range.

i. Rotate the RADIATION-LEVEL SELECTOR wheel to the 400 R/hr position (X100 RANGE ADJUST indicator ON).

j. Record the meter reading on the calibration card.

k. Rotate the SELECTOR wheel to the 40 R/hr position (X10 RANGE ADJUST indicator ON).

l. Change the instrument range to X10.

NOTE

The sequence of steps k and l is important to prevent pinning the needle.

m. Record meter reading on calibration card.

n. Repeat steps k, l, and m for the X1 range.

o. Rotate SELECTOR wheel to the SAFE position (SAFE indicator, ON).

p. Open the chamber door.

q. Disconnect the flex cable from the remote station and remove the instrument from the chamber.

r. Detach the range changer fixture and remove the bottom of the instrument case.

s. Set instrument on the X100 range.

t. Rotate the ZERO control knob until the meter indicates the scale value recorded for exposure to the 400 R/hr intensity level (survey meter on X100 range).

u. Adjust the X100 sensitivity potentiometer until the meter reading is a nominal 400 R/hr or the most precise exposure rate that may be specified.

v. Repeat steps s, t, and u for the X10 and X1 scale range.

w. Zero the meter.

x. Repeat steps d through q.

y. If for all three ranges the meter readings are within ± 2 scale divisions (± 5%) of 400 R/hr, 40 R/hr, and 4 R/hr, calibration is complete for this instrument. Remove batteries and store with instrument. If on any range the meter reading is not within ± 2 scale divisions of the desired value, repeat sensitivity adjustment procedure. If on any range the meter reading cannot be brought within ± 2 scale divisions of the desired value, the instrument should be repaired.

z. At the end of calibration, secure the calibrator if it is to be left unattended. Refer to par. 4-8.

4-5. CALIBRATION OF UNLISTED RADIATION SURVEY INSTRUMENTS

To calibrate unlisted survey instruments, perform the following operations:

a. Prepare universal fixture as described in par. 4-2.3.

b. Zero the meter and perform instrument operability check.

c. Prepare instrument calibration card, as required. See sample, figure 4-8.

d. Place the instrument on the universal fixture and check that the meter reading is zero.

e. Select the highest range of the meter. (Calibration is performed in descending order of ranges.)

f. Close chamber door.

g. Rotate SELECTOR wheel to the radiation level required for the selected range.

h. Observe meter reading and record this value on the calibration card.

i. Rotate the SELECTOR wheel to the SAFE position.

j. Open the chamber door.

k. Repeat steps e through j for all ranges (in descending order) of the instrument.

l. Remove the survey meter from the chamber and detach the case bottom.

m. Set the instrument range to the highest range to be adjusted.

n. Rotate the ZERO control until the meter reading is the value recorded during the instrument's exposure to radiation at the selected range.

o. Adjust the sensitivity potentiometer until the meter reading corresponds to the SELECTOR wheel intensity.

NOTE

For some type instruments, the calibration potentiometers may have to be reset by trial and error approximation.

p. Repeat steps m, n, and o for all ranges to be adjusted.

q. Attach instrument case bottom.

r. Repeat steps d through k.

s. If for all ranges the meter reading is within tolerance, calibration is complete for this instrument. Remove batteries and store the instrument. If not, proceed to step t.

t. For any range whose meter reading is not within tolerance, repeat the calibration procedure as required. If any range cannot be adjusted, the instrument should be repaired.

u. At the end of calibration, secure the calibrator if it is left unattended. Refer to par. 4-8.

4-6. CALIBRATION OF DOSIMETERS

To calibrate the dosimeters, perform the following operations:

a. Prepare the universal fixture as described in par. 4-2.3.

NOTE

If the dosimeter is nonoperable, refer to Volume 4 of the Repair and Maintenance Manual for CD Radiological Instruments.

b. Zero the dosimeter with the CD V-750 charger.

c. Insert the dosimeters into their fixture stations. See figure 4-23.

d. Close the chamber door.

e. Rotate the RADIATION-LEVEL SELECTOR wheel to the appropriate radiation level setting - see note. Refer to typical settings in Table 4-II.

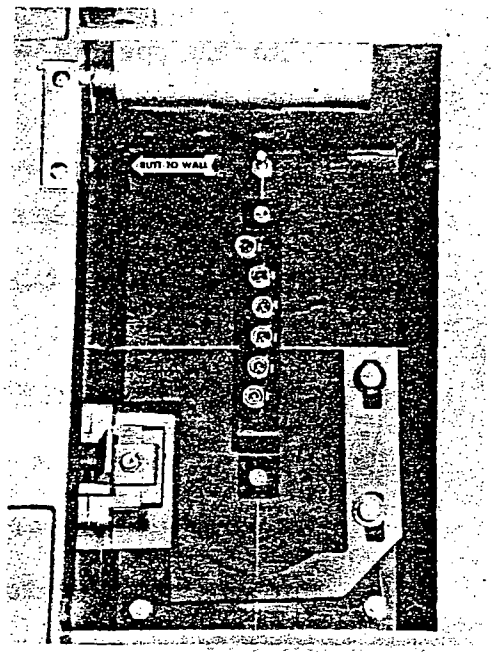


Figure 4-23. Dosimeters Set in Exposure Chamber

NOTE

IMPORTANT: For radiation levels less than 400 R/hr, rotate SELECTOR wheel through the lower intensity level when selecting the appropriate radiation level and when returning to SAFE position. For the 400 R/hr level, rotate SELECTOR wheel directly to the 400 R/hr and to the SAFE positions.

