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TM 3-6665-214-13&P

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, AND DIRECT SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS LIST)

RADIOACTIVE SOURCE SET, M3A1

(NSN 6665-00-856-8235)

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1976

LL/4n

WARNINGS

Dangerous gamma radiation is given off from the cobalt 60 source in the M3A1 radioactive source set. All use of a radioactive source set must be supervised by a responsible individual who has received specific training in the proper use of the set.

Never eat, drink, or smoke while using the radioactive source set.

The radioactive source set will be used only by individuals trained and certified in the proper use of the set. Each time that the radioactive source is removed from the shield, the radiation protection officer must delineate the radiation controlled area and post radiation warning signs.

Never allow personnel without film badges and dosimeters inside the restricted area.

Never touch the radioactive source capsule.

Always use the magnetic handler for handling the radioactive source.

Never look into the well of the shield or unnecessarily expose parts of the body to the radiation which issues from the radioactive source capsule in the well of the shield.

Never take the radioactive source from the shield without having a radiacmeter available and in good working order, e.g., an AN/PDR-27 radiac set.

Never leave an unshielded radioactive source unattended. If necessary to leave the source set, reshield the radioactive source and lock the container.

If a radioactive source capsule is damaged or broken and radioactive contamination occurs, follow the emergency procedures described in paragraph 2-18 of this manual.

Maintain records of exposure of personnel.

Wear a film badge, a calibrated dosimeter, and disposable protective gloves while performing the leak test. Do not spread contamination by touching other objects with the gloves. Do not leave the unshielded radioactive source or the opened storage case unattended. Do not stay in the radiation area no longer than necessary to perform the leak test.

Wear disposable protective gloves.

Before removing the radioactive source capsule from the shield, select a calibration site in an area that is away from the normal stream of traffic. The selected site should be unobstructed and have a level floor or ground surface approximately 16 meters (53 feet) square. The calibration site may be in a one-story building or out-doors.

TECHNICAL MANUAL
No. 3-6665-214-13&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *6 October 1976*

OPERATOR'S, ORGANIZATIONAL, AND DIRECT SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS LIST)

RADIOACTIVE SOURCE SET, M3A1 (NSN 6665-00-856-8235)

Current as of June 1976

REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 (Test) located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 2028-2 (Test) in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, Edgewood Arsenal, ATTN: SAREA-DE-ET, Aberdeen Proving Ground, MD 21010.

In either case a reply will be furnished direct to you.

*This manual supersedes TM 3-6665-214-15, 12 March 1963, including all changes.

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual is published for personnel who operate the M3A1 Radioactive Source Set, and for personnel who perform the organizational and direct support maintenance on the set. The manual contains a description of the source set and information on its use, functioning, and maintenance. It also gives instructions for shipment, storage, and disposal.

1-2. Authorization for Issue of Radioactive Source Sets

M3A1 radioactive source sets are issued throughout the Army without a special license being required of the individual user. The US Nuclear Regulatory Commission (NRC) Byproduct Material License No. 19-1826-2 is issued to the Department of the Army. The licensee is Department of the Army, Edgewood, ATTN: Safety Office (SAREA-SA), Aberdeen Proving Ground, MD 21010. Oversea users (who are exempt from NRC regulations) are authorized possession of the M3A1 source set without a specific DA authorization as the NRC license is equivalent to DA authorization for Army-wide possession.

1-3. Record and Report Forms

a. Use the following forms with the equipment:

(1) DA Form 2791-R (Radioactive Materials Movement—Shipment/Receipt) (LRA).

(2) DD Form 6 (Packaging Improvement Report).

(3) DD Form 1141 (Record of Occupational Exposure to Ionizing Radiation).

(4) NRC (Nuclear Regulatory Commission) Form 3 (Notice to Employees-Standards for Protection Against Radiation).

NOTE

NRC Form 3 (fig. 2-2) can be obtained from the NRC operations offices listed on the Form 3, or the form may be reproduced locally.

b. Equipment maintenance forms and procedures for their use are prescribed in TM 38-750.

c. Refer to TM 43-0139, Painting Instructions for Field Use, for instructions for painting of the storage case.

1-4. Supervision

a. Handling, storage, transfer, use, and disposal of the M3A1 radioactive source set will be under the guidance of the installation, activity, or unit radiation protection officer. He should have successfully completed Radiological Safety Course No. 7KF3 (or its equivalent) given at the US Army Ordnance Center and School, Aberdeen Proving Ground, MD 21005.

b. The radiation protection officer will make sure that each individual who is assigned the responsibility for the use of an M3A1 radioactive source set has received sufficient instructions in the use of the set.

c. The radiation protection officer will prepare a statement of training for each individual who is assigned the responsibility for use of the radioactive source set. This record will be placed in the individual's official personnel folder (201 file).

1-5. Control

The M3A1 radioactive source set is classified as an individually controlled item.

a. The radiation protection officer will obtain written approval from his Command radiological control officer to ship the M3A1 set to another installation or activity. After written approval is obtained, the radiation protection officer will ship the source set. DA Form 2791-R is used as a shipping document and also as a receipt. This form and the radioactive source set records will accompany the source set to its new destination.

b. Within 5 days after receiving the radioactive source set, the receiving radiation protection officer will send two copies of the DA Form 2791-R receipt to his radiation control officer.

c. Leak tests will be made of the M3A1 source set upon initial receipt, at least every 6 months thereafter, prior to shipment or anytime a leak is suspected. (See paragraph 2-5.) Inventory and Leak Test Reports, RCS AMC-192 will be submitted through command channels.

Section II. DESCRIPTION AND DATA

1-6. Use

The Department of the Army is authorized by the Nuclear Regulatory Commission (NRC License No. 19-1826-2) to procure, use, repair, and transport M3A1 radioactive source sets. These sets are used to calibrate radiac survey meters, such as those in the AN/PDR-27( ) radiac set and the IM 9 series radiac dosimeter; and for radiological training purposes (FM 21-48).

WARNING

The radioactive source set will be used only by individuals trained and certified in the proper use of the set. Each time that the radioactive source is removed from the

shield, the radiation protection officer must delineate the radiation controlled area and post radiation warning signs.

1-7. M3A1 Radioactive Source Set

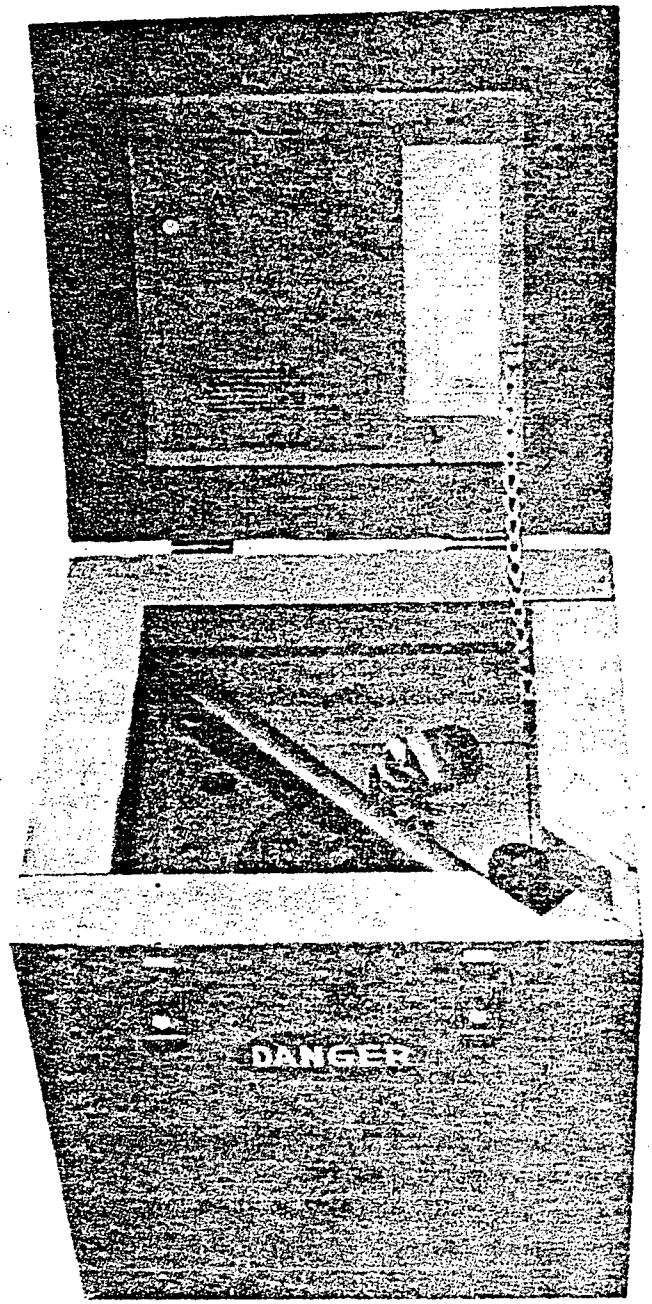


Figure 1-1. M3A1 Radioactive source set.

The M3A1 radioactive source set (fig. 1-1) consists of a storage case, a radioactive source and shield assembly with an M1A1 gamma cobalt 60 radioactive source, a calibration chart for the source, an M4 telescoping radioactive source magnetic handler, and a copy of this manual (TM 3-6665-214-13&P).

a. Storage Case, Exterior (fig. 1-2). The wood storage case measures 18 by 18 by 20 inches and is designed to keep the radiation dose rate at the surface of the case below 200 millirads per hour and 10 millirad/hour at 3 feet from the external surface of the package which meets the yellow III label shipping requirements (Title 49, Department of Transportation). A millirad is equal to 1/1000 rad.

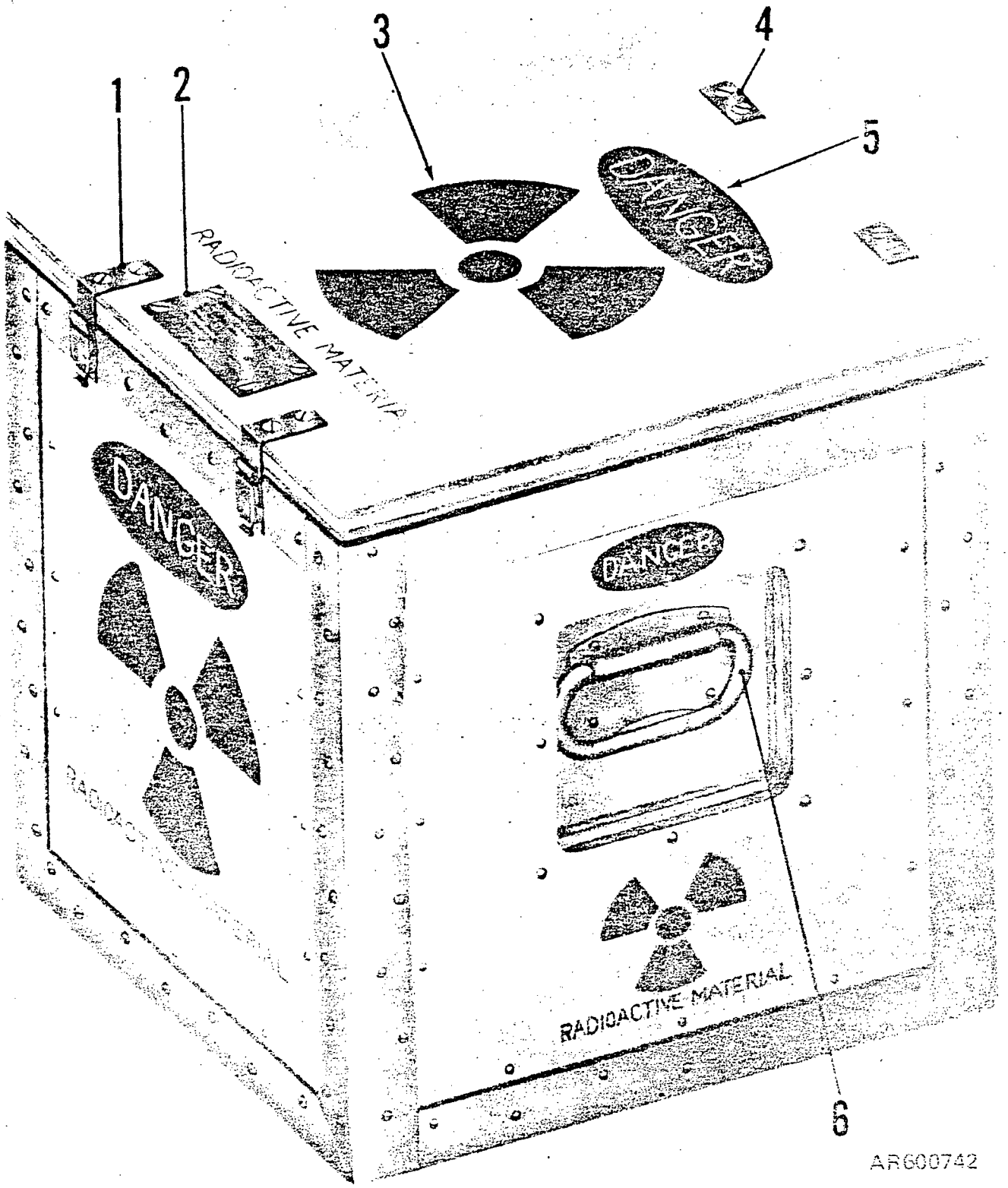
(1) The cover is attached to the case by two hinges (4, fig. 1-2). A chain (7, fig. 1-4) holds the cover in position when the case is open, and two catches (1, fig. 1-2) lock the cover in place when the case is closed. The case is equipped with two handles (6, fig. 1-2), one at each side.

(2) The identification plate on the cover of the storage case of each radioactive source set is shown in figure 1-3.

(3) The case is painted yellow and marked in accordance with Department of Transportation Regulations. Radiation hazard symbols and eliptical DANGER Warning backgrounds are painted purple; the word DANGER is painted white, and the words RADIOACTIVE MATERIALS are painted black.

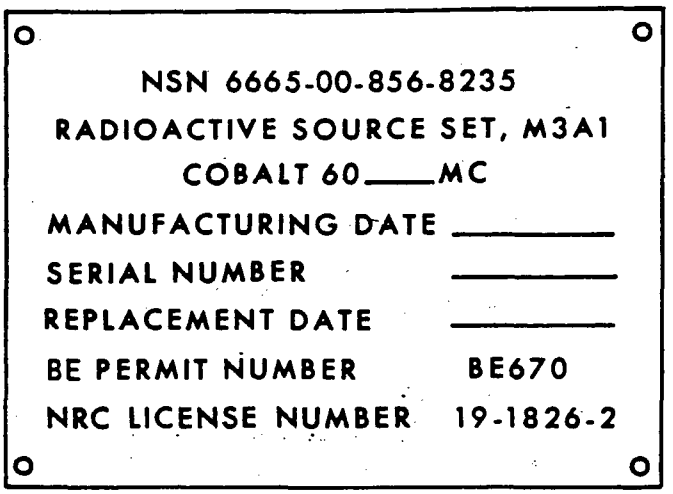
b. Storage Case, Interior (fig. 1-4). A shield (11, fig. 1-4), described in (1) below, is bolted to a platform (8) in the case, and a spacer (1) is bolted down around the top of the shield. A magnet cap socket (9) in one corner and a cutout diagonally opposite the socket in the storage case provide the means for stowing the magnetic handler, described in *d* below. A cobalt 60 decay curve (6, fig. 1-4), described in (2) below, is fastened inside the cover of the case.

(1) *Shield.* A cylindrical lead shield (11, fig. 1-4), approximately 6 ½ inches in diameter and 6 ½ inches high, serves as a container for the radioactive source assembly (13). The shield is encased in a steel jacket and is mounted on a square steel base (10). A lead plug (3) with a handle (2) fits into an opening in the top of the shield. When the plug is in place in the shield, it forms the top of an inclosed space in the center of the shield; this space is approximately 1 inch in diameter and 11/16 inch deep. A shoulder near the top of the inclosed space supports the radioactive source assembly within the inclosed space. The shield and plug provide a lead barrier, approximately 2 ½ inches thick, against gamma rays emanating from the radioactive source. A lockbar (4) passes through the handle of the plug and through slots in the lugs (12) on the shield. The shackle of a combination lock (5) passes through round holes in the bent end of the lockbar and through an adjacent lug and secures the radioactive source in the shield. The combination lock is a high security padlock. The combination can be changed by use of a key which is supplied with the lock.



4 Hinge
5 Eliptical DANGER Warning background
6 Handle
1 Catch
2 Identification plate
3 Radiation symbol

Figure 1-2. M3A1 storage case (exterior).



