RADIAC FILE

RAD SAFE OFFICER

NAVSHIPS 91715

INSTRUCTION BOOK

for

RADIAC SET AN/PDR-18A

TRACERLAB, INC.
130 HIGH STREET
BOSTON 10, MASSACHUSETTS

BUREAU OF SHIPS NAVY DEPARTMENT

JAN 12 1953

TEMPORARY CORRECTION T-1

TO

INSTRUCTION BOOK FOR RADIAC SET AN/PDR-18A (NAVSHIPS 91715)

The Serial Numbers of the equipment covered by this Temporary Correction are: 1 to 4950.

1. A perforated lead screen has been substituted for the fine mesh screen in shutter E-111. Accordingly, substitute the words "perforated lead shield" for "fine mesh screen" throughout the instruction book, as follows:

Page 2-1, paragraph 2a(1), line 21.
Page 2-2, figure 2-2, symbol MS-101.
Page 5-11, figure 5-10, symbol MS-101.
Page 5-12, paragraph 5c, line 3, right column.

2. Insert the following paragraph 2a(5) after 2a(4) on page 2-1:

(5) Gamma radiotion entering photomultiplier tube V-102 is capable of directly producing a small current. This current is negligible for high gamma ray energies, but may amount to as much as 10% of the total current for gamma rays with energies below 200 KEV., when operating on the 0.5, 5.0 or 50 roentgens-per-hour range. On the 500 roentgens-per-hour range, where the light from phosphor E-110 is attenuated by a factor of 10 to 1, the current produced directly in V-102 by the gamma radiation becomes an even larger part of the total current. To minimize this effect a lead tube shield, MS-102, is provided around V-102. Refer to new figure 5-5A below. Lead shield, MS-102, attenuates gamma radiation, especially below 200 KEV. Thus, the current in V-102 produced directly by the gamma radiation is reduced to a negligible port of the total current on all ranges.

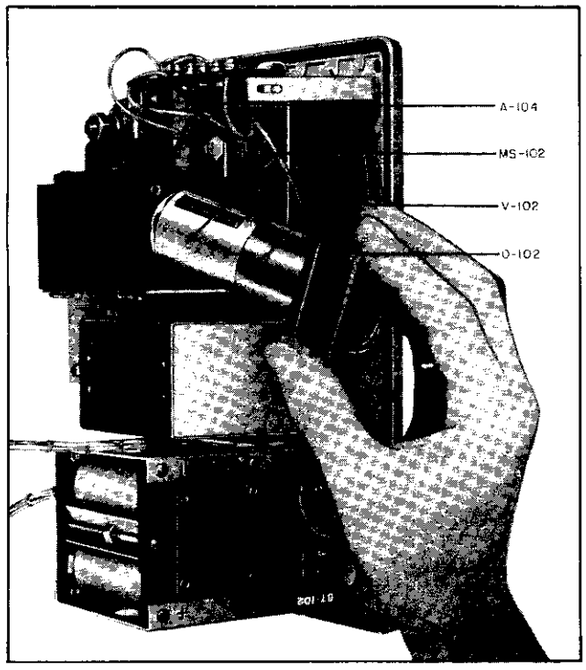

Figure 5-5A
Radiacmeter IM-75/PDR-18A, Rear Side with Photomultiplier Tube Removed.

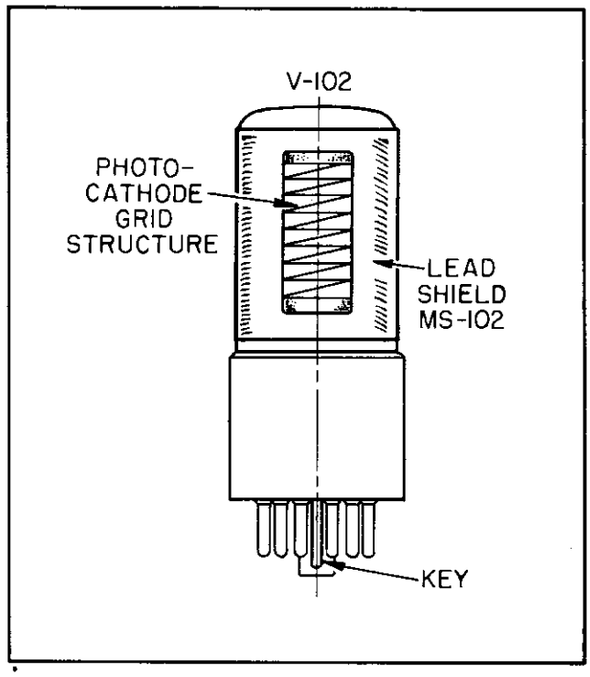

Figure 5-5B
Photomultiplier Tube V-102, Front View Showing Correct Position of Lead Tube Shield MS-102.

3. On page 5-3, paragraph 1f., cross out sentence beginning "Remove photomultiplier tube V-102..." and insert the following sentences:

Remove photomultiplier tube V-102 from sub-assembly O-102. Immerse photomultiplier tube V-102 in acetone to dissolve the cement holding the lead tube shield MS-102 to the glass envelope of the tube. (The cement is localized along the length of the split seam in the lead tube shield E-102). Carefully slide lead tube shield MS-102 off the end of the photomultiplier tube V-102. The shield must be cemented in the same position on a new tube. To do this, first wipe the glass of the new photomultiplier tube V-102 with a clean dry cloth. Apply a thin even coat of rubber-base cement (Minnesota Mining & Manufacturing Co. Cat. No. EC-847 or equiv.) to that glass area of the tube which will be covered by the split seam in lead tube shield MS-102. Allow cement to dry. Coat the inside surface of lead tube shield MS-102 in the vicinity of the split seam with a thin even coat of the same cement. Carefully slide lead tube shield MS-102 over the glass envelope of the new photomultiplier tube V-102 and position it so that the rectangular window in lead shield MS-102 is located directly over the photocathode grid structure in photomultiplier tube V-102 as shown in figure 5-5B. Make sure lead tube shield MS-102 fits snugly around the glass of photomultiplier tube V-102, without any wringles in the lead. Wipe off any excess cement. Apply a rubber band to hold lead tube shield MS-102 in place and allow cement to dry thoroughly. Remove rubber band.