TABLE 4-II. TYPICAL DOSIMETER ACCURACY-CHECK SETUP

Type	Full Scale	Per Cent of Full Scale (%)	SELECTOR WHEEL Setting	Exposure Time for Per Cent of Full Scale (minutes)
CD V-138	200 mR	80	4	2.4
CD V-730	20 R	80	400	2.4
CD V-736*	2 R	80	40	2.4
CD V-740	100 R	80	400	12
CD V-742	200 R	50	400	15
CD V-746	600 R	50	400	45

*(0-12 R/hr); (0-120 R/hr)

f. After the specified exposure time, rotate the SELECTOR wheel to the SAFE position.

g. Remove the dosimeters and observe the scale reading. Record data and perform other checks as necessary.

h. At the end of the calibration check, secure calibrator if it is unattended. Refer to par. 4-8.

4-7. CALIBRATION OF CD V-781

To calibrate survey meter CD V-781, perform the following operations:

a. Prepare instrument calibration card. See sample, figure 4-8.

b. Remove the cover from the detector unit of the aerial survey meter and install batteries.

c. Place the special 781 fixture in the exposure chamber and push it as close to the left wall as it will go. See figure 4-24(A).

d. Insert metering unit signal cable through port on calibrator back. See figure 4-24(B).

e. Check that the power switch on metering unit is OFF and connect signal cable to detector unit. See figure 4-24(C).

f. Switch the power selector to the BAT position and depress the battery check switch. When this switch is depressed, the left hand meter should indicate at, or above, the battery check mark on the meter scale. If a lower reading is observed, batteries should be replaced and the check repeated.

g. Remove detector unit cover and place detector unit on 781 fixture. See figure 4-24(D).

h. Close the chamber door.

i. Rotate the RADIATION-LEVEL SELECTOR wheel to the 4 R/hr position (X1 RANGE ADJUST indicator, ON).

j. Read the right hand meter and record the value on the calibration card. The left and center meter readings should be full scale.

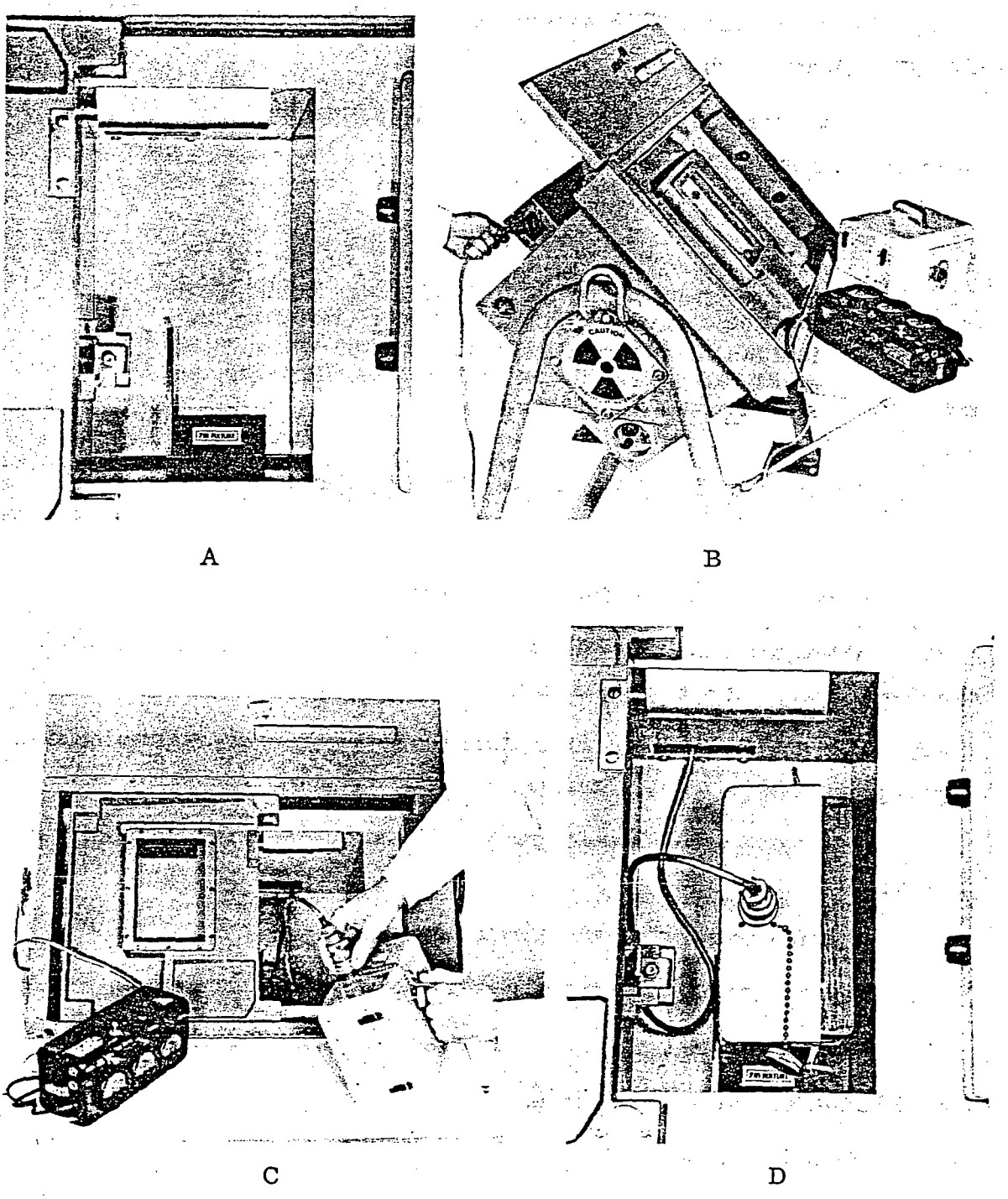


Figure 4-24. Positioning CD V-781 Aerial Survey Meter in the CD V-794 Model 2 Calibrator

k. Rotate the SELECTOR wheel to the 0.4 R/hr position (X0.1 RANGE ADJUST indicator, ON).

l. Record the center meter reading on the calibration card. The left meter reading should be full scale.