1 Spacer
2 Handle
3 Plug
4 Lockbar
5 Combination lock
6 Cobalt 60 decay curve chart
7 Chain
8 Platform
9 Magnet cap socket
10 Base
11 Shield
12 Lug
13 Radioactive source assembly

Figure 1-3. Identification plate.

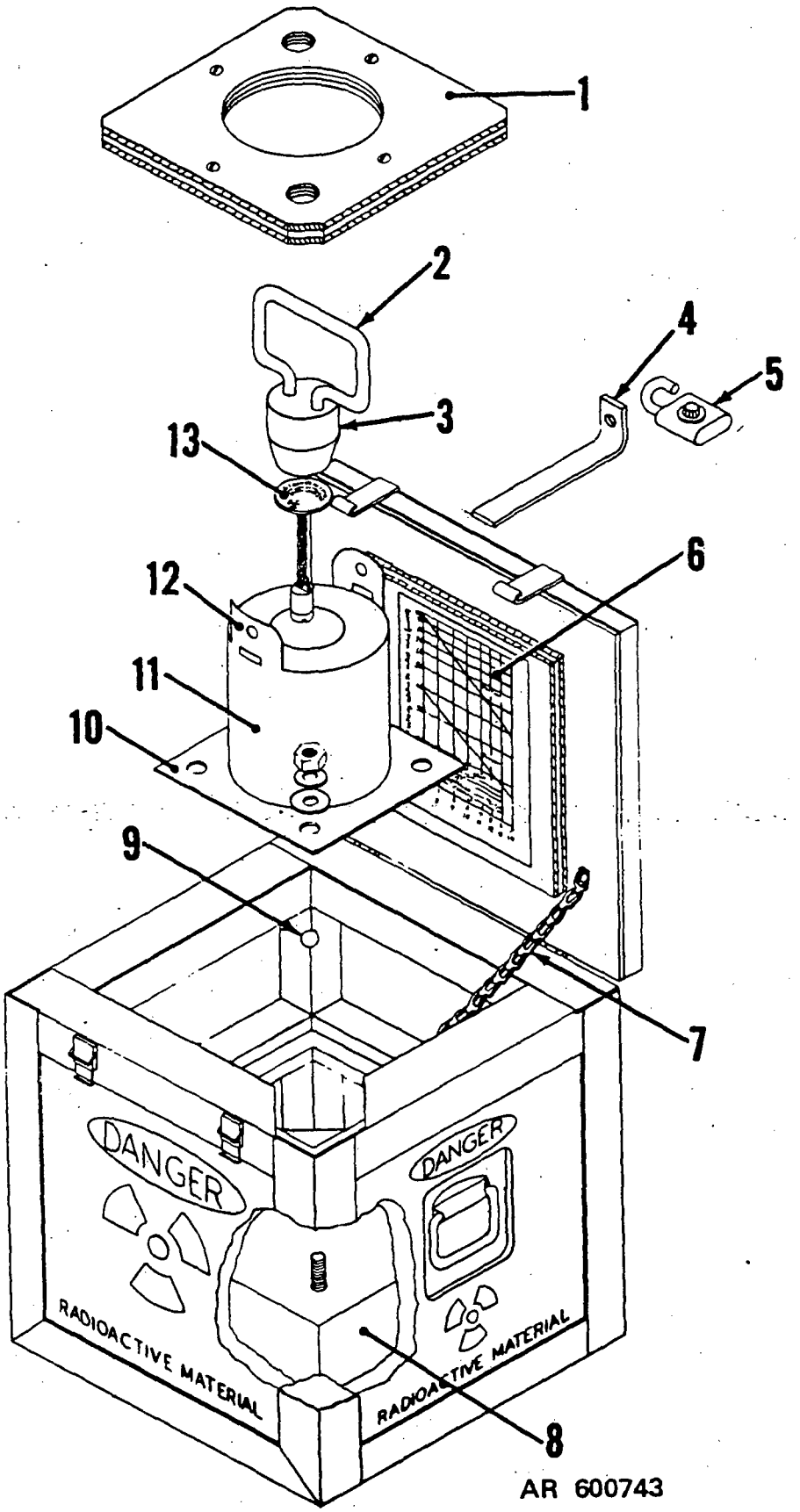


Figure 1-4. Storage case and radioactive source assembly (exploded view).

(2) *Cobalt 60 decay curve* (fig. 1-5). The cobalt 60 decay curve, mounted on the inside cover of the radioactive source case, bears the same serial number as the source. The name and address of the manufacturer; the date of calibration of the radioactive source; the strength at time of calibration in units for exposure

dose rate at a standard distance; i.e., millirads per hour (mrad/hr) at a distance of 1 meter; the activity at the time of calibration in millicuries (mCi); and the replacement date are shown on the decay curve chart. The decay curve is used to determine the relative percent strength or activity of the cobalt 60 at a given time (years and months) after the date of initial calibration.

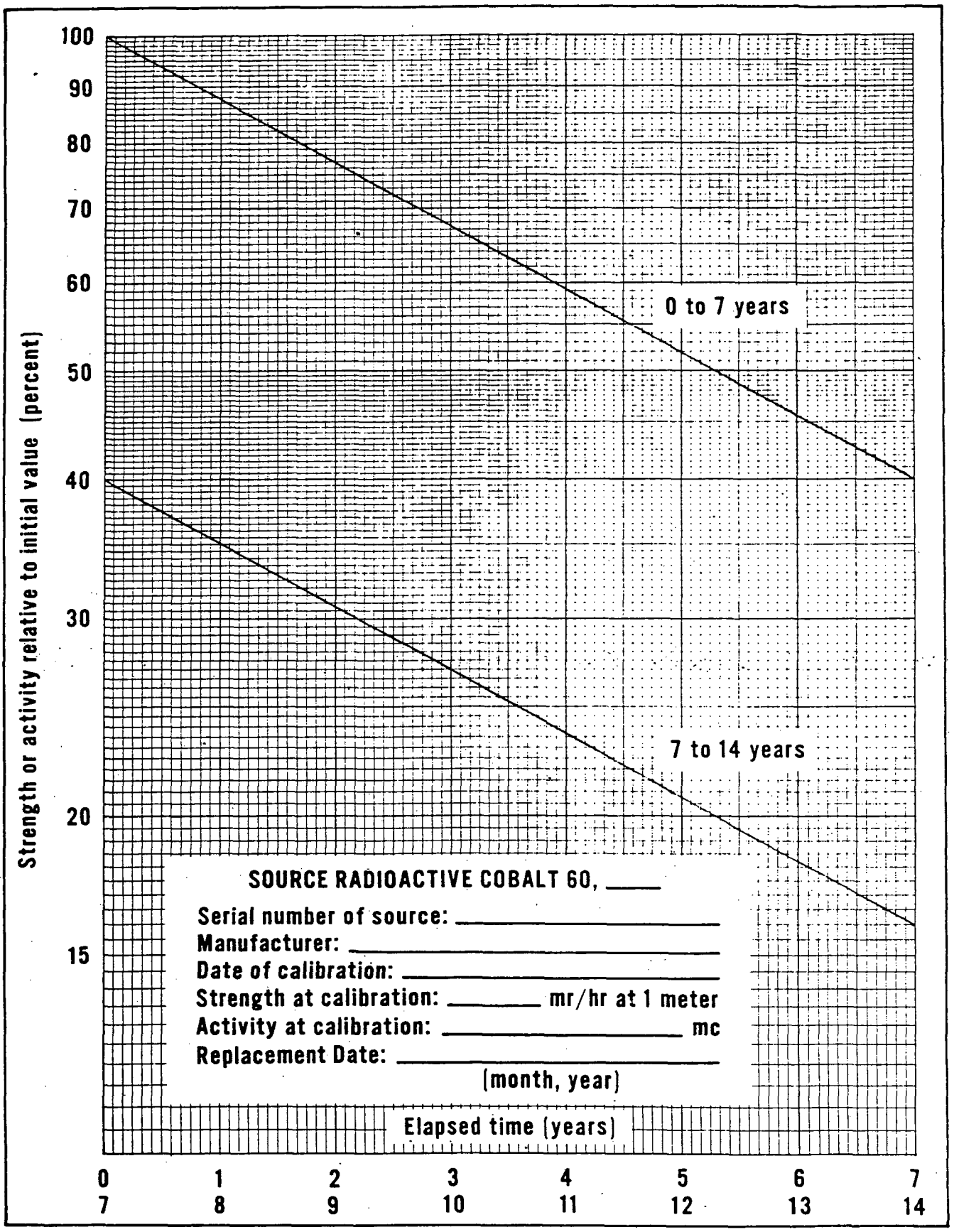


Figure 1-5. Cobalt 60 decay curve.

c. M1A1 Gamma Cobalt 60 Radioactive Source Assembly (fig. 1-6). The M1A1 gamma cobalt 60 radioactive source assembly consists of a sealed radioactive source capsule (3) containing cobalt 60, a chain (2), and a lifting disk (1). Connecting rings (4) connect the chain to the radioactive source capsule and the lifting disk.

WARNING

Dangerous gamma radiation is given off from the cobalt 60 source in the M3A1 radioactive source set. All use of a radioactive source set must be supervised by a responsible individual who has received specific training in the proper use of the set.

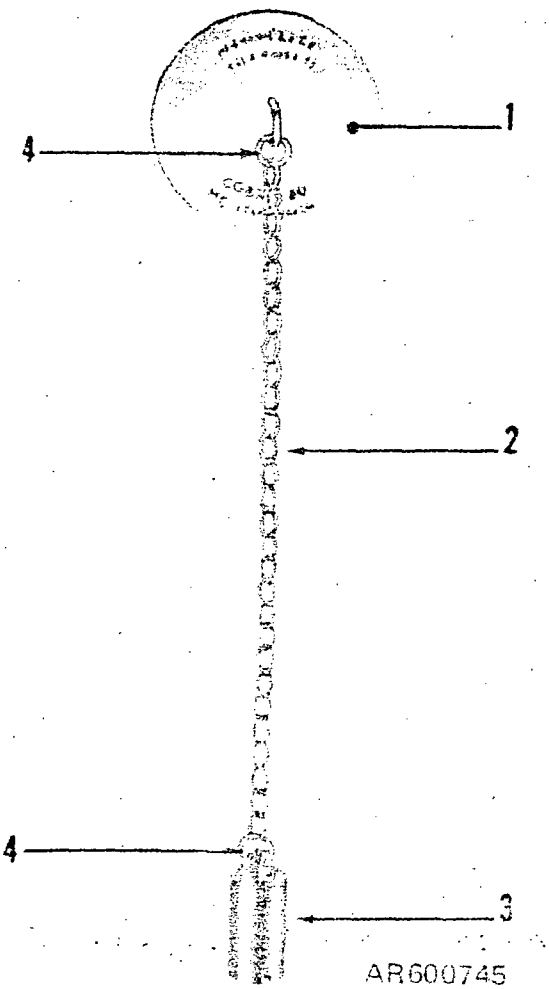
WARNING

Never eat, drink, or smoke while using the radioactive source set.

(1) *Radioactive source capsule.* The radioactive source capsule is a sealed steel capsule, ¼ inch in diameter by ⅝ inch high, containing cobalt 60. An eye in the stem at the top of the capsule permits the capsule to be suspended from a lifting disk by a chain. The activity of the radioactive source at the time of initial calibration may vary from 80 to 130 mCi. (For an activity level of 100 mCi of cobalt 60, the exposure dose rate is 132 mrad/hr at a distance of 1 meter from the source capsule.) Cobalt 60 has a halflife of 5.3 years. Cobalt 60 emits one beta particle (energy: 0.32 MeV) and two gamma rays (energy: 1.17 MeV and 1.33 MeV) at each disintegration. The steel wall of the capsule stops most of the beta particles but the gamma rays pass through the wall.

(2) *Ring and chain assembly.* The ring and chain assembly consists of a round link brass chain, approximately 5 inches long, and two connecting rings (4) at each end of the chain. One end of the ring and chain assembly is connected to the underside of the lifting disk (1); the other end is connected to the radioactive source capsule.

(3) *Lifting disk.* The lifting disk, made of ferromagnetic steel, is approximately 13/16 inch in diameter and 1/16 inch thick. A metal eye on the underside of the disk provides the means for attaching the ring and chain assembly. The underside of the disk is marked with the serial number of the radioactive source assembly, the activity of the source at the time of initial calibration, the date at which the activity was determined, and the words COBALT 60. The upper side of the disk is marked with the words DANGER RADIOACTIVE MATERIAL, NOTIFY ARMY AUTHORITIES IF FOUND, and with the word DANGER above a radiation hazard symbol. The disk is painted yellow, the letters are black, and the radiation hazard symbol is purple.

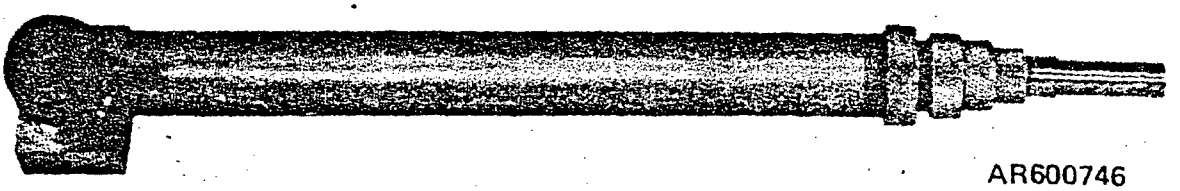


1 Lifting disk
2 Chain
3 Source capsule
4 Connecting ring

Figure 1-6. M1A1 gamma cobalt 60 radioactive source assembly.

d. M4 Telescoping Radioactive Source Magnetic Handler. The M4 telescoping radioactive source magnetic handler (fig. 1-7 and 1-8) is designed to manipulate the M1A1 gamma cobalt 60 radioactive source assembly. When using the fully extended magnetic handler, the operator can remain at a safe distance for the short time required to place or remove the radioactive source. Telescope the handler when it is not in use (fig. 1-7), and stow it in the storage case. The handler weighs approximately 2 ½ pounds and is approximately 20 inches long when telescoped and 72 inches long when fully extended. (See figure 1-8.) The magnetic handler consists essentially of a flexible arm assembly (2, fig. 1-8), three extensions of aluminum tubing (3), and a handle and housing assembly (5). Knurled retaining nuts (4), fitted with plastic packing rings, hold the telescoping sections of the handler in the extended position. A small permanent magnet under a stainless steel magnet cap (1) is attached by a length of

wire that passes through the telescoping sections of the handler to a spring-loaded motor assembly in the handle and housing assembly (5). A compression spring holds the magnet against the magnet cap; a magnet control knob (6) retracts the magnet. When the magnet is against the cap, the handler picks up and holds th radioactive source assembly. When the magnet retracted, the radioactive source assembly is release from the handler.



1 Magnet cap
2 Flexible arm assembly
3 Extension
4 Retaining nut
5 Handle and housing assembly
6 Magnet control knob

Figure 1-7. M4 radioactive source magnetic handler (telescoped).

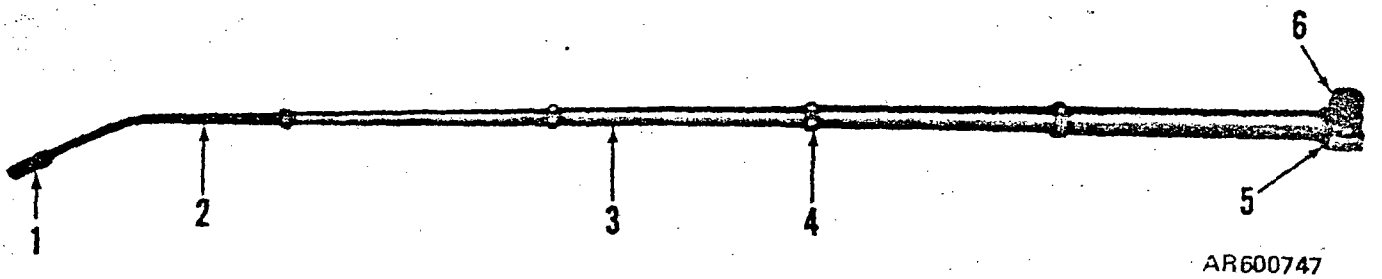


Figure 1-8. M4 radioactive source magnetic handler (extended).

1-8. Tabulated Data

Numerical data are approximate.