4. On Page 5-5, substitute new figure 5-5A on T-1 page 1 for figure 5-5. Add figure 5-5B shown on T-1 page 1.

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5. On page 6-7, in TABLE 6-4, TABLE OF REPLACEABLE PARTS, REF. DESIGN. MS-101, change the entry under NAME AND DESCRIPTION to read:

SHIELD, radiac detector: lead; curved rectangle; 1-7/32" lg., 1-1/8" dia., .020" thk. approx.; adhesive mounted; rectangular opening 1/2" x 1"; for reference only. Manufacturer and manufacturer's designation, TL, 47-A102345A; contractor's drawing and part number, 47-A102345A.

6. On page 6-7, add the following entry to TABLE 6-4, TABLE OF REPLACEABLE PARTS, following REF. DESIGN. MS-101:

REF. DESIGN.	STOCK NOS. SIG. CORPS. NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTION
MS-102		SHIELD, radiac detector: lead, split cylinder; 1-7/16" lg., 1-1/8" dia., .020" thk. approx; adhesive mounted; rectangular opening, 1/2" x 1". Manufacturer and manufacturer's designation, TL, 47-A102346A; contractor's drawing and part number, 47-A102346A.	Gamma ray shield for photomultiplier tube V-102; mounts on tube envelope by adhesive cement.

7. On page 6-13, add the following entries to TABLE 6-4, TABLE OF REPLACEABLE PARTS, following REF. DESIGN. R-135D:

REF. DESIGN.	STOCK NOS. SIG. CORPS. NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTION
R-135E	N16-R-51245-811	Same as R-104	Same as R-135A
R-135F	N16-R-51281-811	Same as R-113	Same as R-135A
R-135G	N16-R-51236-811	Same as R-109	Same as R-135A
R-135H		RESISTOR, fixed: composition; 11 megohms ±5%; 1/2 watt, "F" characteristic; .175" diam. x .406" lg. max.; insulated, moisture resistant; two wire leads. JAN and Navy type number, JAN, RC20BF116J; manufacturer and manufacturer's designation, IRC, Type BTS 1/2; contractor's drawing and part number. R116-1.	Same as R-135A

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TRACERLAB, INC.
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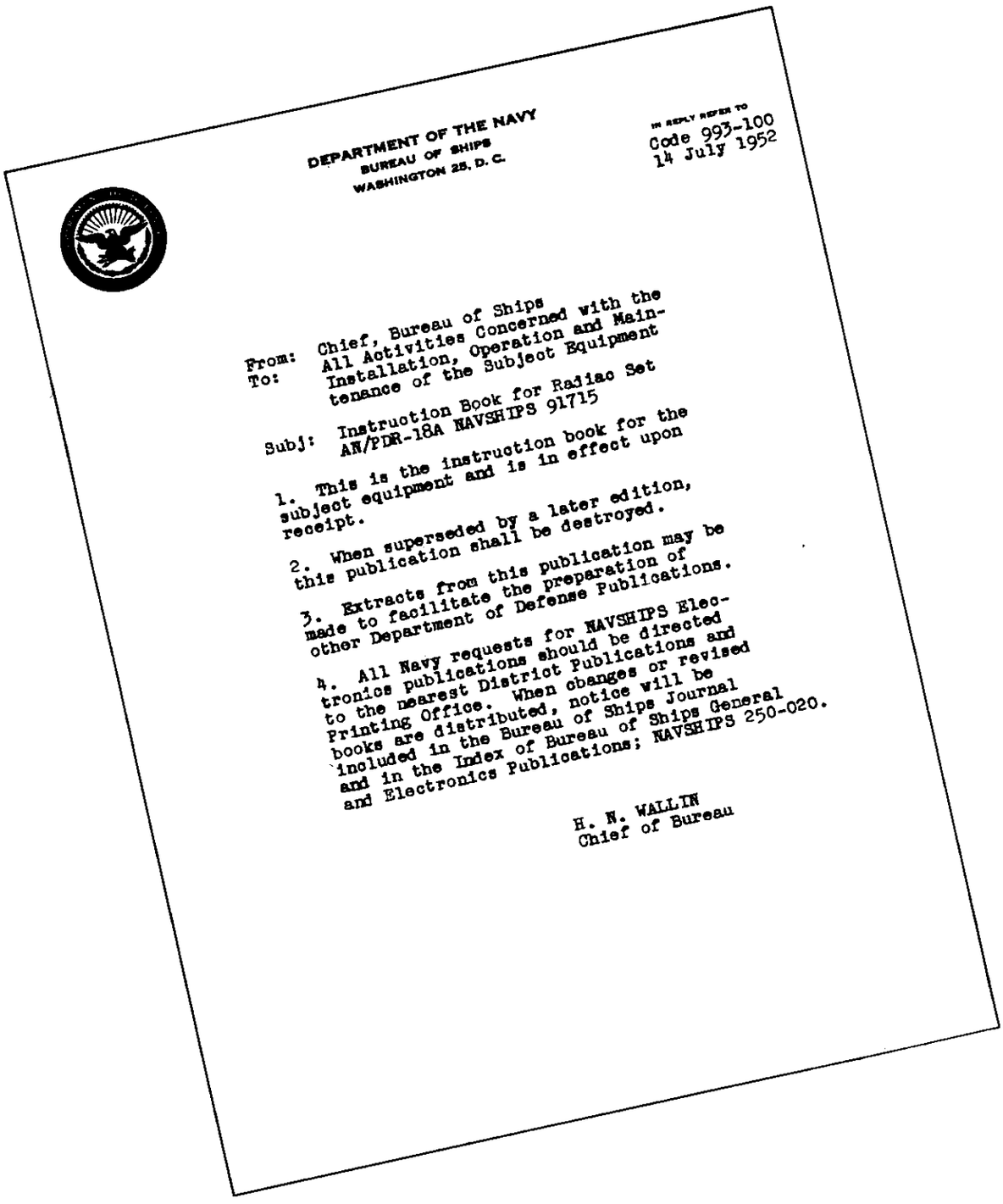
BUREAU OF SHIPS NAVY DEPARTMENT