NOTE

The accuracy of the left hand meter (0-0.1 R/hr) cannot be checked with the CD V-794. However, calibration of this range can be checked with a pulse generator as described on p. 30 of the CD V-781 instruction and maintenance manual.

m. Return the SELECTOR wheel to the SAFE position.

n. Open the chamber door.

o. Remove the detector from the chamber.

p. Adjust potentiometers R50 (4 R/hr) and R37 (0.4 R/hr) by approximation if necessary. If not, proceed to r.

q. Replace the cover, set the detector into the chamber, and repeat steps h through o. Repeat step p if necessary.

r. Turn metering unit power switch OFF and disconnect cable from the detector unit.

s. Carefully remove the cable from the chamber.

t. Remove the batteries from the detector unit and store with instrument.

u. At the end of calibration, secure the calibrator. Refer to par. 4-8.

4-8. SECURING THE CALIBRATOR

4-8.1. DOSIMETER CHECK TESTS

During tests requiring extended radiation exposure time (such as exposing dosimeters), the RADIATION-LEVEL SELECTOR wheel should be secured at the desired radiation level. Holes are provided in the SELECTOR wheel to allow padlocking at a desired level.

4-8.2. CALIBRATOR NOT IN USE

Upon completion of tests and calibration, if the calibrator is left unattended it should be secured as follows:

a. Rotate the RADIATION-LEVEL SELECTOR wheel to the SAFE position. The SAFE radiation-level indicator (green) should be ON.

b. Open the chamber door.

c. Turn off the main power switch at the left side of the calibrator. The main-power and radiation-level indicator lamps and the chamber lamp should be OFF.

d. Close the lower and upper covers and lock.

e. Remove the key.

section 5

maintenance instructions

5-1. PREVENTIVE MAINTENANCE

The calibrator normally requires only the limited operator maintenance given in this section. Because of the presence of the cesium radioactive source and of certain calibrator parts that have been precisely adjusted for instrument calibration purposes, NO OTHER ADJUSTMENTS OR REPAIRS ARE AUTHORIZED. Any malfunction not described in this section must be reported immediately to the Nucleonics Division, Technical Services, Office of Civil Defense, Department of the Army, The Pentagon, Washington, D. C. 20310 and to the Radiological Defense Officer of the appropriate OCD Region.

5-2. OPERATOR MAINTENANCE

Operator maintenance assures long, uninterrupted calibrator service. Routine inspection and calibrator care as outlined in Table 5-I is suggested as a step preceding the daily use of the calibrator.

TABLE 5-I. OPERATOR ROUTINE MAINTENANCE

Procedure	Corrective Action
NOTE All parts are designed for smooth operation. Apply gentle force when handling controls and chamber door.	
1. Inspect cabinet and stand for paint chips, scratches, rust, loose parts, and broken parts.	1. Tighten and secure loose parts. Report paint chips, scratches, rust, or broken parts to Maintenance Officer.
2. Check power cord for cracks and fraying.	2. Replace.
3. Check for defective lamps.	3. a. Replace: chamber lamp power pilot lamp indicator lamp group
4. Dust and clean the calibrator.	4. a. With a dry, lint-free cloth wipe control panel, chamber, covers, rail grooves, and outside surfaces. b. Wash writing surface of lower cover with mild soap. (Any other surface except lead-glass window and rail grooves may be carefully washed with mild soap.)
5. Clean accumulated dirt in rail grooves.	5. Clean rail grooves with trichloroethylene or other approved solvent.

TABLE 5-I CONTINUED

Procedure	Corrective Action
6. Clean soiled plexiglass window.	6. Wash with mild soap solution.
7. Inspect calibrator accessories for damage or missing parts.	7. Report defective and damaged parts to Maintenance Officer for repair. Replace missing parts. Refer to Parts List, Section 6.

5-3. PERIODIC MAINTENANCE

Periodic maintenance assures personnel safety and operational readiness of the equipment.

5-3.1. RADIOLOGICAL PROTECTIVE PROCEDURES

A wipe test must be made on the equipment at intervals not to exceed 6 months. This test is normally conducted by the licensee's Radiation Protection Officer according to the procedures given by par. 2-4.

5-3.2. TWO-YEAR ADJUSTMENT OF DECAY COMPENSATOR

Every 2 years the decay-disc setting should be changed to diminish attenuation in the radiation-beam path. (See Table 5-II and refer to chart on top cover of calibrator.) Perform the following operations:

a. Place the CD V-715 instrument in the exposure chamber and close the chamber door.

b. Rotate the RADIATION-LEVEL SELECTOR wheel to 400 R/hr and record the radiation level of the chamber in the permanent log.

c. Remove the right control panel retainer screws (6).

d. Carefully remove the right control panel. See figure 5-1.

e. For disc-setting data, refer to the calibrator adjustment chart in Table 5-II or on the top cover of the calibrator.

f. Pull back lock pin and rotate disc clockwise enough to clear the hole. See figure 5-2(A).

g. Release the lock pin and rotate the disc until the pin engages the next hole. See figure 5-2(B).

h. Check new hole number against chart data. See figure 5-2(C).

i. Read the meter in the chamber to verify that the radiation level has increased approximately 5%. Record reading in permanent log.

j. Replace control panel and secure with screws.

k. Sign and date calibrator adjustment chart on calibrator top cover.

TABLE 5-II. CALIBRATOR ADJUSTMENT CHART

Decay-Disc Position No.	Period of use	Decay-Disc Position No.	Period of use
0	1968-69	4	1976-77
1	1970-71	5	1978-79
2	1972-73	6	1980-81
3	1974-75		

5-4. CORRECTIVE MAINTENANCE

Corrective action listed in Table 5-III is calibrator maintenance that should be performed only by a qualified technician. A parts list in Section 6 is provided for identification of parts needing replacement.

CAUTION

THE OPERATOR/TECHNICIAN IS PROHIBITED FROM ATTEMPTING ANY CORRECTIVE MAINTENANCE NOT GIVEN IN THIS TABLE. IN THE EVENT OF MALFUNCTIONS NOT LISTED, NOTIFY THE NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, THE PENTAGON, WASHINGTON, D.C. 20310.