Radioactive material	Co^{60} (1 beta particle 0.32 MeV; 2 gamma rays 1.17 and 1.33 MeV)
Activity at time of initial calibration.	80-130 mCi.
Exposure rate at activity level of 100 mCi Cobalt 60.	132 mrad/hr at 1 meter, (158 mrad/hr at 1 yard)
Dose rate at surface of capsule	Greater than 10,000 rad/hr
Half life	5.3 years
Weight:	
M3A1 radioactive source set.	150 lb.
Magnetic handler	2 ½ lb.
Cubage:	
M3A1 radioactive source set.	1.75 cu. ft.
NRC license number	19-1826-2
BE permit number	BE670

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. PREPARATION FOR USE

2-1. Initial Inspection

When the M3A1 Radioactive Source Set is received, the operator under the supervision of the installation's Radiation Protection Officer, or his qualified alternate, will:

a. Post the radiation area (para 2-3).

b. Maintain dosimetry records (para 2-4).

c. Inspect exterior and interior of the storage case for damage. Examine case and contents for missing parts. If source set is damaged, or parts are missing, report an improper shipment (DD form 6).

d. Within three hours during normal duty hours, or 18 hours of nonduty hours of initial receipt, perform a leakage test (para 2-5), or upon initial receipt, perform a leak test (para 2-5), or at any time a leak is suspected. If the source set is leaking, emergency procedures set forth in paragraph 2-18 will be followed.

e. Inspect the M4 magnetic handler for workability (para 2-9*b*).

f. Check serial number on underside of lifting disk with serial number recorded on the cobalt-60 decay curve chart (para 2-8).

g. Determine present strength of source (para 2-12).

2-2. Calibration of M3A1 Radioactive Source Sets

The M3A1 radioactive source set will be sent to depot maintenance personnel once a year for calibration.

2-3. Posting Radiation Controlled Area

a. A radiation controlled area will be posted. A radiation controlled area is a delineated area in which exposure of personnel to radiation is under the supervision of an individual in charge of radiation protection. The perimeter of a radiation controlled area is usually established where the radiation intensity is 2 mrad/hr. Only authorized occupationally exposed individuals (radiation workers) with a minimum of a film badge dosimeter shall be permitted within the radiation controlled area. Because gamma rays emitted by a radioactive source will pass through solid objects, such as partitions and walls, a radiation controlled area may extend beyond a wall or partition.

b. Establish perimeter by estimate and calculation prior to exposing source, then adjust barriers as necessary by measuring with a survey meter after source is exposed. Rope off or otherwise establish with barriers and signs the perimeter of the radiation controlled area. A high radiation area is any area accessible to personnel in which radiation exists such that a major portion of the body could receive a dose in excess of 100 millirem in any one hour. After the radiation controlled area is established, a survey should be made with a calibrated radiac survey meter to establish the high radiation area in which personnel occupancy must be strictly controlled.

NOTE

If an unshielded Co ^{60} source having an activity of 100 millicuries is being used, the radiation controlled area will be all the area within a radius of approximately 8 meters (26.2 feet) of the source. The radiation controlled area of a more active source will be larger, and the radiation controlled area of a less active source will be smaller.

c. Post radiation warning signs at conspicuous points adjacent to the periphery of the radiation controlled area so that only authorized personnel with film badge dosimeters will be permitted within the radiation controlled area. Self-reading dosimeters are recommended as a positive means of preventing over exposures. They should be required for personnel approaching or entering the high radiation area. Figure 2-1 shows suggested dimensions for radiation warning signs. The dimensions of the signs can be varied so long as the proportions of the three-bladed radiation hazard symbol remain as shown and the wording is easy to read.

d. Post NRC Form 3 (fig. 2-2) in a conspicuous location near the radioactive source set.

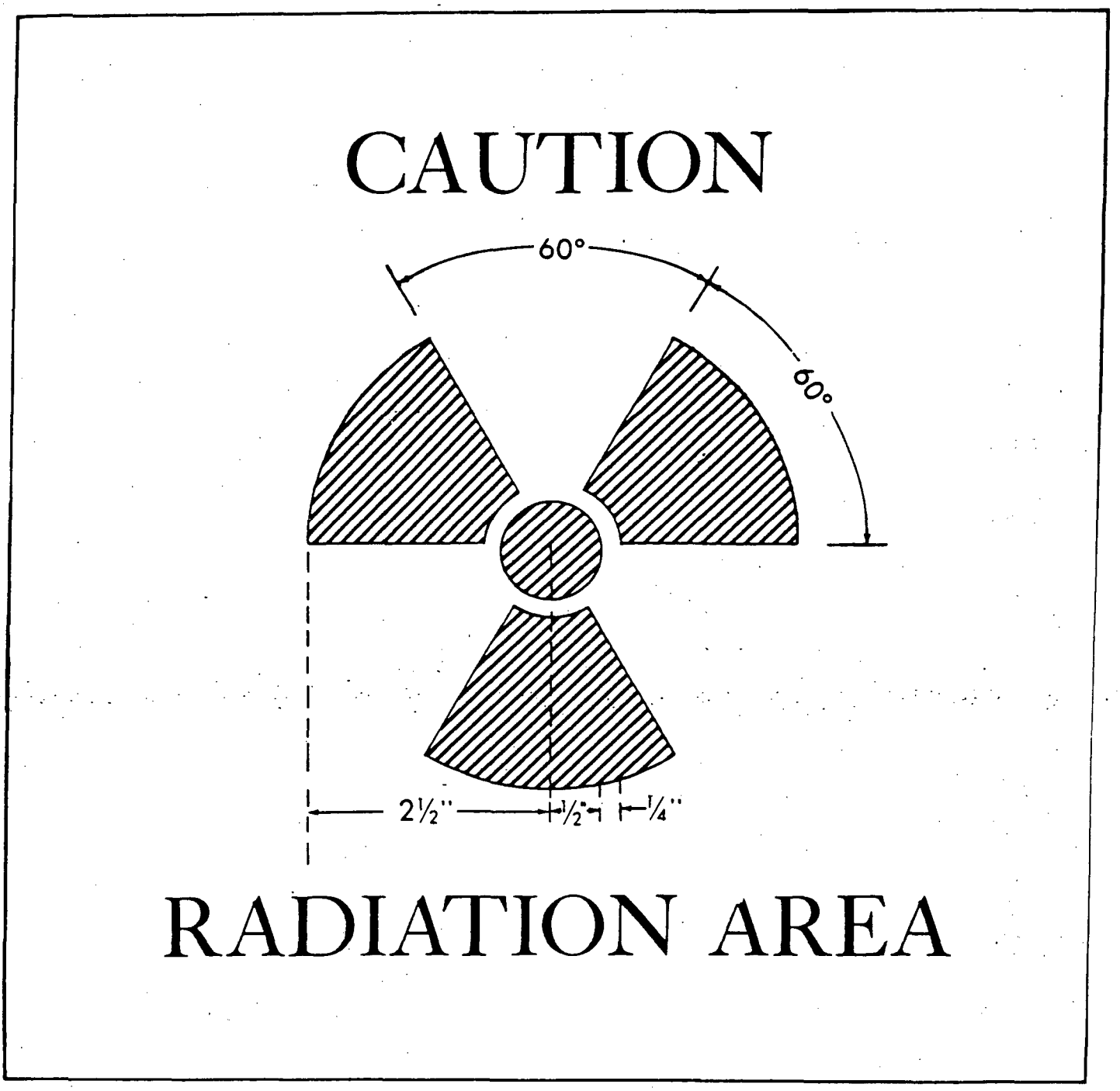


Figure 2-1. Radiation warning sign.

Form NRC-3
(4-76)
10 CFR 19
10 CFR 20

UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19)

In Part 20 of its Rules and Regulations, the Nuclear Regulatory Commission has established standards for your protection against radiation hazards from radioactive material under license issued by the Nuclear Regulatory Commission. In Part 19 of its Rules and Regulations, the Nuclear Regulatory Commission has established certain provisions for the options of workers engaged in NRC-licensed activities.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding NRC inspections and
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

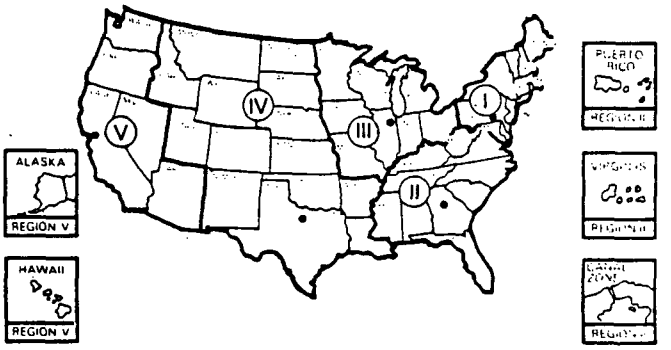
1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Sections 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202:
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Inspection and Enforcement Regional Office (shown on map at right). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

POSTING REQUIREMENTS

Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.



UNITED STATES NUCLEAR REGULATORY COMMISSION
Regional Offices

REGION	ADDRESS	TELEPHONE	
		DAYTIME	NIGHTS AND HOLIDAYS
I	Region I, Office of Inspection and Enforcement, USNRC 631 Park Avenue King of Prussia, Pennsylvania 19406	215 337-1180	215 337-1150
II	Region II, Office of Inspection and Enforcement, USNRC 230 Peachtree Street, N.W., Suite 818 Atlanta, Georgia 30303	404 526-4503	404 526 4503
III	Region III, Office of Inspection and Enforcement, USNRC 799 Roosevelt Road Glen Ellyn, Illinois 60137	312 858-2660	312 858-2660
IV	Region IV, Office of Inspection and Enforcement, USNRC 611 Ryan Plaza Drive, Suite 1000 Arlington, Texas 76012	817 334-2841	817 334-2841
V	Region V, Office of Inspection and Enforcement, USNRC 1990 N. California Boulevard, Suite 202, Walnut Creek Plaza Walnut Creek, California 94596	415 486-3141	415 486-3141

AR600749

Figure 2-2. NRC Form 3.

2-4. Dosimetry Records

a. Record daily self-reading dosimeter readings of individuals for exposure control purposes.

b. Film badge dosimetry exposure records will be maintained. Unusual exposures will be investigated and reported.

Section II. LEAK TEST

2-5. Leak Test

Perform a leak test (wipe test) upon receipt of a radioactive source set and at least once every 6 months thereafter; perform a leak test prior to shipment or at any time it is suspected that the radioactive source may be leaking.

WARNING

Wear a film badge, a calibrated dosimeter, and disposable protective gloves while performing the leak test. Do not spread contamination by touching other objects with the gloves. Do not leave the unshielded radioactive source or the opened storage case unattended. Do not stay in the radiation area any longer than necessary to perform the leak test.

a. Assemble the Following Items Before Beginning Leak Test.

(1) A calibrated beta-gamma type radiac survey meter such as the AN/PDR-27( ) radiac survey meter.

(2) A film badge and a calibrated IM-9 series dosimeter for each individual taking part in the leak test.

(3) A pair of disposable protective gloves for the individual who wipes the shield.

(4) An unfolded sheet of paper toweling or plastic sheeting of approximately the same size as the paper toweling.

(5) At least one high-wet-strength filter paper disk approximately 1 inch in diameter for each wiping.

NOTE

If filter paper disks are not available, suitable disks can be cut from a sheet of paper toweling.

(6) One small envelope and one larger envelope for each filter disk that is to be mailed to a radiological laboratory for evaluation.

(7) A pencil, dowel, or stick approximately 7 inches long with a flat end.

(8) Pressure-sensitive tape.

b. Prepare the Test Site. Select an area away from the normal stream of traffic. The test site may be in a

one-story building or outside. The area of the test site should be unobstructed and have a level floor or ground surface approximately 16 meters (53 feet) square.

(1) Place the sheet of paper toweling or plastic sheeting on a table or work bench in the center of the site.

(2) Anchor the paper or sheeting to the flat surfaces with pressure-sensitive tape or with weights.

(3) Mark the center of the paper or sheeting to indicate where the radioactive source will be placed during the test procedure.

c. Obtain Survey Meter Readings.

(1) Remove the radioactive source from the shield (para 2-9) and place it on the paper or sheeting.

(2) Use a calibrated AN/PDR-27( ) radiac survey meter to delineate the radiation area (para 2-3).

(3) Use the probe of the radiac survey meter with the beta window open to test the well in the shield and the surfaces of the shield plug for radioactive contamination.

(*a*) If the meter reading is 1.0 mrad/hr or more above the background reading, the radioactive source capsule is leaking and must not be used. Return the radioactive source to the shield (para 2-10). Report leak test results to the command radiological control officer and request disposition instructions. Dispose of the plastic gloves as radioactive waste. If the area is contaminated, dispose of the paper or plastic sheeting, and follow decontamination procedures given in TM 3-220.

(*b*) If the meter reading is less than 1.0 mrad/hr above the background reading, proceed with the wipe test (*d* below).

d. Perform a Wipe Test.

WARNING

Wear disposable protective gloves.

(1) Mark a filter paper disk with the serial number of the radioactive source set. (The set bears the same serial number as the radioactive source capsule.)

(2) Carefully center and wrap the filter paper disk over the flat end of a pencil or dowel. Make sure that the marked side of the disk is adjacent to the pencil. Use pressure-sensitive tape to hold the folded disk in place.

(3) Moisten the filter paper disk with distilled or clear tap water and gently but thoroughly wipe the sides and bottom of the well in the shield and the surfaces of the plug that fit into the shield.

(4) Carefully remove the disk from the pencil. Dispose of the pencil as radioactive waste. Flatten the paper disk to dry with smeared side up.

(5) Return the radioactive source to the shield (para 2-10).

2-6. Test Evaluation

a. When the filter paper disk has dried (para 2-5*d*(4) above), position a calibrated AN/PDR-27( ) radiacmeter over the disk. Place the probe of the radiacmeter (with the beta window open) as close to the filter disk as possible; do not allow the probe to touch the filter paper disk.

(1) If the dose rate is 0.4 mrad/hr or greater above background radiation, lock the radioactive source in the shield. Decontaminate the outside of the shield and the storage case if necessary, report leak test results to the command radiological control officer, and request disposition instructions.

(2) If the meter reading is less than 0.4 mrad/hr but greater than 0.1 mrad/hr above background radiation, lock the radioactive source in the shield. Set the radioactive source set aside. Submit the filter disk to a radiological laboratory for evaluation. Do not use the set until you get a report from the laboratory.

NOTE

The laboratory will report its evaluation of the filter disk in microcuries of cobalt 60. If the report reads 0.005 microcurie of cobalt 60 or greater, turn the radioactive source set in for disposal. If the report reads less than 0.005 microcurie of cobalt 60, the radioactive source set may be used.

(3) If the meter reading is 0.1 mrad/hr or less above background radiation, submit the filter disk to a radiological laboratory for evaluation. The set may be used while awaiting the report from the laboratory. See note in (2) above.

b. If laboratory equipment capable of accurately measuring 0.001 microcurie is available, evaluate the filter paper disk, and send a copy of the results of the test to the area Radioactive Material Control Point. If the quantity of cobalt 60 on the disk measures more than 0.005 microcurie, the radioactive source set is unserviceable. Turn it in for disposal.

c. If a using installation does not have the proper laboratory equipment:

(1) Place the filter paper disk in a small envelope marked with the name and location of the user, the serial number of the radioactive source, and the words: MAILROOM—DO NOT OPEN. Seal the envelope with pressure-sensitive tape and place it in a second envelope for forwarding. Do not include more than one filter disk in any one mailing envelope. Mark the following on the second envelope:

RADIOACTIVE MATERIAL—Gamma radiation at surface of envelope less than 10 millirads for 24 hours—No significant alpha, beta, neutron radiation.

(2) Installation commanders in CONUS will forward the smear paper for evaluation to the nearest Depot as follows:

Commander
Lexington-Blue Grass Army Depot
ATTN: DRXLX-QCP
Lexington, KY 40507

Commander
Sacramento Army Depot
ATTN: DRXSA-QMD-1
Sacramento, CA 95813

(3) The Depot will forward a test evaluation report to the sender.

(4) Commanders at overseas installations will follow the procedures established by the responsible commander.

2-7. Test Records

a. Maintain records of leak tests. Indicate date of test, results of test, and names of personnel making the test.

b. Test records are subject to periodic inspections.

Section III. OPERATING UNDER NORMAL CONDITIONS

WARNING

From the time that the lead plug is removed from the shield until the source has been returned to the shield and the plug replaced, the source is an exposed radiation hazard. Always use the magnetic handler for handling the radioactive source. Never touch the radioactive source capsule. The dose rate at the surface of the capsule is greater than 10,000 rad/hr.