Contract: NObsr-52283 *Approved by BuShips: 14 July 1952*

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	3-1	Original
A to C	Original	4-0 to 4-1	Original
i to v	Original	5-0 to 5-15	Original
1-0 to 1-3	Original	6-0 to 6-17	Original
2-0 to 2-4	Original	i-0 to i-5	Original



DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
14 July 1952

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Radiac Set AN/PDR-18A NAVSHIPS 91715

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships General and Electronics Publications; NAVSHIPS 250-020.

H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed to be free from any defects in material or workmanship for a period of one year from the date of delivery of the equipment to and acceptance by the Government. Notice of any such defect shall be given by the Government to the Contractor within one year of the delivery of the defective item. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective item or part thereof; provided that the defect is not the result of normal expected shelf life deterioration. When this correction or replacement requires transportation of the item or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This guarantee shall then continue as to corrected or replaced items or, if only parts of such items are corrected or replaced after the date of redelivery. If the Government does not require correction or replacement of a defective or non-conforming item, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the item as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number NObsr–52283 Date of Contract: 26 February 1951

Serial Number of equipment .....

Date of acceptance by the Navy .....

Date of delivery to contract destination .....

Date of completion of installation .....

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "Date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised). The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the *Bureau of Ships Manual* or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available, the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections or electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the *Bureau of Ships Manual* or superseding instructions on the subject of radio-safety precautions to be observed.

RADIOLOGICAL SAFETY WARNING

All personnel working in high intensity levels of radioactivity must exercise caution to prevent bodily damage. While the radiation from radioactive substances cannot usually be seen or felt, prolonged or intensive exposure may result in serious damage. One-tenth of a roentgen per day (.1 R/day) is considered to be the maximum amount of such radiation which can be absorbed continuously, every day, without serious damage.

If a radioactive source is required for calibration of the instrument described herein, due care must be exercised in handling it. The safety instructions enclosed herein, and with the source, must be closely followed.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

Radio Activity Detection Identification and Computation

DEFINITIONS OF RADIOACTIVITY TERMS

CHARGER, RADIAC DETECTOR. A device for providing an electrostatic charge to a radiac detector. May include means for measuring the amount of charge.

COMPUTER-INDICATOR, RADIAC. A device which performs the combined function of computing and indicating radiac data.

COMPUTER, RADIAC. A device which receives information from a radiac detector and does one or more of the following: scales, integrates or counts. Does not indicate.

DENSITOMETER. An item specifically designed to measure the density or opacity of material.

DETECTOR-COMPUTER, RADIAC. A device specifically designed to detect and compute radioactivity information.

DETECTOR, RADIAC. A device that is sensitive to radioactivity or free nuclear particles and produces a reaction which can be interpreted or measured by other components.

INDICATOR, RADIAC. A device which displays radioactivity detection, identification or computation information.

RADIACMETER. A device specifically designed to detect and indicate radioactivity. May or may not include radiac computer.

RADIAC SET. All the components and items required for a complete radioactivity detecting and measuring system.

RECEPTOR, RADIAC. All the components and items required to receive, record and/or indicate radioactivity data transmitted by a radiac data transmitting set.

TRANSMITTING SET, RADIAC DATA. All the components and items required to detect radioactivity and transmit radioactivity data as modulation on a carrier.