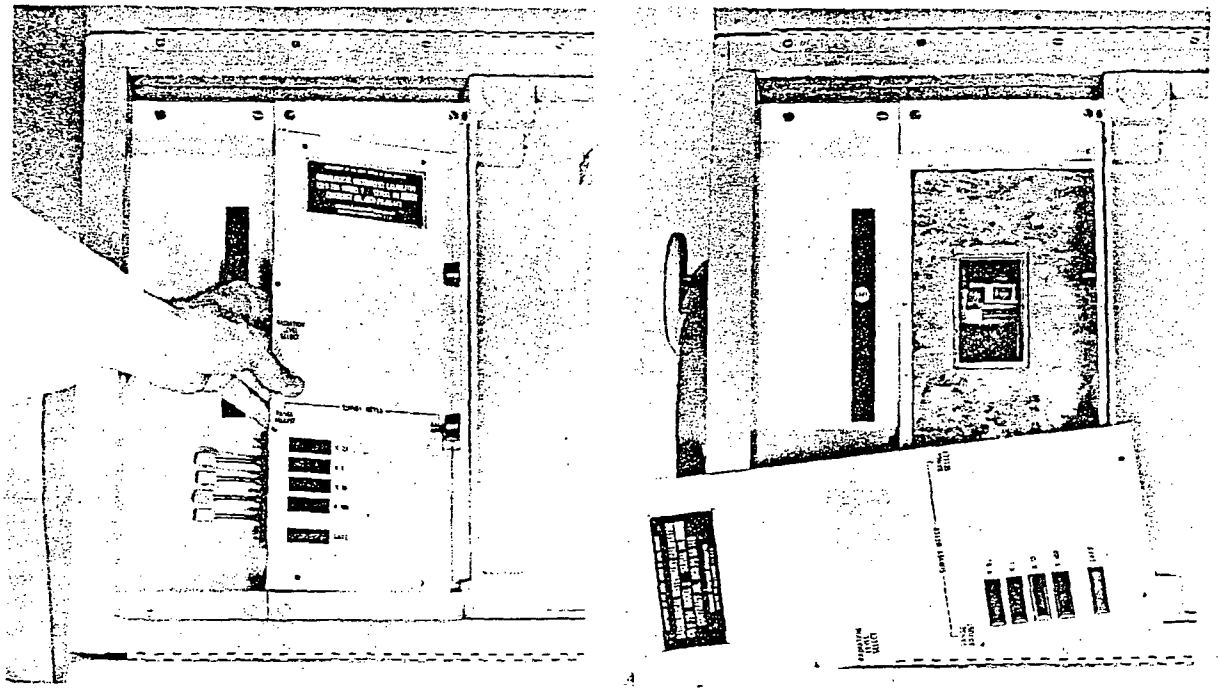
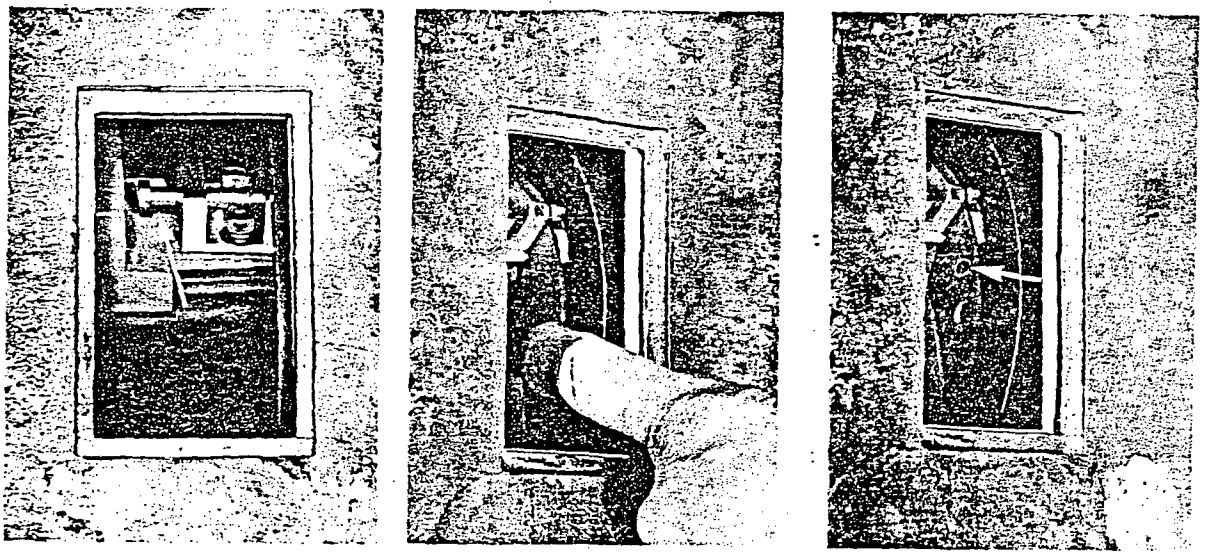