2-8. Checking Serial Numbers

a. The serial number on the underside of the lifting disk (ring) of the radioactive source assembly and the serial number on the cobalt 60 decay curve chart (attached inside the cover of the storage case) must be identical. If the serial numbers are not identical, the radioactive source set cannot be used for calibration purposes, because the source strength value printed on the chart will not be the correct value for the radioactive source.

b. Check the serial numbers on the lifting disk and the chart upon receipt of a radioactive source set. If the serial numbers on the disk and chart differ, report an improper shipment (DD Form 6).

c. To check the serial number on the underside of the lifting disk, follow the procedures described in paragraph 2-9*b*(1) through (6). Raise the lifting disk of the radioactive source assembly just high enough to deposit the lifting disk on the rim of the shield. Be sure to keep the radioactive source capsule in the well in the shield and out of the line of sight. Use a pair of pliers to turn the lifting disk over. Be careful not to withdraw the radioactive capsule from the shield. Make note of the serial number and return the disk to its original position in the shield.

2-9. Removing Radioactive Source From Shield

a. General. Each time that a radioactive source is removed from a shield, use the probe of an AN/PDR-27 radiac set to test the well in the shield for radioactive contamination (para 2-5*c*). If contamination is detected, return the source to the shield; use the magnetic handler and follow emergency procedures (para 2-17 and 2-18).

b. Using the M4 Magnetic Handler.

(1) Open the storage case (fig. 1-2).

(2) Remove the M4 magnetic handler (fig. 1-7) from storage case. Extend the flexible arm assembly (2, fig. 1-8) and each of the three extensions in turn. Tighten each of four retaining nuts just enough to hold the handler in the extended position. Bend the flexible arm downward.

(3) Make sure that the magnetic handler is fully extended and in operating condition. Bring the front end of the magnet cap (1, fig. 1-8) close to a paper clip or small nail. The clip or nail should be attracted and held to the cap by the magnet. Turn the magnet control knob (6) about one-fourth turn *counterclockwise* to retract the magnet and release the clip or nail from the magnet cap.

CAUTION

Never turn the magnet control knob unless the magnetic handler is fully extended. Never turn the knob in a clockwise direction.

(4) Unlock the combination lock (5, fig. 1-4) and remove the lockbar (4).

NOTE

The radiation protection officer will keep a record of the combination and change the combination as required. He will keep the key that is used to change the combination. When a radioactive source set is transferred from one installation to another, the combination for the lock and the key for changing the combination will be forwarded under separate cover; they will never be sent with the set.

(5) Remove the lead plug (3) from the shield and step back from the shield as quickly as possible.

WARNING

Never look into the well of the shield or unnecessarily expose parts of the body to the radiation which issues from the radioactive source capsule in the well of the shield.

(6) Bring the magnet cap end of the handler in contact with the lifting disk.

(7) Lift the radioactive source assembly out of the

shield with the handler and carry it to the calibration site.

2-10. Returning Radioactive Source to Shield

Use the magnetic handler (remote-handling tongs) to return the radioactive source assembly to the shield; lower the source capsule gently into the well in the shield. *Do not look into the well.* Release the lifting disk. Replace the lead plug in the shield; insert and lock the lockbar. Loosen the nuts on the extension arms of the magnetic handler to telescope the handler; place the handler in the storage case and close the case.

Section IV. CALCULATIONS

2-11. General

The activity of cobalt 60 decreases with time; therefore the strength of the source must be determined before using the source for calibrating an instrument. After the strength of the source has been determined, the dose rate in millirads per hour (mrad/hr) at a given distance from the source, and distance from the source to obtain a given dose rate, can be calculated. Distance from source is measured in meters. One meter equals 39.37 inches.

2-12. Determining Present Strength of Source and Calculating Dose Rates, Distances, and Dose

a. Determining Present Strength of Source.

(1) From the cobalt 60 decay curve chart (fig. 1-5) attached inside the cover of the storage case, note the date of initial calibration (year and month) and the strength of the source in mrad/hr at 1 meter (39.37 inches) at that date. Compute the years and months that have elapsed since that date.

(2) From the decay curve on the chart, determine the percent strength remaining in the source.

(3) Calculate the present strength of the source by use of the following formula: Present strength = strength when initially calibrated X percent strength remaining ÷ 100.

Example:

Present date..... August 1974
Date of initial ..... February 1972
calibration
Elapsed time ..... 2 years 6 months
Percent strength... 72
remaining
Strength of source 132 mrad/hr at 1 meter
when initially
calibrated
Calculation..... $\frac{132 \times 72}{100} = 95.04$
Present strength... 95.04 mrad/hr at 1 meter
of source

b. Calculating Dose Rate at a Given Distance. Use the following formula to calculate the dose rate at a given distance (d): $R = \frac{S}{d^2}$

Where: R = dose rate in mrad/hr
S = present strength of source (*a* above)
d = distance from source in meters (1 meter equals 39.37 inches or 3.281 feet).

Example:

Present strength of source (S) (*a* above) 95.04 mrad/hr at 1 meter
Distance from source (d) ..... 2 meters
Calculation..... $\frac{95.04}{2^2} = \frac{95.04}{4} = 23.76$
Dose rate (R) ..... 23.76 mrad/hr at 2 meters

c. Calculating Distance From Source to Obtain a Given Dose Rate. Use the following formula to calculate the distance at which a given dose rate (R) will be obtained:

$$d = \sqrt{\frac{S}{R}}$$

Where: d = distance from source in meters (1 meter equals 3.281 feet)
S = present strength of source
R = given dose rate in mrad/hr

Example:

Present strength of source (S), 95.04 mrad/hr at 1 meter (*a* above).
Given dose rate (R), 23.76 mrad/hr at 2 meters (*b* above).
Calculation..... $\sqrt{\frac{95.04}{23.76}} = \sqrt{4} = 2$
Distance from source (d), 2 meters

d. Calculating the Dose. Use the following formula to calculate the dose (D) at a given distance when the dose rate (R) at a given distance and the exposure time (t) are known, D = Rt.

Where: D = the total amount of nuclear radiation absorbed (mrad)
R = the dose rate at the given distance (mrad/hr)
t = time of exposure in hours

Example:

Dose rate (R) at 2 meters, 23.76 mrad/hr (*b* above).
Time (t) in hours. ½ hr
Calculation..... $23.76 \times \frac{1}{2} = \frac{23.76}{2} = 11.88$
Dose (D)..... 11.88 mrad

Section V. CALIBRATION OF RADIAC SURVEY METERS AND DOSIMETERS

2-13. General

Calibration of radiac survey meters and dosimeters provides the means for determining the extent that an instrument reading deviates from the true value. Calibration may be performed by checking the instrument against a standard radioactive source; the M3A1 radioactive source set can be used for this purpose.

2-14. Calibration of Radiac Survey Meters

a. General. Radiac survey meters should be calibrated each time that batteries or electronic components are changed, or after long periods of continual use, and after being exposed to extreme temperature changes (FM 21-48).

b. Preliminary Procedure.

WARNING

Never take the radioactive source from the shield without having a radiacmeter available and in good working order; e.g., an AN/PDR-27 radiac set.

(1) Prepare a worksheet for record purposes. Record the name and serial number of the radiac survey meter that is to be calibrated, the serial number of the radioactive source, the date, and the name of the individual performing the calibration. Prepare a table with the following column headings:

(*a*) Distance from Source (meters).

(*b*) Calculated Dose Rate (mrad/hr).

(*c*) Survey Meter Scale Reading (mrad/hr).

(2) Under the Distance from Source reading, list ½, 1, 1 ½, 1 ¾, 2, 2 ½, 3, 4, 5, 7, and 9 meters.

(3) From the cobalt 60 decay curve chart, calculate the present strength of the radioactive source (para 2-12*a*).

(4) Use the value obtained to calculate the dose rate for each of the distances listed in the table (para 2-12*b*). Record these dose rates.

(5) Calculate the distance from the radioactive source at which the dose rate is 0.4 mrad/hr (para 2-12*c*). List the distance and the dose rate in the table.

(6) Calculate the distance from the radioactive source at which the dose rate is 2.0 mrad/hr (para 2-12*c*). Use the calculated distance to delineate radiation area (para 2-3).

c. Prepare a Calibration Site.

WARNING

Before removing the radioactive source capsule from the shield, select a calibration site in an area that is away from the normal stream of traffic. The selected site should be unobstructed and have a level floor or ground surface approximately 16 meters (53 feet) square. The calibration site may be in a one-story building or out-doors.

(1) Mark with an X the point (center of site) where the radioactive source will be located. Draw a straight line approximately 16 meters long from the point X.

(2) Start from the point marked X; measure and mark off intervals for each of the distances listed in the table.

(3) Use the point marked X as the center of a circle, and calculate the distance for a dose rate of 2 mrad/hr as the radius; post the radiation area (para 2-3).

(4) Provide a wood stand with a hook or other means for suspending the radioactive source directly over and approximately 3 inches above the point marked X.

d. Obtain Survey Meter Readings.

WARNING

Never allow personnel without film badges and dosimeters inside the restricted area. Be sure to wear film badges and dosimeters inside the restricted area. Do not linger in the radiation area any longer than is necessary to obtain the meter readings.

(1) To check the survey meter for proper operation, use the procedure described in the appropriate technical manual and record the background reading.

(2) Remove the radioactive source from the shield (para 2-9) and suspend the source over the point marked X. Leave the radiation area.

(3) Start with the highest scale on the survey meter and obtain three meter readings on each scale (except the 0 to 0.5 mrad/hr scale): one near the top, one near the middle, and one near the lower end of each scale. Obtain one scale reading ((*c*) below) on the 0 to 0.5 mrad/hr scale.

(*a*) Select the scale to be calibrated. Start with the marked interval closest to the point X and work away from the source. Before taking a scale reading, place the survey meter so that the detecting element in the meter is centered on the interval marked.

(*b*) Record each scale reading in the proper place in the table.

(*c*) Turn the selector switch to the 0 to 0.5 mrad/hr scale. Place the survey meter at the marker farthest from the source (the point at which the calculated dose rate is 0.4 mrad/hr). Observe the scale reading. Subtract the background scale reading and record the difference as the survey meter readings.

(*d*) Return the radioactive source to the shield (para 2-10).

e. Evaluate the Data. Compare the tabulated scale readings with the comparable calculated dose rates for each distance from the radioactive source as recorded in the table.

(1) If any tabulated scale reading differs by more than ± 15 percent from the calculated dose rate, do not

continue the calibration but turn the survey meter in for adjustment or repair.

(2) If all the tabulated scale readings are within ±15 percent of the calculated dose rate, prepare a calibration curve as described in *f* below.

f. Preparing a Calibration Curve.

(1) Use linear graph paper to mark off calculated dose rate intervals on the horizontal axis and survey meter scale intervals on the vertical axis; date the graph with the calibration date.

(2) Plot each survey meter scale reading in the table against the comparable calculated dose rate.

(3) Complete the calibration graph by drawing a smooth curve through the plotted points.

(4) Attach the calibration graph to the radiac survey meter.

g. Use the Calibration Curve. Each time a survey meter scale reading is observed, refer to the calibration graph and obtain the true dose rate. Report as survey data the true dose rate obtained from the curve.

2-15. Calibration of Radiac Dosimeters

a. General. IM-9( )/PD radiac dosimeters should be calibrated every 6 months (TB 750-242-3). If, after exposure to a radioactive source, a dosimeter scale reading differs from the comparable calculated dose by more than ± 10 percent (*f*(3) below) the dosimeter should be turned in for disposal.

b. Preliminary Procedure.

WARNING

Never take the radioactive source from the shield without having a radiacmeter available and in good working order; e.g., an AN/PDR-27 radiac set.

(1) Draw a table with three column headings and date it with the calibration date. Head the three columns:

(*a*) Dosimeter Serial Numbers.

(*b*) Scale Reading (SR), mrad.

(*c*) Correction Factor (CF).

(2) In the first column in the table, list the serial number of each dosimeter that is to be calibrated.

(3) Use data from the cobalt 60 decay curve chart to calculate the present strength (mrad/hr at 1 meter) of the radioactive source (para 2-12*a*). Record this value on the worksheet.

(4) Use the value obtained above to calculate the dose rate (mrad/hr) at a distance of ½ meter from the radioactive source (para 2-12*b*). Record this value on the worksheet.

(5) Calculate the dose (mrad) resulting from a 15-minute exposure and a 30-minute exposure at a distance of ½ meter from the radioactive source (para 2-12*d*). Record on the worksheet the calculated dose (CD) that is closest to 150 mrad. Record length of exposure.

NOTE

The calculated dose resulting from a 15-minute exposure at ½ meter will be numerically equal to the present strength of the radioactive source ((3) above). For example, if the present strength of the source is 95.04 mrad/hr at 1 meter, the calculated dose resulting from a 15-minute exposure at ½ meter will be 95.04 mrad. The calculated dose resulting from a 30-minute exposure at ½ meter will be numerically equal to twice the present strength of the radioactive source. For example, if the present strength of the source is 95.04 mrad/hr at 1 meter, the calculated dose resulting from a 30-minute exposure at ½ meter will be twice 95.04 or 190.08 mrad.

(6) Calculate the distance from the radioactive source at which the dose rate is 2 mrad/hr (para 2-12*c*). Record this value on the worksheet and use it to delineate the radiation area (para 2-3).

c. Preparing the Calibration Site.

WARNING

Never leave an unshielded radioactive source unattended. If necessary to leave the source set, reshield the radioactive source and lock the container.

(1) Select a calibration site in a one-story building or outside in a location that is away from the main stream of traffic.

(2) Select a flat unobstructed surface within the calibration area and draw a circle having a radius of ½ meter.

(3) Mark the center of the circle; this is where the radioactive source will be suspended.

(4) Prepare a wood stand with a hook or other means for suspending the radioactive source directly over and approximately 3 inches above the center of the circle.

d. Charging Radiac Dosimeters. Radiac dosimeters must be fully charged before they are calibrated. Charge the dosimeters as described in TB SIG 226-9. Be sure that the scale reading is zero on each dosimeter to be calibrated.

e. Exposing Charged Dosimeters to the Radioactive Source.

WARNING

Wear film badges and dosimeters. Do not linger in the radiation area any longer than is necessary. Do not leave the unshielded radioactive source unattended.

(1) Stand dosimeters to be calibrated approximately 6 to 8 inches apart on the circumference of the circle (*c*(2) above). Stand each dosimeter on its viewing end (the end with the clip).

(2) Remove the radioactive source from the shield

(para 2-9) and suspend the source over the center of the circle. Note and record the exact time (hours, minutes, and seconds).

(3) Leave the radiation area.

(4) Expose the dosimeters to the radioactive source for either exactly 15 minutes or exactly 30 minutes depending on the strength of the source (*b*(3) above).

(5) As quickly as possible, remove the source and return it to the shield (para 2-10).

f. Calibrating Radiac Dosimeters.

(1) Collect the exposed dosimeters. Read each dosimeter and enter the scale reading (SR) in the second column opposite the appropriate serial number in the first column.

(2) Calibrate a correction factor (CF) for each dosimeter. Divide the calculated dose (CD) (*b*(3) above) by the scale reading (SR) listed in the second column on the worksheet and list the correction factor (CF) in the third column opposite the appropriate serial number.

Example:

$$\frac{\text{Calculated Dose (CD)}}{\text{Scale Reading (SR)}} = \text{Correction Factor (CF)}$$

If the calculated dose is 180 mrad and the scale reading is 190 mrad, the correction factor is $\frac{180}{190}$ or 0.95.

(3) Scan the list of correction factors in the third column of the table. Any dosimeter requiring a correction factor of less than .90 or greater than 1.10 is considered unserviceable and should be turned in.

(4) Record the calibration date, serial number, and correction factor for each serviceable dosimeter on separate pieces of paper and attach the papers to the appropriate dosimeters.

Section VI. EMERGENCY SITUATIONS AND PROCEDURES

NOTE

The procedures outlined below will be followed in an emergency situation.

2-16. Loss of Radioactive Source Set

a. Try to recover the radioactive source set.

(1) Review records to determine the responsible individual.

(2) Make a physical survey.

b. If the radioactive source set is recovered, revise procedures as necessary to prevent a recurrence.

c. If the radioactive source set is not recovered, report the loss through command channels to the area Radioactive Material Control Point. State the serial number of the source, the circumstances involved, and the procedures taken to prevent a recurrence.

2-17. Internal Exposure of Personnel

a. Internal exposure is the result of personnel becoming contaminated when radioactive particles are inhaled, swallowed, or absorbed through breaks in the skin.

b. In the event of a known or suspected internal exposure:

(1) Seek advice from the Medical Officer.