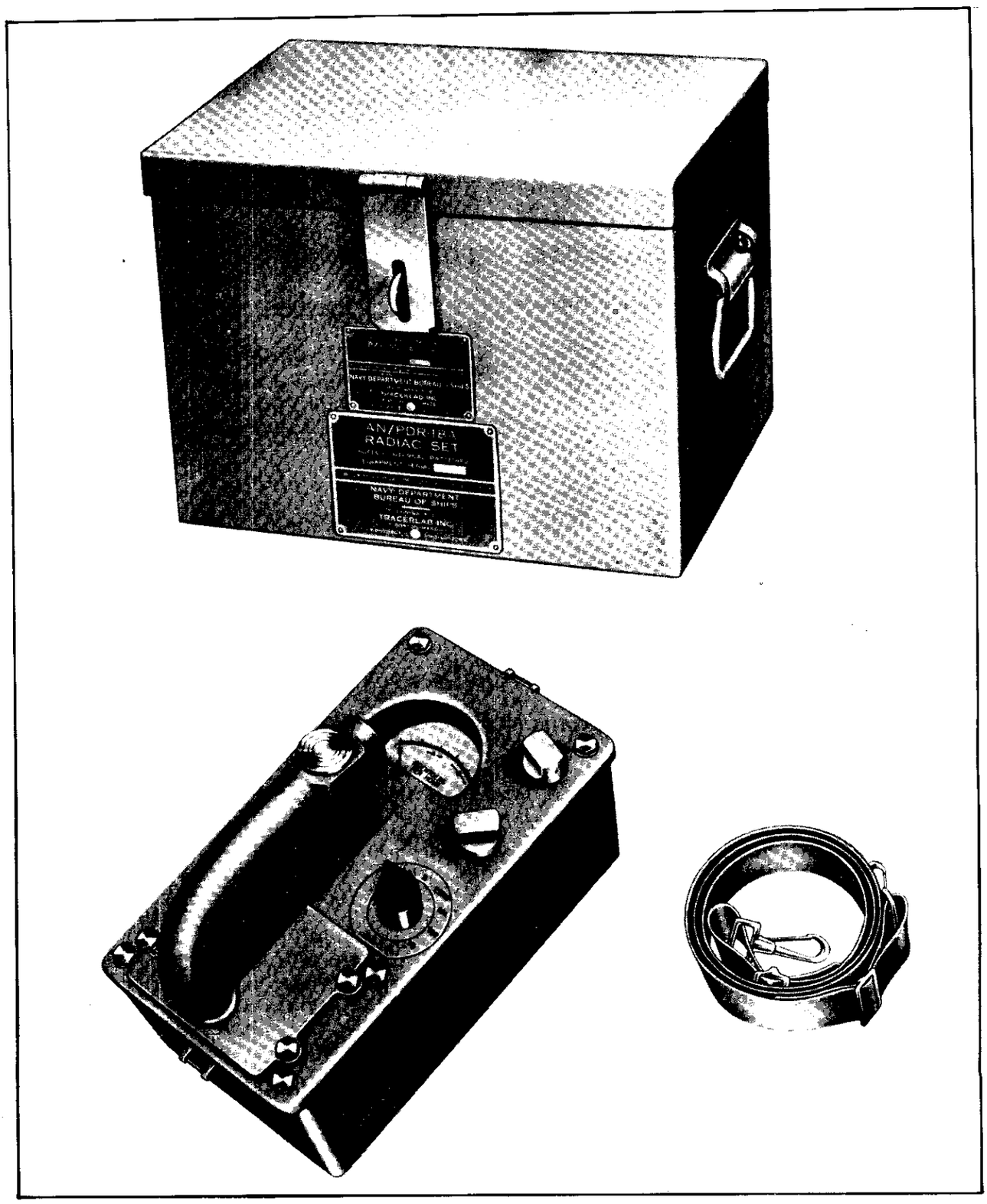


Figure 1–1. Radiac Set AN/PDR–18A

SECTION 1

GENERAL DESCRIPTION

1. INSTRUCTION BOOK COVERAGE.

This instruction book covers the theory, operation and maintenance of Radiac Set AN/PDR–18A. No other models are affected.

2. PURPOSE AND BASIC PRINCIPLES.

The purpose of Radiac Set AN/PDR–18A is to detect and measure high intensity gamma radiation. The detection of gamma radiation is accomplished by means of a sensitive phosphor element. Gamma radiation impinging on the phosphor causes it to fluoresce and illuminate a photomultiplier tube. The d-c output of the photomultiplier tube is directly connected to the grid of a triode cathode follower. The change in plate current of the cathode follower circuit is proportional to the intensity of the gamma radiation being measured, and is indicated on a microammeter that is calibrated in roentgens per hour.

3. DESCRIPTION OF RADIAC SET AN/PDR–18A.

As shown in figure 1–1, Radiac Set AN/PDR–18A consists of Carrying Case CY–1092/PDR–18A and Radiacmeter IM–75/PDR–18A. Carrying Case CY–1092/PDR–18A is fabricated from steel sheet and finished with smooth gray paint. The overall dimensions and weight of Carrying Case CY–1092/PDR–18A are tabulated in Table 1–I in this Section. Carrying Case CY–1092/PDR–18A contains space for Radiacmeter IM–75/PDR–18A and the equipment spare parts for Radiac Set AN/PDR–18A. Radiacmeter IM–75/PDR–18A contains a sensitive phosphor, a photomultiplier tube, a switching circuit for the manual selection of intensity ranges, a cathode follower triode, a microammeter, a vibrator type regulated high voltage power supply, and dry cell batteries. The instrument case of Radiacmeter IM–75/PDR–18A is equipped with a shoulder strap. A handle, located on the front panel as shown in figure 1–1, provides a hand grip for the operator to use when holding Radiacmeter IM–75/PDR–18A in a position where the microammeter can be read. A meter range selector switch is located to the right of the handle on the front panel. A push-button for the control of meter dial illumination is located on the handle. A knob for zero setting the microammeter is located in the upper righthand corner of the front panel, a similar knob is located just above the selector switch on the front panel for the calibration of the microammeter. The meter ranges are 0.5, 5, 50, and 500 roentgens per hour. The meter scales are mechanically changed by the range selector switch so that only the calibration for selected range appears on the dial of the microammeter. To indicate the degree of personal danger, each scale has a different background color. The color of the 0.5 roentgens per hour scale is yellow; the 5.0 roentgens per hour scale is orange; the 50 roentgens per hour scale is pink; and the 500 roentgens-per-hour scale is red.