Figure 5-1. Removing Right Control Panel



A B C

Figure 5-2. Setting Decay Disc to Next Position Number

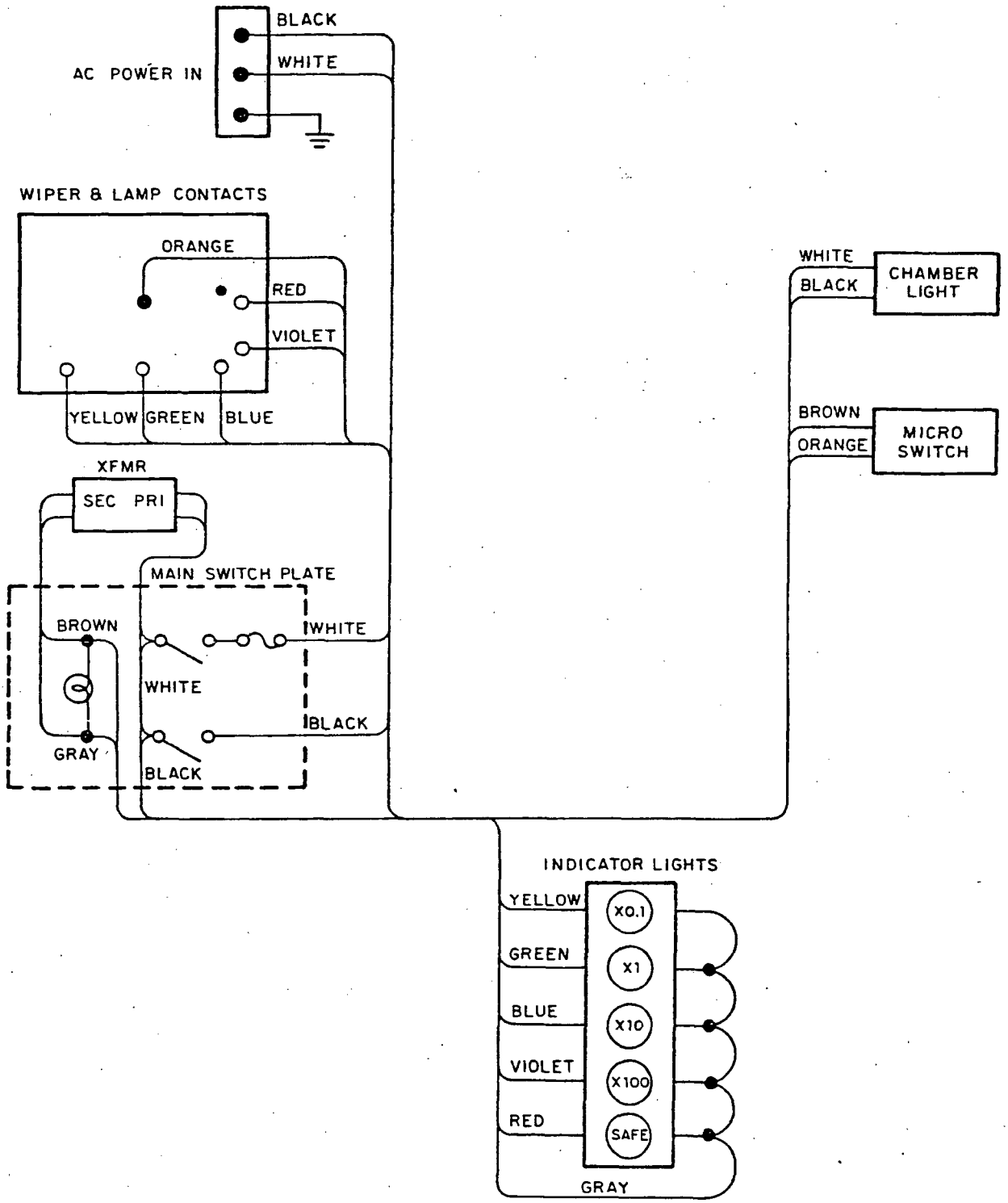


Figure 5-3. Intercabling Diagram

TABLE 5-III. TROUBLE ANALYSIS PROCEDURE

Trouble	Probable Cause	Corrective Action
1. All or any lamps OFF.	1. No power. Power not connected. Faulty extension cord. Burned fuse. Faulty main switch. Faulty attenuator switch. Poor electrical connections. Misaligned wiper-lamp contact.	1. a. Replace lamps, fuse, and extension cord as required. b. Troubleshoot electrical circuitry. Refer to figures 1-10 and 5-3. NOTE Remove main switch plate by unscrewing bolts. Remove indicator-lamp group by snapping each lamp from its panel station. Reach wiper-contact assembly by removing cabinet access cover. To service attenuator switch, remove chamber door. Refer to procedure below, steps 2.a to 2.h. To check harness control panel assembly must be removed.
2. Soiled chamber-door window (chamber side).		2. Clean window. NOTE Door must be removed. a. Place RADIATION-LEVEL SELECTOR wheel at SAFE position.

TABLE 5-III CONTINUED

Trouble	Probable Cause	Corrective Action
2. Soiled chamber-door window. (Continued)		WARNING A RADIATION HAZARD EXISTS IF DOOR IS REMOVED WITHOUT SAFE-SECURING THE INTERLOCK MECHANISM. 2. b. Secure interlock mechanism by screwing safe-secure bolt in place through access hole in the control panel. c. Remove chamber-door skirt. d. Remove rail end bar on exposure chamber side. CAUTION DOOR WEIGHS 70 LB. BE CAREFUL NOT TO SOIL OR DAMAGE LEAD GLASS WHEN HANDLING CHAMBER DOOR. e. Remove chamber door from rail assembly. f. Avoid touching the glass. Wash glass with distilled water, carbon tetrachloride, or alcohol. As a

TABLE 5-III CONTINUED

Trouble	Probable Cause	Corrective Action
2. Soiled chamber-door window. (Continued)		final operation always wash glass with distilled water. Do not allow a cleaning agent to remain on glass surface for any length of time. To clean surface under plexiglass shield, remove plexiglass. g. Replace door in rail assembly. h. Replace rail end bar and bolt in place. i. Replace chamber-door skirt. j. Remove and store safe-secure bolt.
3. Broken chamber-door window.	3.a. Crack in lead glass. WARNING A CRACKED GLASS IS A POTENTIAL HEALTH HAZARD. BEFORE USING CALIBRATOR, DO AN EXPOSURE-RATE CHECK ON ITS EXTERIOR SURFACE.	3. a. (1) Refer to par. 2-3. for precautionary measures. (2) If the radiation level is safe on exterior surface, the calibrator may be used; if not, secure the calibrator.