(2) Notify responsible commands, and Commander, Edgewood Arsenal, ATTN: SAREA-SA, Aberdeen Proving Ground, MD 21010. During duty hours, telephone area code 301, telephone number 671-4411; during nonduty hours, 671-2403.

2-18. Damaged or Leaking Radioactive Source Set

A radioactive source set could begin to leak as a result of age, or if it is crushed or dropped. In the event of a known or suspected leaking source, perform the following:

a. Monitor personnel, equipment, and areas for possible contamination.

b. Dispose of the radioactive source set (para 6-3). Decontaminate, as required (TM 3-220).

c. Report the disposal through command channels to the area Radioactive Material Control Point.

2-19. Firefighting Emergency Procedures

a. General. Emergency plans must include procedures for combating fires involving radioactive items. Plans should be commensurate with the quantity and type of items present. Firefighting personnel must know the location(s) of the items and must be familiar with radiation protection procedures. The M3A1 source set and source assembly are designed to withstand high temperatures. Even in temperatures high enough to melt the lead shield, the lead will be contained within the steel jacket and surround the source. No airborne radioactivity is expected from a fire involving only the M3A1 source set. However, if other radioactive sources are involved, firefighting activities may produce airborne radioactivity. As a general rule, personnel should wear protective respiratory equipment when fighting fires involving radioactive items.

b. Emergency Procedures.

(1) Evacuate personnel in the immediate area who are not directly involved.

(2) Notify the fire department.

(3) Determine radiation hazard and type of respiratory equipment required. Extinguish the fire with readily available portable extinguishers if radiation hazard is not present.

(4) Notify the Radiation Protection Officer.

(5) Notify medical personnel when appropriate.

(6) Control access to the immediate area.

(7) Monitor personnel, equipment, supplies, and environs.

(8) Decontaminate personnel, equipment, supplies, and environs.

(9) Record and report the fire on proper forms.

CHAPTER 3
OPERATOR'S MAINTENANCE INSTRUCTIONS

3-1. General

a. The operator must perform inspection and preventive maintenance services under the supervision of a radiation protection officer who has received specific training in the proper operation of the radioactive source set and who has met the minimum qualifications as they are defined in paragraph 1-4*a* of this manual.

b. The operator is authorized to clean the exterior of the storage case and to clean the M4 telescoping radioactive source magnetic handler.

3-2. Operator's Preventive Maintenance Checks and Services

a. General. Inspection and maintenance services described in table 3-1 will be performed each day that the equipment is used and at least semiannually when the equipment is in unit storage. Deficiencies beyond the maintenance capability of the operator must be reported to higher level maintenance.

b. Purpose. The preventive maintenance checks and services table provides a step-by-step guide for making inspections and performing required preventive maintenance.

c. Explanation of Columns. The numbers in the first three columns indicate the sequence in which the item listed in the fourth column should be inspected. The procedures for performing the inspections and the paragraph references are listed in the fifth column. In the sixth column, the estimated mean value of time to perform each individual test is shown in man-hour units.

Table 3-1. Operator's Preventive Maintenance Checks and Services

B—Before Operation Time required: 2.0 | D—During Operation | A—After Operation Time required: 0.1

Interval and sequence No.			ITEM TO BE INSPECTED PROCEDURE	Work time (M/H)
B	D	A		
			WARNING Follow the instructions in paragraph 2-3 before removing the radioactive source capsule from the shield in the storage case. Use the magnetic handler to handle the radioactive source.	
1			**STORAGE CASE** Inspect the exterior of the storage case for breakage.	0.1
			Check to see if the paint is chipped or peeled, and if the hardware is loose, damaged, or missing.	0.1
2			**IDENTIFICATION PLATE** Make sure that an identification plate (2, fig. 1-2) is attached to the outside cover of the case and that markings on the plate are legible. Check the replacement date on the identification plate. (The replacement date also appears on the decay curve chart.)	0.1
3			**TECHNICAL MANUAL** Make sure that a copy of this manual, TM 3-6665-214-13&P, in usable condition, is packed in the case.	0.1
4			**M4 MAGNETIC HANDLER** Inspect the magnetic handler to make sure that it is clean and that it functions properly.	0.3
5			**COBALT 60 DECAY CURVE CHART** Check the chart (fig. 1-4) on the inside of the cover of the storage case to make certain that the information printed on the chart is legible.	0.1
6			**SHIELD ASSEMBLY** Inspect the lead shield (11, fig. 1-4) to make certain that it is undamaged. See that the plug (3) and the lockbar (4) are in place and that the padlock (5) is locked. If the lock is open or broken, do not remove the plug but check the surface of the storage case with any approved radiac meter capable of measuring a dose rate of 5 mrad/hr to 200 mrad/hr to determine if the radioactive source capsule is in the shield. A reading in excess of 5 mrad/hr but less than 200 mrad/hr indicates the presence of the radioactive source in the shield.	0.3
			Perform a leak test (para 2-5).	0.8
7			**RADIOACTIVE SOURCE ASSEMBLY** Inspect the radioactive source assembly to make sure that the source capsule is suspended from the lifting disk (or ring).	0.1
		8	**STORAGE CASE** Clean the exterior of the storage case by wiping it off with a clean, damp cloth.	0.1

CHAPTER 4
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

4-1. General

Organizational maintenance personnel must perform inspection and preventive maintenance services under the supervision of a radiation protection officer.

4-2. Preventive Maintenance Checks and Services (Table 4-1)

Organizational maintenance personnel are authorized to perform the preventive maintenance services listed below. Except for the motor and clutch assembly, these services should be performed weekly when the source set is in use. Motor and clutch assembly should be inspected and serviced monthly after issue to field personnel. Deficiencies beyond their maintenance capability must be reported to higher level maintenance.

a. Make minor repairs of the storage case, such as replacing missing nails and screws and tightening loose screws and nuts.

b. Retouch or repaint the storage case when necessary (para 4-3).

c. Replace or repair lock bar.

d. Inspect, service, and repair magnet, flexible arm, and extension assembly of the M4 telescoping radioactive source magnetic handler. Repair is limited to removal of distorted segment(s) of flexible arm assembly or extensions.

e. Inspect and service motor and clutch assembly.

Table 4-1. Organizational Maintenance Checks and Services

Weekly
Time required: 5.2

Sequence No.	ITEM TO BE INSPECTED PROCEDURE	Work time (M/H)
1	**STORAGE CASE**	
	Make minor repairs. Tighten loose screws and nuts. Replace missing nails and screws. Retouch or repaint case (para 4-3*a*).	0.5
2	**RADIOACTIVE SOURCE AND SHIELD ASSEMBLY**	
	Repair lockbar, if damaged.	0.3
	Replace lockbar, if missing (para 4-4).	1.0
3	**M4 RADIOACTIVE SOURCE MAGNETIC HANDLER**	
	Inspect magnet, flexible arm, and extension assembly.	0.6
	Repair, if damaged (para 4-5*c* and table 4-2).	0.7
	Inspect motor, clutch assembly, magnet control, and handle housing cover.	1.8
	Service, if needed (para 4-5*c*).	0.3

Section II. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

4-3. Storage Case

Organizational maintenance personnel are authorized to make minor repairs of the storage case, to retouch the paint on the storage case and, when necessary, to thoroughly clean and repaint the case.

a. Paints To Be Used. Use synthetic paint primer and synthetic gloss enamel. (Refer to TM 43-0139 for painting instructions.)

(1) *Primer.* Paint all exposed exterior surfaces with one coat of primer.

(2) *Enamel.*

(*a*) Paint the storage case with yellow gloss enamel color number 13655.

(*b*) Paint radiation symbols (3, fig. 1-2) and eliptical DANGER Warning backgrounds (5) with magenta (purple) gloss enamel color number 17142.

(*c*) Paint the word DANGER on the eliptical DANGER Warning backgrounds with white gloss enamel color number 17875.

(*d*) Paint the words RADIOACTIVE MATERIALS underneath the radiation symbols with black gloss enamel color number 17038.

b. Identification Plate. If the identification plate (fig. 5-1) is bent or twisted, remove the plate from the storage case and straighten it. Secure the repaired plate to the cover of the storage case.

4-4. Radioactive Source and Shield Assembly (Lockbar)

a. General. Organizational support maintenance personnel are authorized to repair, replace, and manufacture a new lockbar, if necessary. If the lockbar (4, fig. 1-4) is bent or twisted out of its original shape, bend or straighten it to its original shape. If the lockbar is damaged beyond repair, or if it is missing, replace it.

b. Description. The steel lockbar (4, fig. 1-4) passes through the handle of the plug and through slots in the

lugs (12) on the shield. The shackle of a combination lock (5) passes through round holes in the bent end of the lockbar and through an adjacent lug and secures the radioactive source in the shield.

c. Inspection. Inspect the lockbar for distortion, cracks, or other damage. Replace, if damaged or missing.

d. Manufacture. Fabricate the lockbar (fig. 4-1).

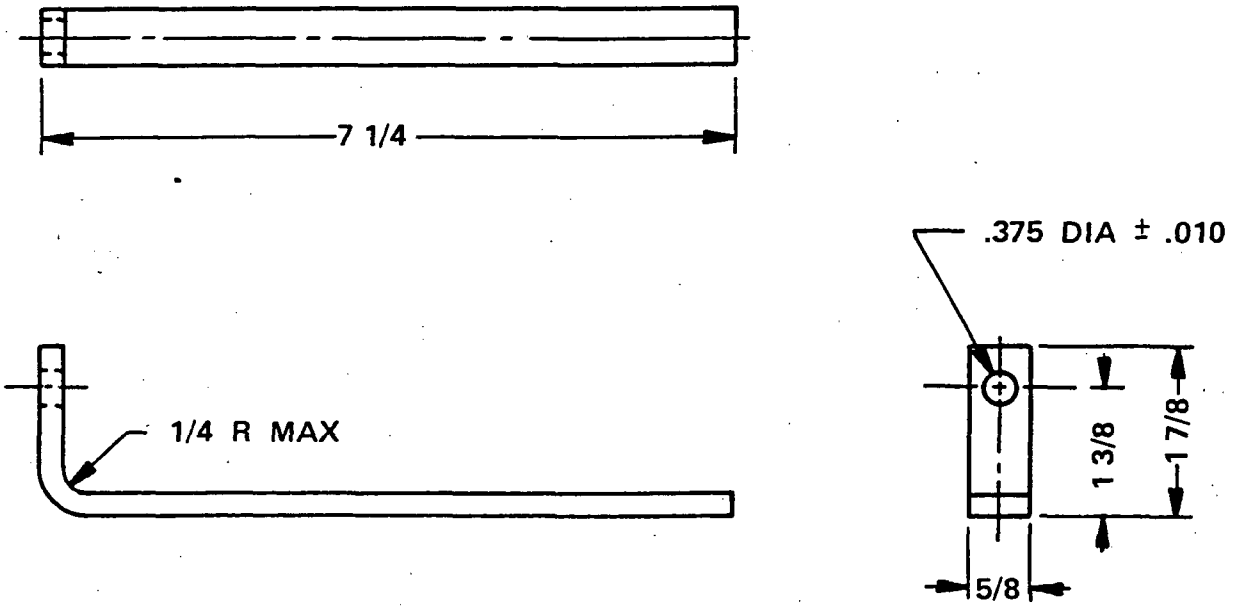


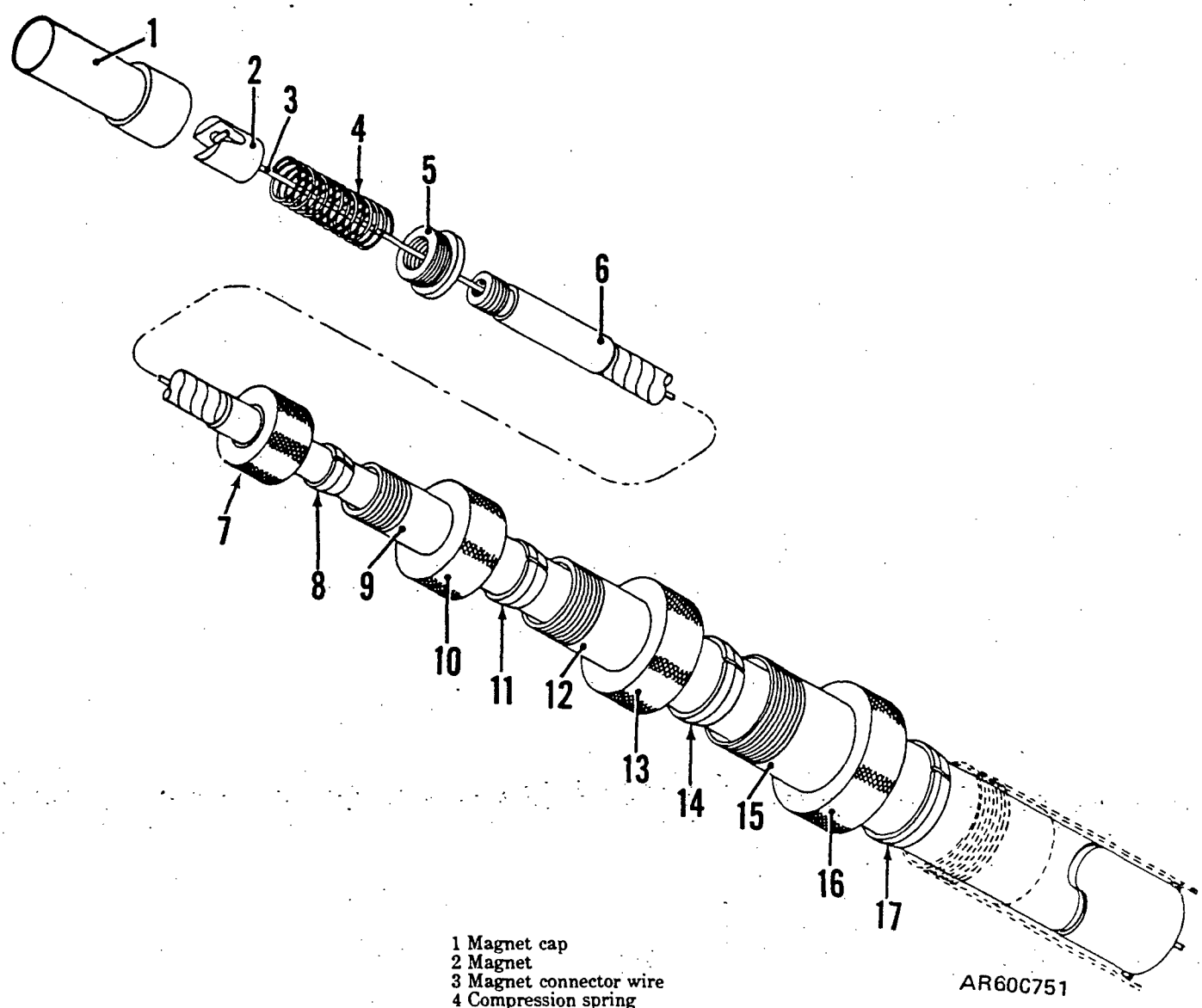
Figure 4-1. Lockbar.

4-5. M4 Telescoping Radioactive Source Magnetic Handler

a. General. The M4 telescoping radioactive source magnetic handler consists of two major groups: the magnet, flexible arm, and extension assembly and the motor and clutch assembly (fig. 4-2) and (fig. 4-3). For purposes of description, the motor and clutch assembly is divided into subgroups and assemblies. Inspection requires at least partial disassembly (para 4-6*b*). Servicing requires complete disassembly (para 4-6*c*).