4. REFERENCE DATA.

a. NOMENCLATURE.
(1) Radiac Set AN/PDR–18A.

b. CONTRACT NUMBER AND DATE.
(1) Basic Equipment Contract No. NObsr–52283, date 26 February, 1951.

c. CONTRACTOR.
(1) Tracerlab, Inc.
130 High Street
Boston 10, Massachusetts

d. COGNIZANT NAVAL INSPECTOR.
(1) Inspector of Naval Material
120 Tremont Street
Boston, Massachusetts

e. NUMBER OF PACKAGES PER SHIPMENT.
(1) The complete Radiac Set AN/PDR–18A, when packed for shipment consists of one package.

f. TOTAL CUBICAL CONTENTS.
(1) The total cubical contents of Radiac Set AN/PDR–18A prepared for shipment is 1.0 cubic foot.

g. TOTAL WEIGHT.
(1) The total weight of Radiac Set AN/PDR–18A prepared for shipment is 33 pounds.

h. POWER SUPPLY.
(1) Six JAN Type BA–30/U or JAN Type BA–2030/U, one and one-half volt dry cell batteries.

TABLE 1–1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	ARMY-NAVY	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
1	Radiacmeter	IM–75/PDR–18A	8⅛	5 5/16	9 3/16	425	
1	Carrying Case	CY–1092/PDR–18A	9⅛	13 5/16	10¼	1250	
1	Carrying Strap	ST–123/PDR–18A		1.5	26 to 40		
3	Allen Wrenches No. 4, 5 & 6 (in case)						
2	Instruction Books						

Unless otherwise stated, dimensions are inches, volume cubic inches, weight pounds.

TABLE 1–2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE	REQUIRED CHARACTERISTICS
6	Battery, dry-cell	BA–30/U	Power Supply	1½ V. each. Use JAN Type BA–2030/U for low temperature operation.
1	Standard Radiation Source		Calibration	Between 10 and 100 millicuries of Radium or Cobalt-60.

TABLE 1–3. SHIPPING DATA

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Radiac Set	AN/PDR–18A	14¾	11½	10¼	1740	33

Unless otherwise stated, dimensions are inches, volume cubic inches, weight pounds.

TABLE 1–4. BASIC SIMILARITIES IN AN/PDR–18 SERIES

MODEL	OPERATING VOLTAGE	MECHANICAL DESIGN	REMARKS
AN/PDR–18	Battery Powered	Portable Intensity Meter IM-68/PDR–18 in Carrying Case CY– /PDR–18.	
AN/PDR–18A	Battery Powered	Radiacmeter IM-75/PDR–18A in Carrying Case CY–1092/PDR–18A.	Same meter range as AN/PDR–18 with similar construction and operation. Circuit and all mechanical details changed.

TABLE 1–5. ELECTRON TUBE AND LAMP COMPLEMENT

UNIT	NUMBER OF TUBES OF TYPE INDICATED						
	1P21	CK522AX					Total No. of Tubes
Intensity Meter IM–75/PDR–18A	1	1					2

SECTION II

THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS.

a. The Radiac Set AN/PDR–18A is a high intensity gamma ray detector using the scintillation detection technique. Basically it consists of a metal shield which passes gamma rays, but holds back beta rays, a phosphor crystal which emits light when excited by radiation, a photomultiplier tube, an amplifying circuit, and an indicating meter. A block diagram of the circuit is shown in figure 2–1.

The instrument case of the Radiacmeter IM–75/PDR–18A does not contain an opening for the emission of radiation to be measured. Consequently, beta radiation is eliminated since only gamma radiation can pass through the wall of the instrument case. Gamma rays from the radiation source cause the stilbene detector E-110 to emit quanta of light directly in proportion to the intensity of the gamma radiation. The light from the phosphor detector E-110 is directed through a mechanically rotated shutter, E-111, to the cathode of the photomultiplier tube, V-102. The shutter E-111 is mechanically linked to the range selector switch so that the various apertures of the shutter can be opened and closed or changed, according to the position of the range selector switch. In addition, when this switch is in the position for calibration of the meter, a radioactive standard source mounted in the first aperture of the shutter E-111, is positioned in front of the phosphor detector E-110.

The light that strikes the cathode of the photomultiplier tube, V-102, develops a d-c voltage proportional in magnitude to the quanta of light radiated from the phosphor E-110. This d-c voltage is applied to a cathode follower circuit where it produces a proportional change in the cathode current. This current is read directly on a microammeter M-101. Hence, the gamma radiation is measured on meter M-101 which indicates directly in roentgens per hour.

b. High voltage for the photomultiplier tube V-102, and plate supply voltage for the cathode follower tube V-101, are developed in the vibrator power supply, E-104. This power supply is a sealed and potted replaceable unit. Primary power for the power supply circuit is supplied by 4, 1.5-volt dry cell batteries.

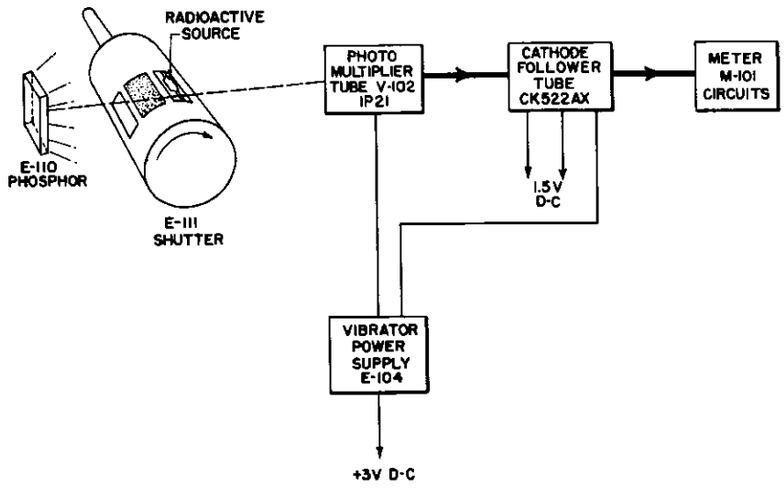


Figure 2–1. Radiacmeter AN/PDR–18A, Functional Block Diagram

2. CIRCUIT ANALYSIS.

a. DETECTOR CIRCUIT.