TABLE 5-III CONTINUED

Trouble	Probable Cause	Corrective Action
3. Broken chamber-door window. (Continued)		(3) Contact Nucleonics Division, Technical Services, Office of Civil Defense, Pentagon, Washington, D.C.
	3.b. Missing glass pieces. WARNING CRACKED GLASS THAT IS CHIPPED OR A GLASS WITH PIECES MISSING MAY BE A RADIOLOGICAL HAZARD.	3. b. (1) By an exposure-rate check, see par. 2-3, determine if radiation level is safe; if not secure calibrator. (2) Contact Nucleonics Division, Technical Services, Office of Civil Defense, Pentagon, Washington, D.C.
4. Chamber door does not roll easily.	4.a. Dirt in rail grooves.	4. a. (1) Remove door. Refer to steps 2.a to 2.e above. (2) Clean rail grooves, using a soft lint-free cloth and trichloroethylene or other suitable solvent. (3) Install door (refer to steps 2.g to 2.j above).

TABLE 5-III CONTINUED

Trouble	Probable Cause	Corrective Action
4. Chamber door does not roll easily. (Continued)	4.b. Dirt on roller bearings.	4. b. (1) Remove door (see 2.a to 2.e above). (2) Check that all bearings turn. (3) Clean surface of roller bearing. Use solvent sparingly and a soft lint-free cloth. (4) Install door (2.g to 2.j above).
	4.c. Damaged bearing.	4. c. (1) Remove door (2.a to 2.e above). (2) Check that all bearings turn. (3) With a screwdriver, unscrew damaged bearings and replace with a new one. (4) Install door (2.g to 2.j above).

TABLE 5-III CONTINUED

Trouble	Probable Cause	Corrective Action
5. Handwheel turns when chamber door is partially open.	5. Broken or disconnected parts. Damaged interlock mechanism. WARNING POTENTIAL HEALTH HAZARD EXISTS SINCE THE DOOR MAY BE OPENED WHEN HIGH RADIATION INTENSITIES ARE PROJECTED INTO THE CHAMBER.	5. Place chamber door over chamber. Perform a radiation check according to par. 2-3. Follow all directions. Contact Nucleonics Division, Technical Services, Office of Civil Defense, Pentagon, Washington, D.C.
6. Chamber door can be opened when radiation level in chamber is other than SAFE.	6. Damaged interlock mechanism. WARNING POTENTIAL HEALTH HAZARD	6. Place RADIATION-LEVEL SELECTOR wheel to SAFE position. Observe SAFE indicator, ON. Perform a radiation check according to par. 2-3. Follow all directions. Secure the calibrator if radiation levels are above normal.
7. Rubbing or binding.		7. Any rubbing or binding in the mechanisms of the calibrator should be investigated. Avoid prolonged use of calibrator under these circumstances. Take necessary corrective action.

section 6

parts list

6-1. GENERAL

The following parts list provides a comprehensive identification of the calibrator components. The list includes numerous items directly related to calibration accuracy and to the gamma radiation shields. These items are marked with an asterisk and MUST NOT BE ADJUSTED OR REPLACED EXCEPT AS-SPECIFICALLY DIRECTED BY THE NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, PENTAGON, WASHINGTON, D.C.

6-2. ORDERING PARTS

When ordering a part, give part name and part number. Table 6-II lists the manufacturers' names and addresses for procurement of commercial items.

TABLE 6-I. PARTS LIST

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
D79400		MAIN ASSEMBLY I	
E79400		MAIN ASSEMBLY II	

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
		STAND ASSEMBLY	
D79406-1		Stand*	1
B79406-4		Lower cover support tube	2
B79406-5		Lower cover support rod	2
A79406-6		Lower cover rod pin	2
A79406-8		Lower cover tube bushing	2
B79406-7		Cabinet access plate	1
	655	Support tube stop (Maxwell collar)	2
	5100-31	Rod pin retainer ring (Truarc)	4
		Unisorb type H leg plate pad	4
D79401		CABINET AND RAIL ASSEMBLY	
E79401-1		Cabinet	1
B79400-9		Cable port	1
B79400-1C		Divider plate bar	2
C79400-1B		Divider plate*	1
B79400-8		Left compartment liner (back)	1
B79400-7		Left compartment liner plate (back)	1
B79400-10		Left compartment liner (top and bottom)	2
B79400-9		Left compartment liner plate (top and bottom)	2
A79400-10		Attenuator-switch spacer	1
C79410		Interlock-mechanism assembly*	1
D79400-4		Lock-pin guide bracket	1
B79400-8		Lock pin	1

*NOT TO BE ADJUSTED OR REPLACED WITHOUT SPECIFIC INSTRUCTIONS FROM THE NUCLEONICS DIVISION, TECHNICAL SERVICES, OFFICE OF CIVIL DEFENSE, DEPARTMENT OF THE ARMY, PENTAGON, WASHINGTON, D.C. 20310

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
	12L2-FF	Nylon bushing (Thomson)	2
A61602-6		Spring	1
B79410-2		Lever bar	1
A79400-5		Attenuator-switch actuator	1
	CFH-$\frac{3}{4}$-5	Cam roller (McGill)	1
B79410-3		Arm link	1
B79410-1		Arm-link pivot	1
	FB812-6	Bronze bearing (Boston Gear)	1
D79403		Primary Shield Assembly*	1
C79404		Main shield assembly	1
D79403-1		Main shield	1
B79404-1		Source tube	1
B79404-2		Source plug capsule	1
B79404-3		Source plug shield	1
		Spark-plug gasket (14 mm)	1
A79404-4		Shielding cap	1
A79404-5		Source-tube extender	1
B79403-7		Attenuator-shaft bearing	1
	FB-1012-6	Attenuator-shaft bearing (Boston Gear)	1
		Source (see par. 1-4)	1
		Collimator-shield	1
	D-12-1000	Dowel (Pic)	1
		Dowel, 3/8 in. dia., 2 in. long	1