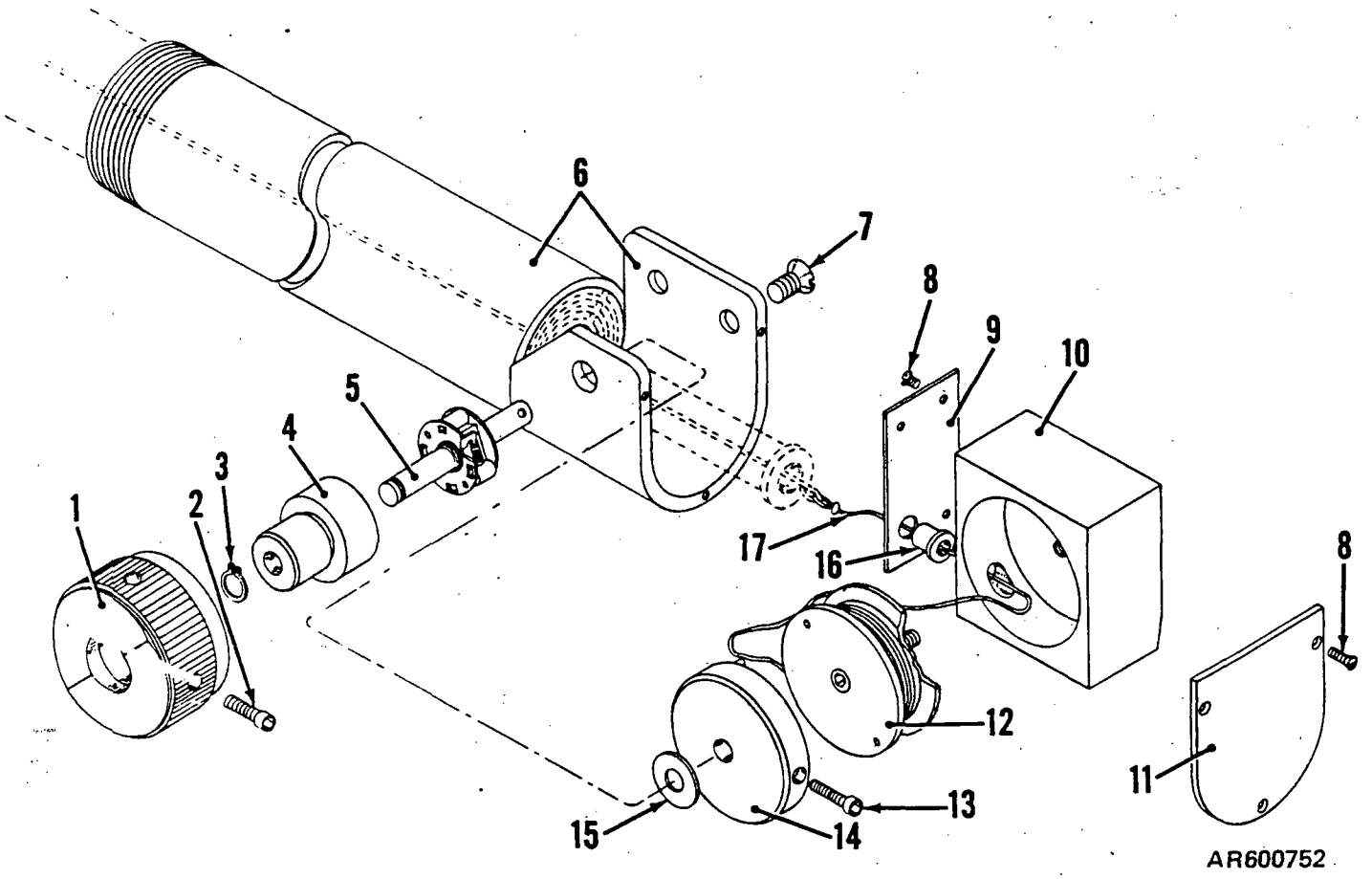
b. Description.

(1) *Magnet, flexible arm, and extension assembly.* The magnet, flexible arm, and extension assembly, from front to back, consists of a magnet cap (1, fig. 4-2), a magnet (2), a magnet connector wire (3), a compression spring (4), an adapter (5), a flexible arm assembly (6), three extensions (9), (12), and (15), four retaining nuts ((7), (10), (13), and (16)), and four split preformed plastic packing rings ((8), (11), (14), and (17)). The back end of the flexible arm assembly and each of the aluminum extensions are flanged so that each can be fitted inside another, to form the telescoping portion of the handler. The tension exerted by the spring motor assembly (12, fig. 4-3) causes the flexible arm assembly and the three extensions to telescope into the tube end of the handle and housing assembly (6). The magnet connector wire connects the magnet with the spring motor assembly. The magnet cap (1, fig. 4-2) fits over the magnet (2) and compression spring (4) and is screwed onto an adapter (5) on the front end of the flexible arm assembly (6).



1 Magnet cap
2 Magnet
3 Magnet connector wire
4 Compression spring
5 Adapter
6 Flexible arm assembly
7 Retaining nut
8 Packing ring
9 Extension
10 Retaining nut
11 Packing ring
12 Extension
13 Retaining nut
14 Packing ring
15 Extension
16 Retaining nut
17 Packing ring

Figure 4-2. M4 radioactive source magnetic handler, magnet, flexible arm, and extension assembly (exploded view).



1 Magnet control knob
2 Setscrew
3 Retaining ring
4 Clutch housing
5 Clutch
6 Handle and housing assembly
7 Screws
8 Screws
9 Bushing retaining plate
10 Spring motor assembly housing
11 Handle housing cover
12 Spring motor assembly
13 Setscrew
14 Clutch adapter
15 Washer
16 Bushing
17 Spring motor cable

Figure 4-3. M4 radioactive source magnetic handler, motor and clutch assembly (exploded view).

(2) *Motor and clutch assembly.* The motor and clutch assembly consists of a spring motor assembly subgroup which is installed in the housing end of the handle and housing assembly (6, fig. 4-3), a handle housing cover (11) which fits over the housing end of the handle and housing assembly, and a magnet control and clutch subgroup which is installed in the clutch adapter (14).

(*a*) *Spring motor assembly subgroup.* The spring motor assembly subgroup consists of a bushing retaining plate (9), a bushing (16), a spring motor assembly housing (10), and a spring motor assembly (12).

(*b*) *Magnet control and clutch subgroup.* The magnet control and clutch subgroup contains a clutch assembly consisting of a clutch housing (4) and a clutch (5), a retaining ring (3) which holds the clutch assembly together, a magnet control knob (1) which fits over the clutch housing, a clutch adapter (14), and a washer (15).

c. Disassembly. Disassemble the M4 telescoping radioactive source magnetic handler only to the extent that it is necessary to make the required service, repair or replacement. With the magnetic handler in the telescoped position, follow the sequence of disassembly as given below.

(1) *Magnet cap, magnet, compression spring, and adapter.*

(*a*) Unscrew the magnet cap (1, fig. 4-2) from the adapter (5).

(*b*) Pull the end of the magnet connector wire (3) approximately 6 inches out from the flexible arm assembly (6) and hold it in position with a pair of pliers.

(*c*) Slide the magnet (2) and compression spring (4) back from the end of the wire.

(*d*) Use a second pair of pliers to straighten the bend at the end of the magnet connector wire.

(*e*) Remove the magnet and compression spring.

(*f*) Unscrew the adapter (5) from the end of the flexible arm assembly (6) and remove the adapter.

(2) *Retaining nuts and packing rings.*

(*a*) Unscrew the four retaining nuts ((7), (10), (13), and (16)) and slide the nuts from the end of the flexible arm assembly.

(*b*) Remove the packing rings ((8), (11), (14), and (17)) from their respective retaining nuts.

(3) *Magnet control clutch subgroup.*

(*a*) Loosen two setscrews (2, fig. 4-3) with a 5/64-inch socket-head screw key and pull off the magnet control knob (1).

(*b*) Loosen setscrew (13) in the clutch adapter (14) with a 1/16-inch socket-head screw key and pull the clutch assembly (para 4-5*b*) from the clutch adapter. Remove the retaining ring (3) from the clutch housing (4) only if the clutch is damaged and in need of replacement.

(4) *Handle housing cover.* Unscrew and remove three screws (8) and remove the handle housing cover (11) from the back of the handle and housing assembly (6).

(5) *Spring motor assembly subgroup and clutch adapter subgroup.*

(*a*) Remove two screws (7) which hold the spring motor assembly housing (10) in position in the housing end of the handle and housing assembly (6).

(*b*) Withdraw the spring motor assembly subgroup (*b*(1) above), the clutch adapter (14), and washer (15) from the handle and housing assembly.

(*c*) Remove the washer (15) and the clutch adapter (14).

(*d*) Lay the spring motor assembly beside the back end of the handle and housing assembly.

(*e*) Insert and fully seat a 1/8-inch socket-head screw key in the hexagonal opening in the top of the spring motor assembly (12). Hold the spring motor assembly to prevent it from rotating when the socket-head screw key is turned.

(*f*) Turn the key counterclockwise to release the threaded end of the spring motor assembly shaft from the threaded hole in the spring motor assembly housing (5½ turns). Do not release the socket-head screw key. Tilt the spring motor assembly so that the shaft does not seat in the threaded opening in the spring motor assembly housing. Slowly release the key to release the spring tension.

(*g*) Pull the magnet connector wire (3, fig. 4-2) from the back of the flexible arm assembly (6).

(*h*) Separate the spring motor cable (17, fig. 4-3) from the magnet connector wire by spreading the loop on the end of the magnet connector and removing the soldered loop at the end of the spring motor cable from the magnet connector wire.

(*i*) Remove the spring motor assembly (12).

(*j*) Remove the three screws (8) from the bushing retaining plate (9) and remove the plate from the spring motor assembly housing (10).

(*k*) Remove the bushing (16) from the bushing retaining plate.

(6) *Flexible arm assembly and extensions.* Withdraw the flexible arm assembly (6, fig. 4-2) and the three extensions (9), (12), and (15) from the back of the handle and housing assembly (6, fig. 4-3). If any of the above components are distorted to the extent that they cannot be withdrawn from the handle and housing assembly, cut just back of the distortion with hacksaw and remove that portion from the front of the handle and housing assembly.

d. Maintenance. After disassembling the M4 telescoping radioactive source magnetic handler as directed in *c* above, inspect the disassembled parts and clean them. Wipe all metal parts with a clean, oily cloth. Replace worn, damaged, or missing parts as authorized in the Maintenance Allocation Chart, Appendix C. Assemble the magnetic handler as directed in *e* below.

e. Assembly.

(1) *Flexible arm assembly and extensions.* Insert the extension (15, 12, and 9, fig. 4-2) and the flexible arm assembly (6) in sequence from the back of the handle and housing assembly (6, fig. 4-3). Make certain that the components are inserted so that they can be extended from the front of the handle and housing assembly.

(2) *Spring motor assembly subgroup.*

(*a*) Insert the bushing (16, fig. 4-3) through the large opening in the bushing retainer plate (9).

(*b*) Place the bushing retaining plate against the side of the spring motor assembly housing (10) so that the bushing fits into the recess in the side of the spring motor assembly housing. Aline the bushing retaining plate with the side of the housing.

(*c*) Fasten the bushing retaining plate (9) to the spring motor assembly housing (10) with three screws (8).

(*d*) Pass the loop end of the spring motor cable (17) from the inside of the spring motor assembly housing through the bushing.

(*e*) Hook the spring motor cable loop to the hook at the end of the magnet connector wire (3, fig. 4-2) and bend the hook to form a loop.

(*f*) Insert the magnet connector wire through the back of the flexible arm assembly (6) and pull the wire about 6 inches out from the front of the flexible arm assembly.

(*g*) Install the retaining nuts and packing rings ((3) below).

(*h*) Install the adapter, compression spring, magnet, and magnet cap ((4) below).

(*i*) Telescope the flexible arm assembly and the extensions and seat the spring motor assembly (12, fig. 4-3) in the spring motor assembly housing (10). Place the threaded shaft of the spring motor assembly over the threaded hole in the spring motor assembly housing. Insert and fully seat a 1/8-inch socket-head screw key in the hexagonal opening in the top of the spring motor assembly and turn the key in a clockwise direc-

tion until the spring motor assembly is fully seated. Withdraw the key.

(*j*) With the fingers rotate the spring motor assembly counterclockwise to take up as much of the spring motor cable slack as possible.

(*k*) Insert and fully seat the 1/8-inch socket-head screw key in the hexagonal opening in the top of the spring motor assembly. Hold the spring motor assembly so that it does not rotate in the spring motor assembly housing, and turn the key eight full turns counterclockwise. This action will release the threaded shaft of the spring motor assembly from the threaded opening in the spring motor assembly housing and put sufficient tension in the spring to take up any remaining slack in the spring motor cable when the key is released ((*l*) below).

(*l*) Seat the threaded shaft of the spring motor assembly over the threaded opening in the spring motor housing and slowly release the socket-head screw key allowing the spring motor assembly to become fully seated in the housing. After the tension on the key has been released, remove the key from the spring motor assembly.

(*m*) Fit the two pins on the bottom of the clutch adapter (14, fig. 4-3) into the two round openings in the top of the spring motor assembly and place a washer (15) over the top of the clutch adapter. Insert the assembled spring motor assembly subgroup into the housing end of the handle and housing assembly (6) so that the bushing (16) is adjacent to the back of the flexible arm assembly.

(*n*) Install the spring motor assembly in the housing end of the handle and housing assembly (6) with two screws (7).

(*o*) Aline the opening in the near side of the handle and housing assembly (6) and the washer and the clutch adapter and install the clutch and magnet control subgroup ((5) below).

(*p*) Attach the handle housing cover ((6) below).

(3) *Retaining nuts and packing rings.*

(*a*) Make sure that each retaining nut is fitted with a packing ring. Packing rings (8, 11, 14, 17, fig. 4-2) are seated in the retaining nuts (7, 10, 13, 16).

(*b*) Slip the retaining nuts with the threaded end toward the back of the magnetic handler over the front of the flexible arm assembly (6). Start with the largest nut (16) and end with the smallest nut (7).

(*c*) Screw but do not tighten nut (16, fig. 4-2) on the threaded end of the handle and housing assembly (6, fig. 4-3). Screw but do not tighten the remaining nuts to the threaded ends of the extensions (15, 12, and 9, fig. 4-2) respectively.

(4) *Adapter, compression spring, magnet, and magnet cap.*

(*a*) Slip the adapter (5, fig. 4-2) over the extended magnet connector wire (3) and screw the adapter on the end of the flexible arm assembly (6).

(*b*) Slip the compression spring (4) over the magnet connector wire.

(*c*) Thread the magnet connector wire (3) through the magnet (2) so that the slotted end of the magnet is toward the front end of the magnetic handler.

(*d*) Using a pair of pliers, bend the end of the magnet connector wire just enough to hold the magnet on the wire.

(*e*) Fit the magnet cap (1) over the magnet and compression spring. Use just enough pressure against the head of the magnet cap to seat the threaded end of the cap on the adapter and screw the cap on the adapter.

(5) *Magnet control and clutch subgroup.*

(*a*) See that the clutch housing (4, fig. 4-3) and the clutch (5) are assembled.

(*b*) Clip a retaining ring (3), if there is none, around the end of the clutch shaft that extends through the top of the clutch housing.

(*c*) Insert the bottom of the clutch shaft through the alined holes in the handle and housing assembly, washer, and clutch adapter ((2)(*o*) above). Rotate the clutch shaft to aline the opening in the shaft with the setscrew opening in the clutch adapter. Tighten the setscrew (13) with a 1/16-inch socket-head screw key.

(*d*) Fit the magnet control knob (1) over the clutch housing (4) and tighten the two setscrews (2) with a 5/64-inch socket-head screw key.

(6) *Handle housing cover.* Attach the handle housing cover (11) to the back of the handle and housing assembly (6) with three screws (8).

Section III. TROUBLESHOOTING PROCEDURES

4-6. Scope

a. This section contains troubleshooting or malfunction information and tests for locating and correcting most of the troubles which may develop in the M3A1 Radioactive Source Set. Each malfunction or trouble symptom for an individual component, unit, or system is followed by a list of tests or inspections necessary for you to determine probable causes and suggested corrective actions for you to remedy the malfunction.

b. This manual cannot list all possible malfunctions that may occur or all tests or inspections, and corrective actions. If a malfunction is not listed (except when malfunction and cause are obvious), or is not corrected by listed corrective actions, you should notify higher level maintenance. Skills and actions required to perform organizational maintenance of the M3A1 radioactive source set are approximately the same as those required to perform direct support maintenance of the

item. The essential difference between the two levels of maintenance is that replacement parts are authorized only to direct support maintenance level.

c. Table 4-2 lists the common malfunction that you may find during the operation or maintenance of the M3A1 Radioactive Source Set or its components. You should perform the tests/inspections and corrective actions in the order listed.

NOTE

Before you use this table, be sure you have performed all normal operation checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 4-2. Troubleshooting Procedures

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
MAGNETIC HANDLER, M4 **FLEXIBLE ARM ASSEMBLY AND EXTENSIONS**
Components cannot be withdrawn from the handle and housing assembly (para 4-5*c*(6)). *a.* Cut just back of distortion with hacksaw. *b.* Remove distorted portion from front of handle and housing assembly. *c.* Insert (assemble) remaining components so that they can be extended from front of handle and housing assembly.

CHAPTER 5
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

5-1. General

Direct support maintenance personnel are authorized to repair and replace the magnet, flexible arm, and extension assembly of the M4 magnetic handler. They are also authorized to repair and replace parts of the motor and clutch assembly. In addition, direct support maintenance personnel are authorized to manufacture a new identification plate, if required, and to perform all maintenance allocated to lower categories of maintenance.