(1) The gamma radiation detection circuit of the Radiacmeter IM–75/PDR–18A, shown in figure 2–2 consists of a phosphor detector, E-110, a shutter, E-111, including Strontium-90 radioactive calibration source and a photomultiplier tube, V-102. The shutter is a rotatable cylinder surrounding the tube V-102. There are three apertures in the shutter E-111. When the range selector switch S-101 is turned to the CAL position, the shutter E-111 is rotated so that the radioactive calibration source contained in the first aperture is positioned in front of the phosphor detector E-110. The calibration source emits only beta rays which excite the phosphor detector E-110. Light from the phosphor E-110 passes through that part of the aperture of shutter E-111 not occupied by the calibration source and strikes photomultiplier tube V-102. Under this condition the circuit is adjusted for full scale deflection with the CAL control. When the selector switch is at the 500 position the shutter is positioned so that the second or middle aperture, which is covered with a fine mesh screen, is placed between the phosphor detector E-110 and the tube V-102. This screen is necessary to attenuate the light from the phosphor, on the highest range, because it is bright enough to cause a nonlinear response of the photomultiplier tube V-102. In the 50, 5, 0.5 positions of the selector switch, the shutter is positioned so that the third and largest aperture is placed between the phosphor detector E-110 and V-102. Photomultiplier tube V-102 contains a cathode, nine multiplying anodes and one collector anode. The nine multiplying anodes are called dynodes and function as secondary electron emitters. The potential of the cathode is highly negative with respect to ground while each dynode is progressively less negative until the collector is reached, which is practically at ground potential. Light quanta from the phosphor striking the cathode causes it to emit a number of electrons, proportional to the light quanta, in the direction of dynode 1. Since dynode 1 is positive with respect to the cathode, electrons are accelerated towards it. Each electron striking dynode 1 releases a number of secondary electrons which are attracted by another potential gradient to dynode 2, thus multiplying the current. This multiplication is repeated nine times through the dynodes producing a current gain of approximately one million. At the end of the dynode series, the collector anode attracts the electrons. The load resistor for V-102 is selected by section 1 of the range selector switch S-101, as shown in figure 2–2. The values of load resistors R-116, R-117, R-118 vary by a factor of ten as do the meter ranges. The signal voltage across the selected load resistor is applied to the control grid of V-101 which is operated as a cathode follower. Microammeter M-101 reads the change in cathode current resulting from the signal voltage on the control grid of V-101.

(2) The potential difference between each dynode of V-102 is determined by the bleeder resistor network R-101 through R-109, and R-133. A larger potential difference is applied between each of the first five dynodes than between each of the last four dynodes. The signal-to-noise ratio of V-102 is improved when the first few dynode stages are thus operated at a relatively high potential difference. However, such operation also results in increased over-all gain and increased current from collector anode 10. In order to limit the over-all current gain and to limit the maximum collector current to a safe value, a relatively low potential difference is applied between each of the last four dynode stages. Thus, a satisfactory signal-to-noise ratio results at a safe operating current for V-102. The potential difference between each of the first five dynode stages is about 75 volts while that between each of the last four dynode stages is only about 45 volts. The maximum current for collector anode 10 is limited to about 6 microamperes.

(3) Each photomultiplier tube has a different over-all current gain. The over-all current gain is determined by the total operating voltage applied to the cathode and, in proportion, to the various dynode stages. Hence, when changing tube V-102, it may be necessary to vary the total applied voltage in order to bring the current gain to satisfactory operating value. This is done by short-circuiting one or more of the resistors R-110, R-114 and R-115 at points A to D as shown in figure 2–2.

(4) The range of light intensities over which V-102 must operate exceeds the linear portion of its characteristic curve of current vs. light. Non-linearity at high light intensities introduces a serious error. In order to compensate for this characteristic a light attenuating screen is used to admit only one-tenth as much light for the 500 roentgens-per-hour range as is admitted for the 50 roentgens-per-hour range. Shutter E-111 is connected mechanically to the range selector switch S-101. When S-101 is in the 500 position, the middle aperture of shutter E-111 which contains the light attenuating screen, is brought into position between phosphor E-110 and V-102. Load resistor R-116, which is also used for the 50 roentgens-per-hour range, is connected at anode 10.

b. AMPLIFIER-METER CIRCUIT.