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TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
		Attenuator-disc assembly*	
D79403-3		Attenuator disc	1
B79403-6		Attenuator shaft	1
	10L	Attenuator-shaft clamp collar (Maxwell)	1
	B57-4	Attenuator-shaft clamp bearing (Boston Gear)	1
C79403-4		Attenuator index ring	1
B79403-8		Attenuator disc bushing	1
B79403-5		Decay compensator disc*	1
	TB1019	Thrust washer* (Boston Gear)	1
		Decay compensator lock assembly	
B79405-1		Lock-pin housing support	1
B79405-2		Lock-pin housing	1
A79405-3		Lock pin	1
	LC-026E-5	Spring (Lee)	1
C79403-10		Selector wheel	1
B79415-3		Selector-wheel bushing	1
B79415-2		Wiper disc	1
	5100-25	Snap ring (Truarc)	1
C79400-3		Primary-shield bracket	1
A79400-10		Primary-shield tie rod	3
		Remote Controls	
B79419		Range-select assembly	1
C79414-2		Shaft	1
	B8-12	Shaft spacer (Pic)	1

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TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
A79414-9		Bearing	1
A79414-10		Modified bearing clamp	1
	5100-25	Retainer ring (Truarc)	1
D79401		Range-adjust assembly	1
	S1000-21	Drive-rod knob (Kurz-Kasch)	4
A79407-4		Drive rod	4
	A2-48	Transmission rod (Pic)	4
B79407-6		Modified screwdriver rod	1
B79407-3		Screwdriver rod	3
	4BS	Universal joint (Falcon)	4
A79407-5		Modified universal joint	4
	B35-4	Bronze bushing (Boston Gear)	8
C79407-1		Drive-shaft housing	1
B79400-7		Left control panel	1
D79409		Right control panel assembly	1
D79409-1		Panel housing	1
SK1630-7		Panel liner and access plug	1
A79409-5		Access-plug retainer	1
C79409-2		Right control panel	1
B79409-3		Spacer-mount bar I	2
B79409-4		Spacer-mount bar II	1
		Indicator-lamp group	
	31AJ-G1-2641T	Range-adjust indicator-red, 6 V, 2.5 W (Leecraft)	4
	31AJ-G1-2642T	SAFE radiation-level indicator-green, 6V, 2.5 W (Leecraft)	1

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
C79415		Contact assembly	1
B79415-1		Contact support block	1
	MOD833	Contacts (Ostby & Barton)	6
A79415-5		Modified spacer screw	2
	50F-820	Flex-lock hex nut (Allmetal Co.)	2
		Chamber	
D79400-1		Chamber shield (lead)*	1
D79400-2		Chamber liner	1
C79408		Fixture-adapter assembly	1
C79408-2		Fixture adapter	1
B79408-1		Fixture clamp lever	1
	LC-035E-6	Spring (Lee)	1
	A2-15	Dowel pin (Pic)	1
	B35-4	Bronze bearing (Boston Gear)	8
	2423	Lamp Socket (Morse)	1
B79400-12		Lamp guard	1
		Lamp-guard fasteners (10-32 knurled thumb screws)	2
	25T-6$\frac{1}{2}$DC	Lamp, 115 V, 25 W (GE)	1
	A11	Hydrocal (U.S. Gypsum)	
D79401-2		Rails	2
D79401-3		Rail end bar (right)	1
D79401-4		Rail end bar (left)	1
B79401-5		Panel support bar	2
A79401-6		Liner support I	2

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TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
A79401-1D		Liner support II	2
B79406-9		Cover stop	2
	BH2096	Rubber bumper (Greene Rubber Co.)	4
D79402		Chamber-door assembly	
D79402-1		Door casting (machined)	1
C79402-2		Bezel	1
B79402-3		Window retainer II (length)	1
A79402-4		Window retainer I (width)	2
A79402-5		Striker bar	1
A79402-6		Cabinet lock plate	1
A79402-7		Roller-bearing cover	4
	CF-1-S	Cam roller (McGill)	8
B79402-11		Lead-glass window	1
C79402-10		Window gasket - outside	1
C79402-12		Window gasket - chamber side	1
C79402-9		Lead-glass protector	1
	BH-2096	Rubber bumper (Greene Rubber Co.)	2
B79402-13		Chamber-door skirt	1
D79416		Upper-cover assembly	1
C79416-3		Upper cover	1
B79416-1		Chamber-door stay bar	1
	1704-6T	Cabinet lock (Chicago Lock Co.)	1
	1110	Handle (Harry Miller Co.)	1
B79402		Lower cover	1

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
		Electrical circuitry	
D79400-13		Harness	1
	F-7X	Transformer, 115/5 V (Triad)	1
C79413		Power jack and switch assembly	1
	4716	Input jack - twistlock (Hubbell)	1
B79413-1		Face plate	1
	HKP	Fuse holder (Buss)	1
	COML	Fuse, 1 ampere	1
	51-3402	Pilot-lamp holder	1
	0112-301	Pilot lamp (Chilco)	1
	810246B	Toggle switch (Arrow & Hart)	1
		Extension cord assembly	
	17422-S	Power cord, 12-ft, 3-conductor, 16 AWG, rubber covered, molded 3-prong plug (Belden)	1
	4730	Twistlock plug (Hubbell)	1
	6PL41	Attenuator switch (Micro)	1
A79400-15		Nameplate (calibrator)	1
A79400-20		Nameplate (accessory case)	1
A79400-16		Fixture(s) Decal	1
B79400-17		RAD Sign Decal (cabinet)	2
B79400-18		RAD ID Label	1
B79400-19		RAD Sign Decal (shield)	1
A79400-21		Calibrator Adjustment Chart	1
B79400-22		DOT Spec. data plate	1
B79400-23		Universal Fixture Data Chart Decal	1