5-2. Identification Plate

a. Description. The brass identification plate (fig. 1-3) is fastened with four screws, one in each corner, to the cover of the storage case. The plate shows the National Stock Number (NSN), replacement date, activity (mCi), manufacturing date, serial number of the radioactive source assembly, Bureau of Explosives Association of American Railroads permit number, and the Nuclear Regulatory Commission license number.

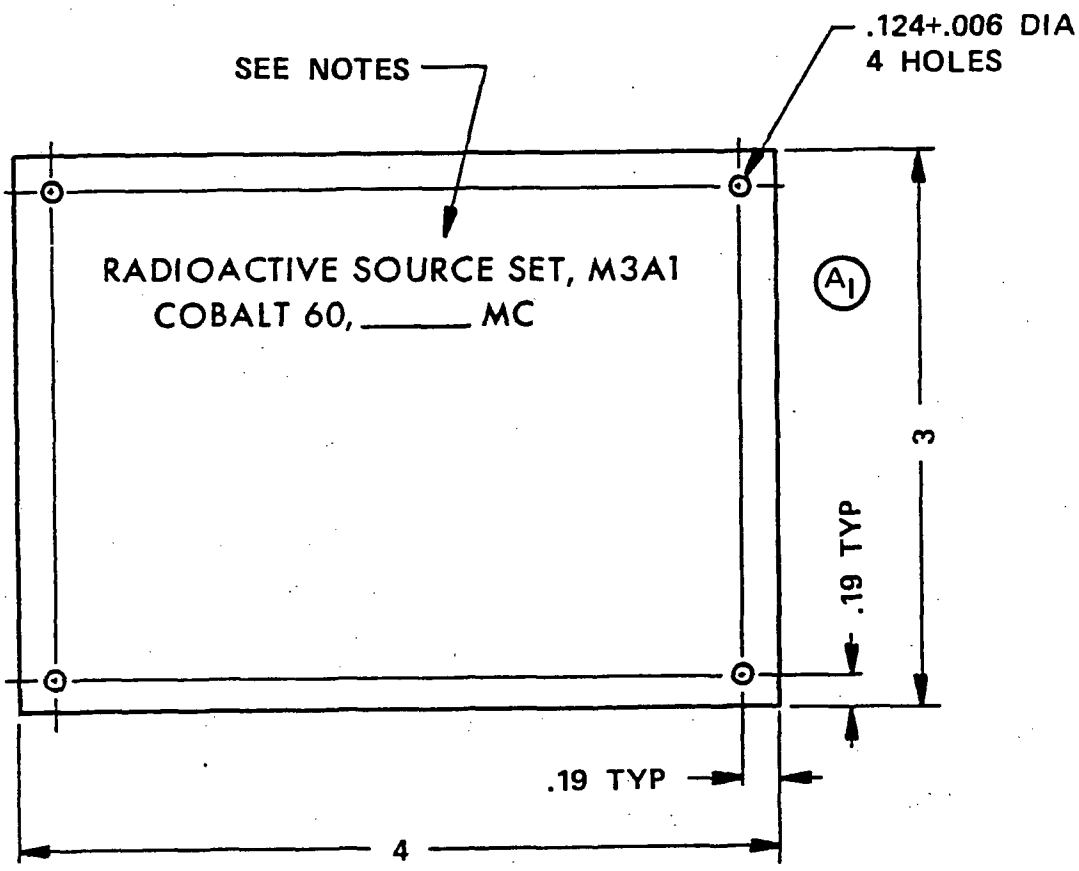
b. Inspection, Manufacture, Removal, and Installation.

(1) *Inspection.* If the identification plate is illegible, damaged beyond repair, or missing, manufacture a new identification plate.

(2) *Manufacture.* Fabricate the identification plate (fig. 5-2).

(3) *Removal.* Remove the four screws, one in each corner, that fasten the identification plate to the cover of the storage case. Lift plate from cover.

(4) *Installation.* Before securing the plate to cover, stamp or engrave the plate with letters approximately one-eighth inch high. Use the correct NSN and nomenclature. Fill in blank spaces with the appropriate information from the cobalt 60 decay chart which is fastened to the inside of the cover of the storage case, or from the shipping document that accompanies the radioactive source set. Fasten the new identification plate to the cover of the storage case.



BRASS STRIP, ALLOY NO. 268 OR 260, ANNEALED TEMPER
.032 NOM STOCK THICKNESS, SPEC QQ-B-613

NOTES:
1. LETTERS SHALL BE ENGRAVED OR STAMPED 1/8 HIGH.
2. MARKING SHALL BE IN ACCORDANCE WITH MIL - STD - 130.
3. THE FOLLOWING ADDITIONAL INFORMATION SHALL BE INCLUDED
   MANUFACTURING DATE _____
   SERIAL NO. _____
   REPLACEMENT DATE _____

NRC LICENSE NO. 19-1826-2

NSN 6665-00-856-8235

AR601247

Figure 5-1. Identification plate (line drawing).

CHAPTER 6
SHIPMENT, STORAGE, AND DISPOSAL

6-1. Shipment

Shipment and transfer of M3A1 radioactive source sets are controlled by the Radiation Protection Officer.

6-2. Storage

a. M3A1 radioactive source sets must be stored only in storage facilities approved by the Radiation Protection Officer, where they are protected against unauthorized removal. Insure that the calibrators are stored in a fire-resistant building and that there are no explosives stored in the same structure.

b. Post the area with CAUTION—RADIOACTIVE MATERIAL signs.

6-3. Disposal

a. Report serviceable unwanted M3A1 radioactive source sets through the radioactive material control point to the national inventory control point (NICP) for disposition instructions.

b. In CONUS, turn in unserviceable M3A1 radioactive source sets for disposal. Forward request for disposition instructions through the radioactive material control point to Commander, Edgewood Arsenal, ATTN: SAREA-TS-MM, Aberdeen Proving Ground, MD 21010.

c. In overseas commands, turn in unserviceable M3A1 radioactive source sets for disposal in accordance with procedures established by the responsible commander.

APPENDIX A
REFERENCES

FM 21-48	Planning and Conducting Chemical, Biological, Radiological (CBR), and Nuclear Defense Training
TB SIG 226-9	Field Expedient for Charging Radiacmeters IM-93/UD and IM-147/PD
TB 43-180	Calibration Requirements for the Maintenance of Army Materiel
TB 750-242-3	Inspection and Certification of Radiac Dosimeters, IM-9( )/PD, IM 93( )/UD, and IM-147( )/PD
TM 3-220	Chemical, Biological, and Radiological (CBR) Decontamination
TM 38-750	The Army Maintenance Management System (TAMMS)
TM 43-0139	Painting Instructions for Field Use

APPENDIX B
ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE REPAIR PARTS LIST

Section I. INTRODUCTION

B-1. Scope
This appendix lists repair parts required for operation and performance of organizational and direct support maintenance of the M3A1 Source Set. It authorizes the requisition and issue of items as indicated by the source and maintenance codes. There are no basic issue items, items troop installed or authorized or special tools applicable to this equipment.

B-2. General
This Repair Parts List is divided into the following sections:

a. Section II. Repair Parts List. A list of repair parts authorized for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending numerical sequence, with the parts in each group listed in figure and item number sequence. Bulk materials are listed in National stock number (NSN) sequence.

b. Section III. National Stock Number and Part Number Index. A list, in ascending numerical sequence, of all NSNs appearing in the listing followed by a list, in alphameric sequence, of all part numbers appearing in the listing. NSNs and part numbers are cross-referenced to each illustration figure and item number appearance.

B-3. Explanation of Columns
The following provides an explanation of columns found in the tabular listings:

a. Illustration. This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration on which the item is shown.

(2) *Item number.* The number used to identify each item called out in the illustration.

b. Source, Maintenance, and Recoverability Codes (SMR).

(1) *Source code.* Source codes are assigned to support items to indicate the manner of acquiring support items for maintenance, repair, or overhaul of end items. Source codes are entered in the first and second positions of the Uniform SMR Code format as follows:

Code	*Definition*
PA	Item procured and stocked for anticipated or known usage.
PB	Item procured and stocked for insurance purposes because essentiality dictates that a minimum quantity be available in the supply systems.
MF	Item to be manufactured or fabricated at the direct support maintenance level.
XB	Item is not procured or stocked. If not available through salvage, requisition.

NOTE

Cannibalization or salvage may be used as a source of supply for any items source coded above.

(2) *Maintenance code.* Maintenance codes are assigned to indicate the levels of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the Uniform SMR Code format as follows:

(*a*) The maintenance code entered in the third position will indicate the lowest maintenance level authorized to remove, replace, and use the support item. The maintenance code entered in the third position will indicate one of the following levels of maintenance:

Code	*Application/Explanation*
O	Support item is removed, replaced, used at the organizational level.
F	Support item is removed, replaced, used at the direct support level.
D	Support items that are removed, replaced, used at depot, mobile depot, specialized repair activity only.

(*b*) The maintenance code entered in the fourth position indicates whether the item is to be repaired and identifies the lowest maintenance level with the capability to perform complete repair. This position will contain one of the following maintenance codes:

Code	*Application/Explanation*
O	The lowest maintenance level capable of complete repair of the support item is the organizational level.
F	The lowest maintenance level capable of complete repair of the support item is the direct support level.
Z	Nonreparable. No repair is authorized.

(3) *Recoverability code.* Recoverability codes are assigned to support items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the Uniform SMR Code format as follows:

Recoverability codes	*Definition*
A	—Item requires special handling or condemnation procedures because of specific reasons (i.e., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.
H	—Reparable item. When uneconomically reparable, condemn and dispose at the general support level.
Z	—Nonreparable item. When unserviceable condemn and dispose at the level indicated in position 3.

c. National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning.

d. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

NOTE

When a stock number item is requisitioned, the repair part received may have a different part number than the part being replaced.

e. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code listed in SB 708-42 which is used to identify the manufacturer, distributor, or Government agency, etc.

f. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

g. Unit of Measure (U/M). Indicates the standard of the basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, ft, sh, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

h. Quantity Incorporated in Unit. Indicates the quantity of the item used in the breakout shown on the illustration figure, which is prepared for a functional group, subfunctional group, or an assembly.

B-4. Special Information

a. Action change codes indicated in the left-hand margin of the listing page denote the following:

N—Indicates an added item

C—Indicates a change in data

b. Detailed manufacturing instructions for items source coded to be manufactured are found in this manual. Bulk materials required to manufacture items are listed in the bulk material group of this appendix.

B-5. How to Locate Repair Parts

a. When National Stock Number or Part Number Is Unknown:

(1) *First.* Determine the functional group within which the repair part belongs since illustrations are prepared for functional groups and listings are divided into the same groups.

(2) *Second.* Find the illustration covering the functional group to which the repair part belongs.

(3) *Third.* Identify the repair part on the illustration and note the illustration figure and item number of the repair part.

(4) *Fourth.* Using the Repair Parts Listing, find the figure and item number noted on the illustration.

b. When National Stock Number or Part Number Is Known:

(1) *First.* Using the Index of National Stock Numbers and Part Numbers, find the pertinent National stock number or part number. This index is in ascending NSN sequence followed by a list of part numbers in ascending alphameric sequence, cross-referenced to the illustration figure number and item number.

(2) *Second.* After finding the figure and item number, locate the figure and item number in the repair parts list.

(Next printed page is B-4)

Section II. REPAIR PARTS LIST

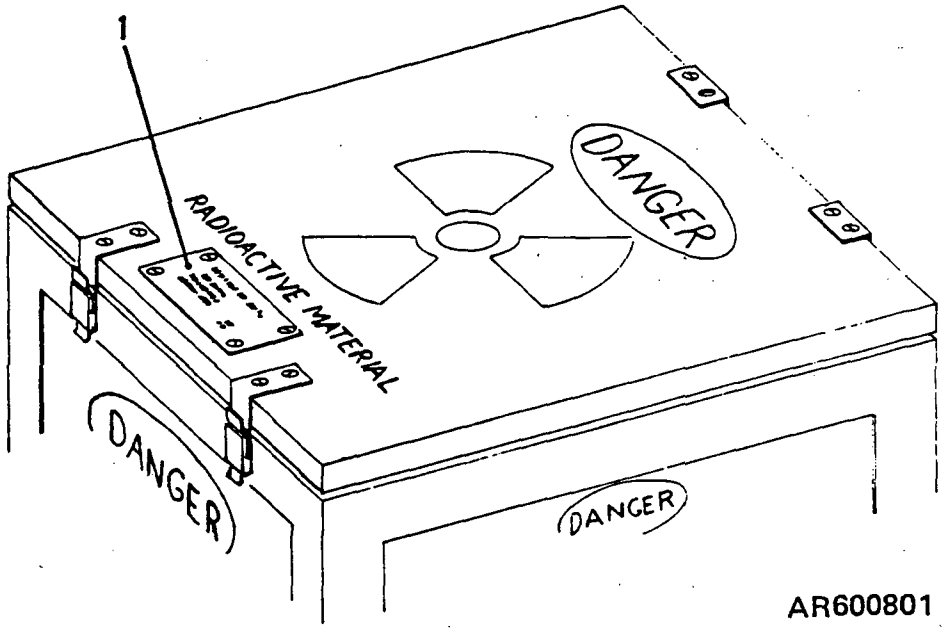


Figure B-1. Storage case.

	(1) ILLUS		(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Fig No.	Item No.	SMR CODE	NATIONAL STOCK NUMBER (NSN)	PART NUMBER	FSCM	DESCRIPTION Usable On Code	U/M	QTY INC IN UNIT
							GROUP 0100 - STORAGE CASE		
C	B-1	1	MFFOZ		B124-10-27	81361	PLATE, IDENTIFICATION: MFD FROM NSN 9535-00-232-6932	EA	1

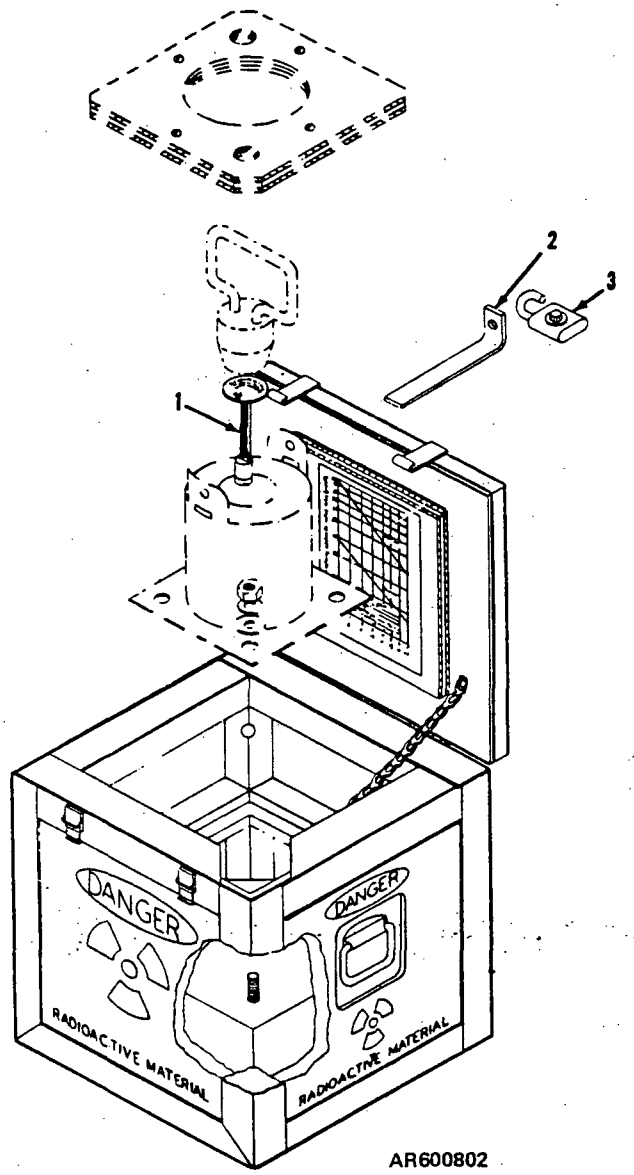


Figure B-2. Source set assembly.