(1) The d-c signal voltage developed across the various load resistors R-116 to R-118 by the current from anode 10 of V-102 is applied to the control grid of V-101 which is operated as a cathode follower. The change in cathode current of V-101 in response to the signal voltage on the control grid is read on meter M-101. Refer to figure 2–2. When switch sections S-101D and S-101E are in the position shown two opposing currents flow through meter M-101. One current from the 1.5-volt battery through R-126 is constant and if unopposed would cause the meter needle to deflect up-scale. On the other hand, the sec-

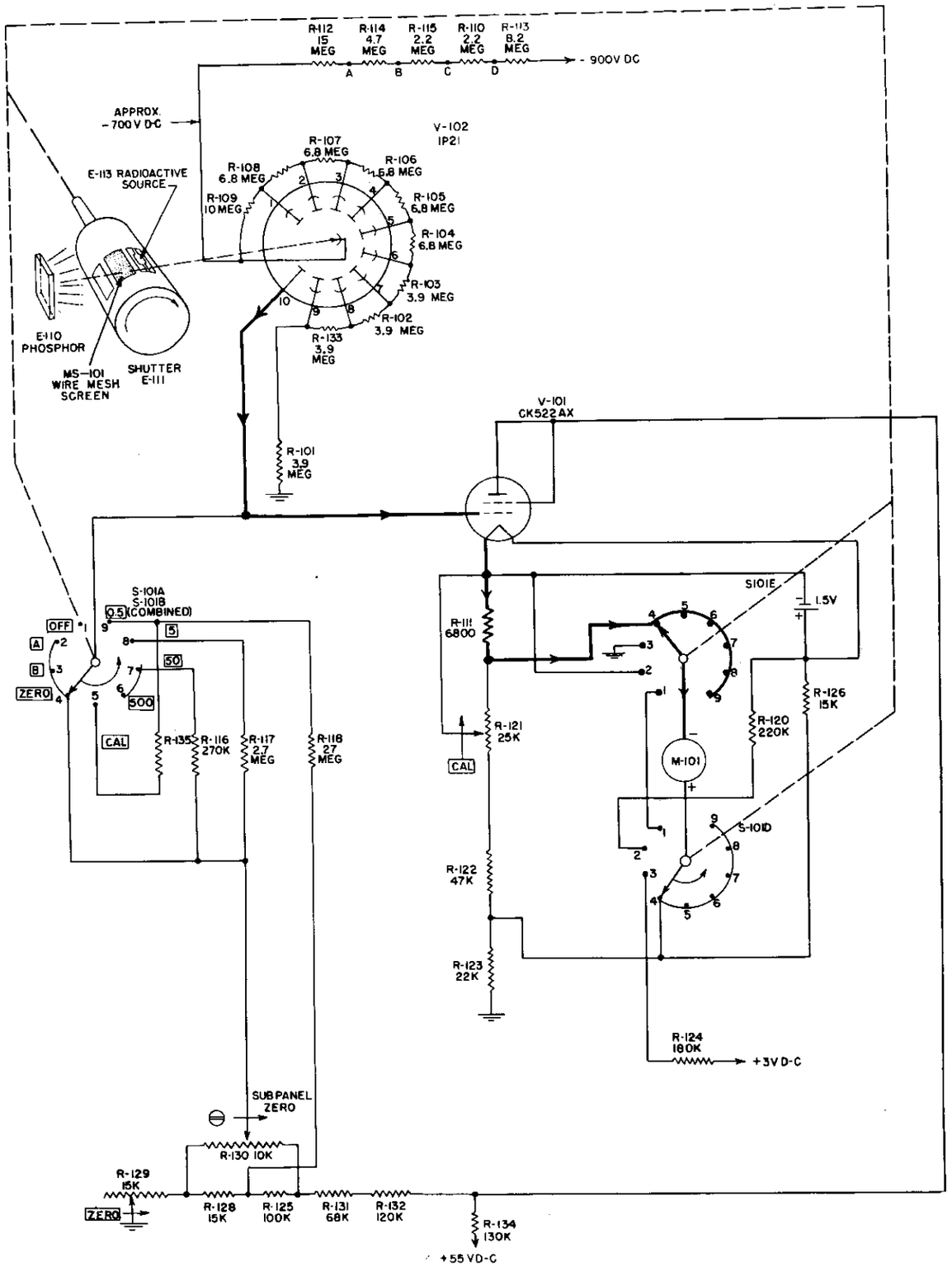


Figure 2–2. Radiacmeter IM–75/PDR–18A, Simplified Schematic Diagram

ond current which is a portion of the cathode current of V-101 through R-111, causes the meter needle to deflect down-scale giving a negative reading. When the two currents are exactly equal the meter reads zero. This is the normal condition with no signal output from V-102. The signal output from V-102 is a negative voltage, which reduces the current in V-101. With a decrease in the current through V-101, the meter needle deflects proportionally up-scale since the bucking current of the battery, which remains constant, causes it to swing in that direction. The observed meter deflection is thus exactly equal to the decrease in the cathode current of V-101, which in turn is directly proportional to the intensity of gamma radiation being measured and is indicated directly in roentgens-per-hour. In addition, the other positions of switch sections S-101D and S-101E provide a system of switching meter M-101 for metering the various ranges, for calibrating and zeroing the instrument, and for reading battery voltages.

(2) Switch sections S-101D and S-101E provide the circuit for calibrating and zeroing of the instrument and for observing the condition of the power supply. Witb sections S-101D and S-101E in the No. 1 or OFF position, the terminals of microammeter M-101 are short-circuited. With switch sections S-101D and S-101E in the No. 2 or A position, microammeter M-101 is connected across the filament supply battery of V-101 through meter multiplier resistor R-120. Thus the V-101 filament supply battery voltage is measured with the range selector switch in the A position. With sections S-101D and S-101E in the No. 3 or B position, microammeter M-101 is connected to ground and to the primary power supply voltage for the vibrator power supply E-104, through meter multiplier resistor R-124. Thus the primary power supply voltage for the vibrator power supply E-104 is read with the range selector switch S-101 in the B position.