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
		FIXTURES	
C79411		715 Fixture assembly (Lionel)	1
C79411-1		715 Modified case	1
B79411-2		Fixture-adapter socket	1
A79411-3		Knurled nut	2
A79411-4		Washer	2
A79411-7		Fixture pad I	1
A79411-5		Fixture pad II	1
		Roll pin, 3/32 in. dia. x 1 in. long	2
C79422		Victoreen 715 Fixture assembly	1
C79422-1		715 Modified case (Victoreen)	1
A79422-2		Fixture pad I	1
B79422-3		Fixture pad II	1
B79411-2		Fixture-adapter socket	1
A79411-3		Knurled nut	2
A79411-4		Washer	2
		Roll pin, 3/32 in. dia. x 1 in. long	2
C79423		L. F. C. 715 Fixture assembly	1
C79423-1		715 Modified case (L. F. C.)	1
B79411-2		Fixture-adapter socket	1
A79411-3		Knurled nut	2
A79411-4		Washer	2
A79411-7		Fixture pad I	1
A79411-5		Fixture pad II	1
		Roll pin, 3/32 in. dia. x 1 in. long	2

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
C79417		717 Fixture assembly	
C79417-1		717 Modified center section	1
B79417-2		Fixture-adapter socket	1
A79411-3		Knurled nut	2
A79411-4		Washer	2
B79417-3		Fixture pad,	2
		Roller pin, 3/32 in. dia. x 1 in. long	2
D79418		Universal fixture assembly	1
C79418-1		Platform	1
B79418-6		Leg	3
B79418-4		Meter-locator bracket	1
A79418-7		Washer	2
		Bracket retainer, 1/4 - 20 thumb screw	2
		Leg-lock assembly	
	119	Platform panel bearing (H. H Smith)	3
	ED 4	Leg "shaft" lock (Pic)	3
		Internal-tooth lockwasher, 3/8 in.	3
		Leg cap, 1/4 in. Lustre cap (Greene Rubber)	3
B79418-5		Dosimeter fixture	
		Retainer screw, 10-32 thumb screw	2
D79414		Range-changer fixture assembly	1
B79414-5		Housing assembly	1

TABLE 6-I CONTINUED

Drawing Number	Mfg. Part Number	Nomenclature and Description	Units Req'd.
A79414-8		Lever clamp	1
	LC-018A-7	Spring (Lee)	1
	D3-875	Dowel pin (Pic)	1
C79414-4		Gear	1
A79414-6		Drive gear	1
	B46-3	Bronze bearing (Boston Gear)	1
B79414-3		Face plate	1
B79414-7		Flexible shaft	1
		Dowel pin, 3/16 in. dia. x 1 in. long	2
B79412		Alignment jig assembly	1
A79412-1		Socket alignment block	1
B79412-2		Alignment probe	2
	C1-2	Collar (Pic)	2
C79420		781 Fixture assembly	1

TABLE 6-II. LIST OF MANUFACTURERS

Identifier	Manufacturer	Address
"Allmetal"	Allmetal Screw Products Co., Inc.	823 Stewart Ave. Garden City, N.Y. 11530
"Arrow & Hart"	Arrow, Hart & Hegman	Hartford, Connecticut 06105
"Belden"	Belden Mfg. Co.	415T S. Kilpatrick Chicago, Ill. 60644
"Boston Gear"	Boston Gear Works	3200 Main St. Quincy, Mass. 02171
"Bronson"	Homer D. Bronson	250 Main St. Beacon Falls, Conn. 06403
"Buss"	Bussman Mfg. Division	2538 W. University St. St. Louis, Mo. 63107
"Chicago"	Chicago Lock Co.	4269 W. Belmont Avenue Chicago, Illinois 60641
"Chilco"	Chicago Miniature Lamp Co.	4433 N. Ravenwood Ave. Chicago, Illinois 60640
"Dialco"	Dialight Corporation	60 Stewart Avenue Brooklyn, N.Y. 11237
"Falcon"	Falcon Machine & Tool Co., Inc.	150 Ballardvale St. N. Wilmington, Mass. 01887
"G.E."	General Electric Co.	Nela Park Cleveland, Ohio 44112
"Greene"	Greene Rubber Co.	99 Broadway Cambridge, Mass. 02142
"Hubbell"	Harvey Hubbell, Inc.	Bridgeport, Conn. 06602
"Kurz-Kasch"	Kurz-Kasch, Inc.	1417 S. Broadway Dayton, Ohio 45041
"Lee"	Lee Spring Company	30 Main Street Brooklyn, N.Y. 11201

TABLE 6-II CONTINUED

Identifier	Manufacturer	Address
"Leecraft"	Leecraft Mfg. Co., Inc.	21-16 44th Road Long Island City, N.Y. 11101
"Maxwell"	The R.D. Maxwell Co.	Box 6400 Winchester, Mass. 01890
"McGill"	McGill Mfg. Co.	1150 N. Campbell St. Valparaiso, Indiana 46383
	H.S. Miller Co.	433 Spring Ave. Naperville, Ill. 60540
"Micro"	Micro Switch Company	11 W. Spring St. Freeport, Ill. 61032
"Morse"	Frank W. Morse Co.	354 Congress Street Boston, Mass. 02210
"Ostby & Barton"	Ostby & Barton Co.	P.O. Box 6267 Providence, R.I. 02804
"Penberthy"	Penberthy Instrument Co.	4301 6th Ave. S. Seattle, Washington 98108
"Pic"	Pic Design Corporation	477 Atlantic Ave. E. Rockaway, N.Y. 11518
	Herman H. Smith, Inc.	812 Snediker Ave. Brooklyn, N.Y. 11207
"Thomson"	Thomson Industries, Inc.	Dept. 10 Manhasset, N.Y. 11030
"Triad"	Triad Distributor Division	305 No. Briant Street Huntington, Ind. 46750
"Truarc"	Waldes Kohinoor, Inc.	Dept. 031 Austel Place Long Island City, N.Y. 11101
"U.S. Gypsum"	U.S. Gypsum Company	101 South Wacker Drive Chicago, Ill. 60606