	(1) ILLUS Fig No.	(1) ILLUS Item No.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER (NSN)	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION Usable On Code	(7) U/M	(8) QTY INC IN UNIT
							GROUP 0200 - RADIOACTIVE SOURCE AND SHIELD ASSEMBLY		
C	B-2	1	XBDZA	6665-00-856-8233	C124-10-10	81361	RADIOACTIVE SOURCE ASSEMBLY, COBALT 60: M1A1	EA	1
C	B-2	2	MF00Z		A124-10-9	81361	BAR, LOCK: MFD FROM NSN 9510-00-596-2065	EA	1
N	B-2	3	XBDZZ		K439N	72053	PADLOCK COMBINATION	EA	1

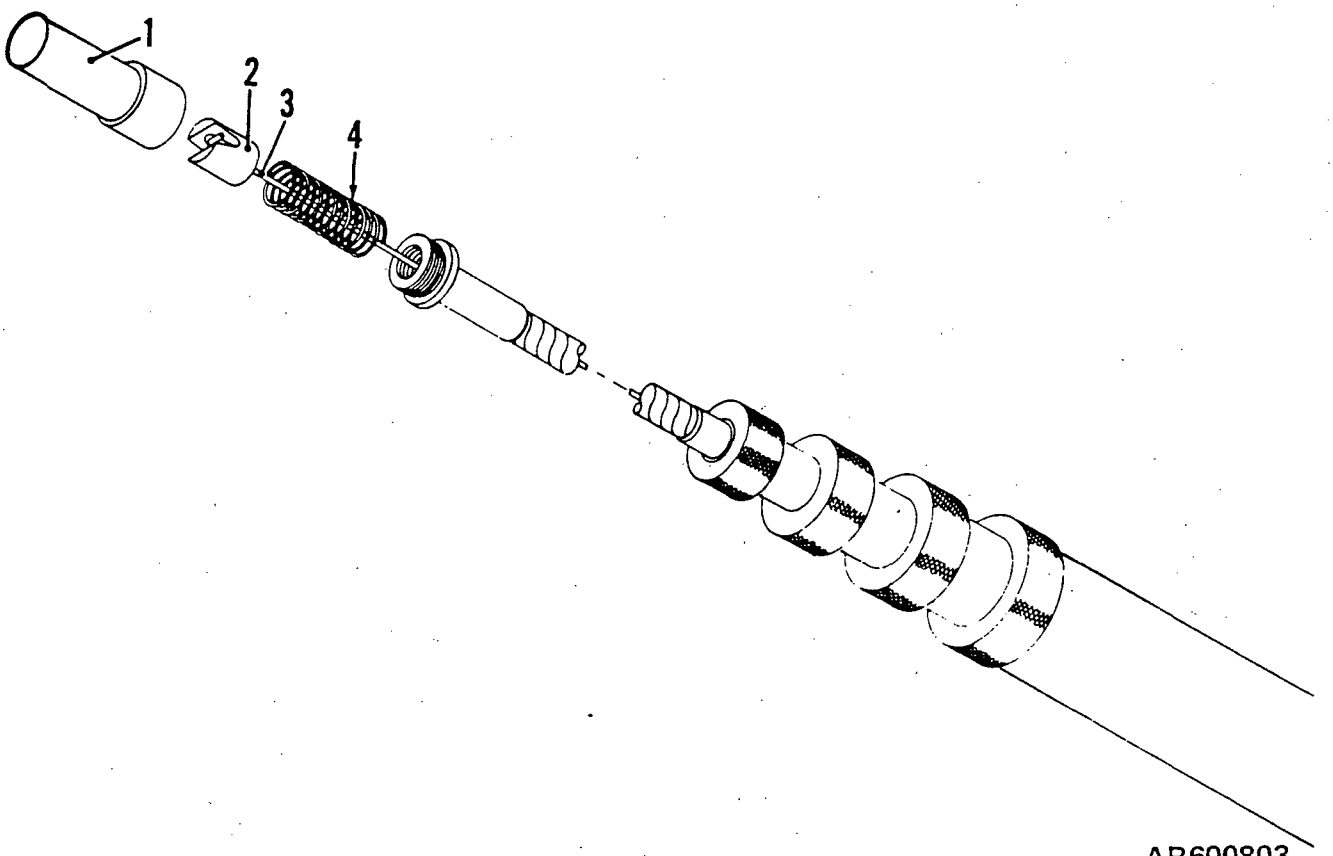


Figure B-3. Magnet, flexible arm extension assembly.

	(1) ILLUS Fig No.	(1) ILLUS Item No.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER (NSN)	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION Usable On Code	(7) U/M	(8) QTY INC IN UNIT
							GROUP 0300 - MAGNETIC HANDLER, M4		
C	B-3		PBOFH	6665-00-856-8234	D124-2-62	81361	MAGNETIC HANDLER, RADIOACTIVE SOURCE, TELESCOPING: M4	EA	1
C	B-3	1	XBFZZ		B124-2-75	81361	MAGNETIC CAP	EA	1
C	B-3	2	XBFZZ		B124-2-77	81361	MAGNET	EA	1
C	B-3	3	PAFZZ	9505-00-060-0882	00W423	81348	WIRE, STEEL, CORROSION RESISTING: RD, 0.063 IN. DIA	IN	18
C	B-3	4	PBFZZ	5360-00-811-9127	B124-2-79	81361	SPRING, HELICAL, COMPRESSION: STL, PLD, 0.046 IN. DIA, 13 COILS, 2 IN. FREE LG, 0.500 IN. FREE OD	EA	1

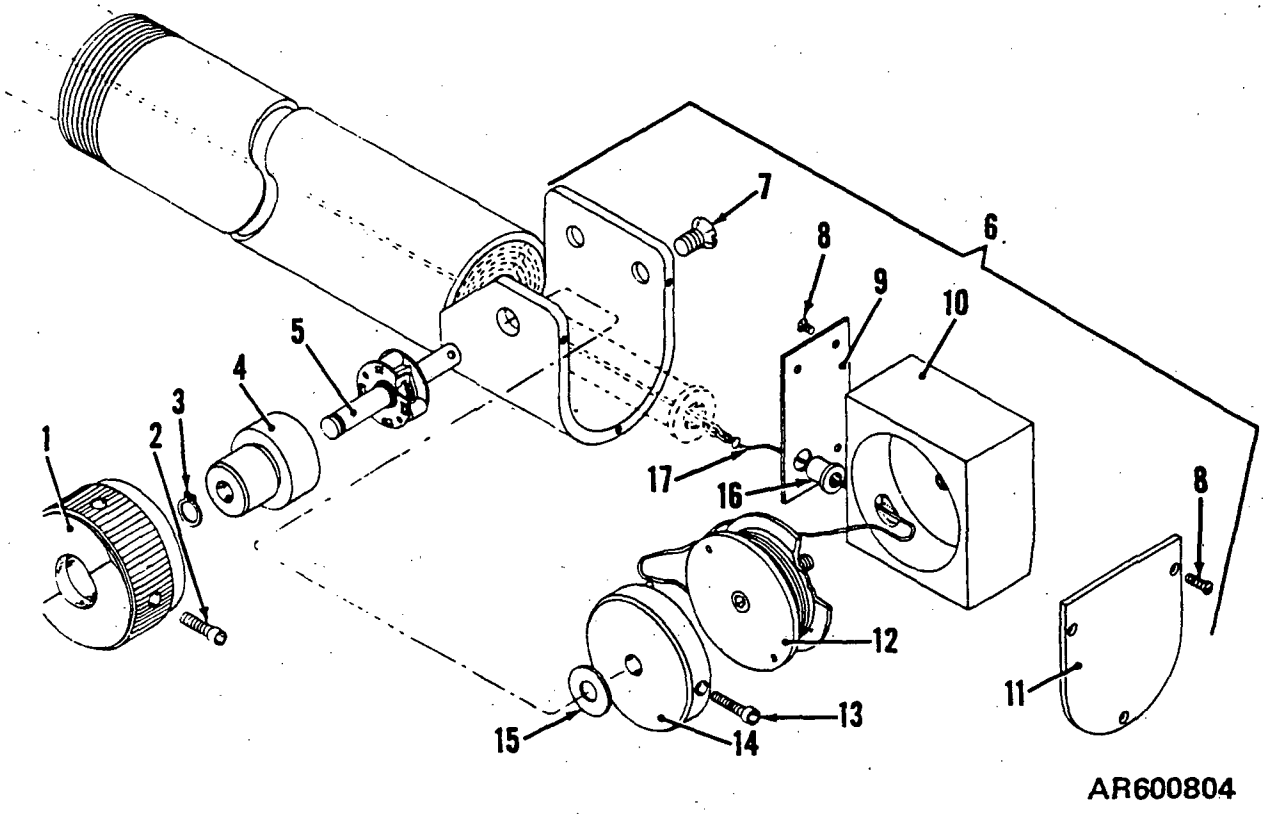


Figure B-4. Motor and clutch assembly.

(1) ILLUS Fig No.	(1) ILLUS Item No.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER (NSN)	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION Usable On Code	(7) U/M	(8) QTY UNIT INC
B-4	1	XBFZZ		B124-2-78	81361	KNOB, CONTROL	EA	1
B-4	2	XBFZZ		MS51030-27	96906	SETSCREW: CRES, HEXAGON SOCKET FLAT PT, #8-32, 1/4 IN. LG	EA	2
B-4	3	XBFZZ		MS16624-4025	96906	RING, RETAINING: CRES, EXT APPLICATION, 0.250 IN. SHAFT SIZE	EA	1
B-4	4	XBFZZ		B124-2-81HSG	81361	HOUSING, CLUTCH	EA	1
B-4	5	XBFZZ		B124-2-81	81361	SHAFT AND ROLLER ASSEMBLY	EA	1
B-4	6	XBFZZ		C124-2-63	81361	HANDLE AND HOUSING ASSEMBLY	EA	1
B-4	7	XBFZZ		MS35202-51	96906	SCREW, MACHINE: AL ALLOY, FLAT CSK HEAD, #10-24, 1/4 IN. LG	EA	2
B-4	8	XBFZZ		MS35218-2	96906	SCREW, MACHINE: AL ALLOY, PAN HEAD, #2-56, 0.187 IN. LG	EA	6
B-4	9	XBFZZ		A124-2-67	81361	PLATE, BUSHING RETAINING	EA	1
B-4	10	XBFZZ		B124-2-73	81361	HOUSING, SPRING MOTOR ASSEMBLY	EA	1
B-4	11	XBFZZ		A124-2-66	81361	COVER		

	(1) ILLUS Fig No.	(1) ILLUS Item No.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER (NSN)	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION Usable On Code	(7) U/M	(8) QTY INC IN UNIT
C	B-4	12	PBFZZ	6665-00-474-7226	C124-2-80	81361	MOTOR ASSEMBLY, SPRING LOADED	EA	1
C	B-4	13	XBFZZ		MS51029-20	96906	SETSCREW: CRES, HEXAGON SOCKET, FLAT PT, #6-32, 3/8 IN. LG	EA	1
C	B-4	14	XBFZZ		B124-2-76	81361	PLATE, CLUTCH	EA	1
C	B-4	15	XBFZZ		MS27183-10	96906	WASHER, FLAT: STL PLD, RD, 0.250 IN. ID	EA	1
							GROUP 0400 - BULK MATERIALS		
NB	ULK		PAOZZ	9510-00-596-2065	QQS634	81348	STEEL BAR: CARBON COLD FINISHED FLAT, 1/4 IN. THK, 5/8 IN. W, 10 TO 14 FT LG	FT	14
NB	ULK		PAFZZ	9535-00-232-6932	QQB613	81348	METAL STRIP: 12 IN. W, 48 IN. LG BRASS, 0.032 IN. THK	SH	1

Section III. NATIONAL STOCK NUMBER AND PART NUMBER INDEX

a. National Stock Numbers.

National Stock Number	Fig. No.	Item No.	National Stock Number	Fig. No.	Item No.
9505-00-060-0882	B-3	3	6665-00-856-8234	B-3	
6665-00-474-7226	B-4	12	9510-00-596-2065	BULK	
5360-00-811-9127	B-3	4	9535-00-232-6932	BULK	
6665-00-856-8233	B-4	2			

b. Part Numbers.

Part Number	FSCM	Fig. No.	Item No.	Part Number	FSCM	Fig. No.	Item No.
A124-10-9	81361	B-2	1	C124-2-63	81361	B-4	6
A124-2-66	81361	B-4	11	C124-2-80	81361	B-4	12
A124-2-67	81361	B-4	9	D124-2-62	81361	B-3	
B124-10-27	81361	B-1	1	K439N	72053	B-2	3
B124-2-73	81361	B-4	10	MS16624-4025	96906	B-4	3
B124-2-75	81361	B-3	1	MS27183-10	96906	B-4	15
B124-2-76	81361	B-4	14	MS35202-51	96906	B-4	7
B124-2-77	81361	B-3	2	MS35218-2	96906	B-4	8
B124-2-78	81361	B-4	1	MS51029-20	96906	B-4	13
B124-2-79	81361	B-3	4	MS51030-27	96906	B-4	2
B124-2-81HSG	81361	B-4	4	QQB613	81348	BULK	
B124-2-81LESSHSG	81361	B-4	5	QQS634	81348	BULK	
C124-10-10	81361	B-2	2	OOW423	81348	B-3	3

APPENDIX C
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

C-1. General

The maintenance allocation chart (sec II) lists the authorized maintenance functions assigned the maintenance categories for maintenance of the M3A1 Radioactive Source Set. This chart is to be used by all levels of maintenance to insure complete support of the equipment.

C-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with standards through examination.

b. Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition; i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisions of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

e. Replace. The act of substituting a serviceable like type part, subassembly or module (component or assembly) for an unserviceable counterpart.

f. Repair. The application of maintenance services or other maintenance actions to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of man-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. This time will be expressed in man-hours and carried to one decimal place (tenths of hours).

e. Column 5, Tools and Equipment. Column five (5) specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Tool and Test Equipment Requirements List. This list identifies all tools and test equipment required for maintenance and repair of the M3A1 Radioactive Source Set as specified in the maintenance allocation chart (MAC). The list gives tool or test equipment reference codes; user maintenance category code; a short description of items required; and National stock numbers. The tool or test equipment code corresponds to the code in column 5 of the MAC. The maintenance category code indicates the level of availability and authorized use. All remaining columns are self-explanatory.

Section II. MAINTENANCE ALLOCATION CHART FOR M3A1 RADIOACTIVE SOURCE SET

(1)	(2)	(3)	(4)					(5)
Group number	Component/Assembly	Maintenance function	Maintenance category* C	O	F	H	D	Tools and equipment
0100	STORAGE CASE	Inspect	0.3					1,2
		Service	0.1 [b]					
		Repair		0.5 [b]				
		Replace [a]			0.8			
0200	RADIOACTIVE SOURCE AND SHIELD ASSEMBLY							
	Radioactive Source Assembly, M1A1	Inspect	0.1					1,2
	Shield Assembly	Inspect	0.3					1,2,3
		Test	0.8					
		Repair [c]		0.3				
		Replace [c]		1.0				
0300	M4 MAGNETIC HANDLER	Inspect [b]	0.3					
	Magnet, Flexible Arm, and	Inspect		0.6				
	Extension Assembly	Repair		0.7 [d]	1.8			
		Replace			1.2			
	Motor and Clutch Assembly	Inspect [b]		1.8				
		Service [b]		0.3				
		Repair			0.8			
		Replace			1.0			

*The subcolumns are as follows:
C—operator/crew
O—organizational
F—direct support
H—general support
D—depot

[a] Manufacture nameplate.
[b] Monthly.
[c] Repair and replacement of lockbar only.
[d] Remove distortion by bending or cutting out segment of arm extension elements.

TOOL AND TEST EQUIPMENT REQUIREMENTS LIST FOR M3A1 RADIOACTIVE SOURCE SET

Tool or test equipment reference code	Maintenance category	Nomenclature	National/NATO stock number	Tool number
1	0	FILM BADGE (Photodosimetry)	See SB 11-206	
2	0	DOSIMETER	6665-00-243-8199	IM-9/PD
3	0	RADIAC SET	6665-00-961-0846	AN/PDR(R)

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PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.
13	1-6	5	
27	2-5a (2)	1	
29	2-5c (2)	1	
33	2-6c (2)	5 9	
38	2-11a (1)	1	

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Delete "and AN/PDR-46".

Reason: Set is obsolete.

Change IM-93 to IM-9.

Reason: The IM93 is a high range (up to 600R) dosimeter. The IM-9 reads up to 200 mR which is more appropriate for radiation protection.

Delete "or an AN/PDR-46".

Reason: Set is obsolete.

Change to: Attn: DRXLY-QCE.
Change to: Attn: DRXSA-CMD-1.

Reason: To correct file symbol for LBAD and to accomodate new name of AMC.

Change last word to: (Fig. 1-5).

Reason: To correct typographical error.

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