(3) When switch sections S-101D and S-101E are in the No. 4 or ZERO position, the terminals of microammeter M-101 are connected across resistors R-121 and R-122 in the cathode circuit of V-101 and remain so connected throughout the remainder of the positions of S-101. In the No. 4 or ZERO position, switch sections S-101A and S-101B remove the load resistor of V-102 and connect the control grid of V-101 directly to the sub-panel zero control R-130. The bias on the control grid of V-101 may then be varied by adjusting the ZERO potentiometer R-129 until a zero reading is obtained on microammeter M-101, indicating that current from the cathode of V-101 just balances the bucking current from the 1.5-volt filament battery through R-126.

(4) With the range selector switch in the CAL position, a radioactive beta ray standard source excites the phosphor detector E-110 causing it to emit approximately the same quanta of light as when exposed to a gamma radiation intensity of 0.5 roentgens-per-hour. The light quanta from phosphor detector E-110 passes through the first or calibrate aperture in shutter E-111 to photomultiplier tube, V-102. The value of R-135 has been selected in manufacture so that the output voltage of the photomultiplier tube, V-102 *exactly* equals the output of the tube when the phosphor E-110 is exposed to a gamma radiation intensity of 0.5 roentgens-per-hour. Under this condition, microammeter M-101 should indicate full scale deflection. Adjustment for the current deflection of microammeter, M-101, may be made by adjusting CAL potentiometer R-121.

(5) Leakage current and thermionic emission from the photocathode comprises a small current through the photomultiplier tube V-102 known as the dark current since it is present even in the absence of light, such as from phosphor detector E-110. This current, which is constant on all ranges, develops a negative voltage across the load resistors R-116 through R-118 exactly as does the signal output current from V-102. The dark current is so small however that it only develops a significant voltage drop when the range selector switch is on the 0.5 or 5 position, where high value load resistances of 27 megohms (R-118) and 2.7 megohms (R-117) are used. With range switch S-101 on position 0.5 the voltage developed across R-118 by the dark current may cause as much as 10% of full scale deflection on meter M-101. Unless compensated for, this dark current causes a false indication of the presence of radiation on the meter M-101. To compensate for the effect of the dark current it is necessary to place a positive bias voltage on the control grid of V-101 exactly equal to the negative voltage developed by the dark current, when range switch S-101 is set at positions 0.5 or 5. The two opposing voltages cancel each other, thereby bringing the reading of meter M-101 back to zero in the absence of any signal voltage from V-102. The necessary positive voltages are taken from a bleeder network across the B+ plate supply for V-101. With S-101 in the 0.5 position the voltage is taken from the junction of R-128 and R-125, and is adjusted by means of potentiometer R-129 until meter M-101 reads zero. With S-101 in the 5 position the voltage is taken from potentiometer R-130 which is also adjusted until the meter M-101 reads zero. No further adjustments are necessary when switch S-101 is in position 50 or 500, since the effect of the dark current is negligible on these ranges.

(6) The dark current for V-102 is also dependent on the ambient temperature resulting in increased dark current at high temperature and vice versa. Such a change in the dark current, if not compensated for, will produce a change in the reading of the meter M-101 with temperature, thereby introducing an error. With switch S-101 on position 0.5 changes in the dark current with temperature are compensated for by means of thermister resistor R-125, which changes in re-

sistance with temperature. As the temperature goes up, the resistance of R-125 decreases, thereby producing a higher positive bias voltage with respect to ground at the junction of R-128 and R-125. This increased bias voltage exactly compensates for the increased negative voltage across R-118 produced by the increased dark current. Thus, the effect of ambient temperature on the dark current is compensated for, within the desired limits of temperature.

c. POWER SUPPLY CIRCUITS.

(1) The power supply circuits of Radiacmeter IM-75/PDR–18A are shown in figure 2–3. High voltage for the photomultiplier tube V-102 and B+ voltage for tube V-101 are supplied by a vibrator power supply, E-104. Power supply E-104 is a hermetically sealed and potted, replaceable unit. Primary power is supplied by four 1.5-volt dry cell batteries connected in series-parallel to yield 3 volts, which is applied at terminal 4 of E-104. The current from the batteries causes the vibrator to alternately open and close its contacts and this in turn causes the current flowing in the primary of the transformer to rise and fall, thereby inducing an alternating voltage in the secondary. The purpose of the .004 uf condenser and 27-ohm resistor is to minimize sparking across the contacts.

(2) The stepped up voltage induced in the whole secondary of the transformer is rectified by the type CK 1027 cold cathode rectifier to supply the high d-c voltage to photomultiplier tube V-102. The output of the CK 1027 rectifier is passed through a 2-section resistance-capacity filter to reduce the ripple voltage. A corona-discharge voltage regulator tube at the output of the filter holds the high voltage constant with any variations in the primary power supply voltage. The high voltage output is — 900V. ± 25 V. D-C.

(3) A portion of the stepped up voltage induced in the secondary is rectified by the selenium rectifier to produce the plate supply voltage for tube V-101. The output of the selenium rectifier is passed through a 2-section resistance-capacity filter to reduce the ripple voltage. A glow-discharge voltage regulator tube maintains the plate supply voltage at the output constant with any variations in the primary power supply voltage. The plate supply voltage output is + 58 ± 5 V. D-C.

(4) Switch section S-101C connects the primary supply voltage to vibrator power supply E-104 for any position of operation except the OFF position. Switch section S-101F connects the filament supply battery to V-101 for any position of operation except the OFF position. Thus, switch sections S-101C and S-101F are the OFF-ON connection for the instrument. Lamp E-105 is an illumination lamp for the meter face. Lamp E-105 is caused to glow when pushbutton switch S-102 is closed.

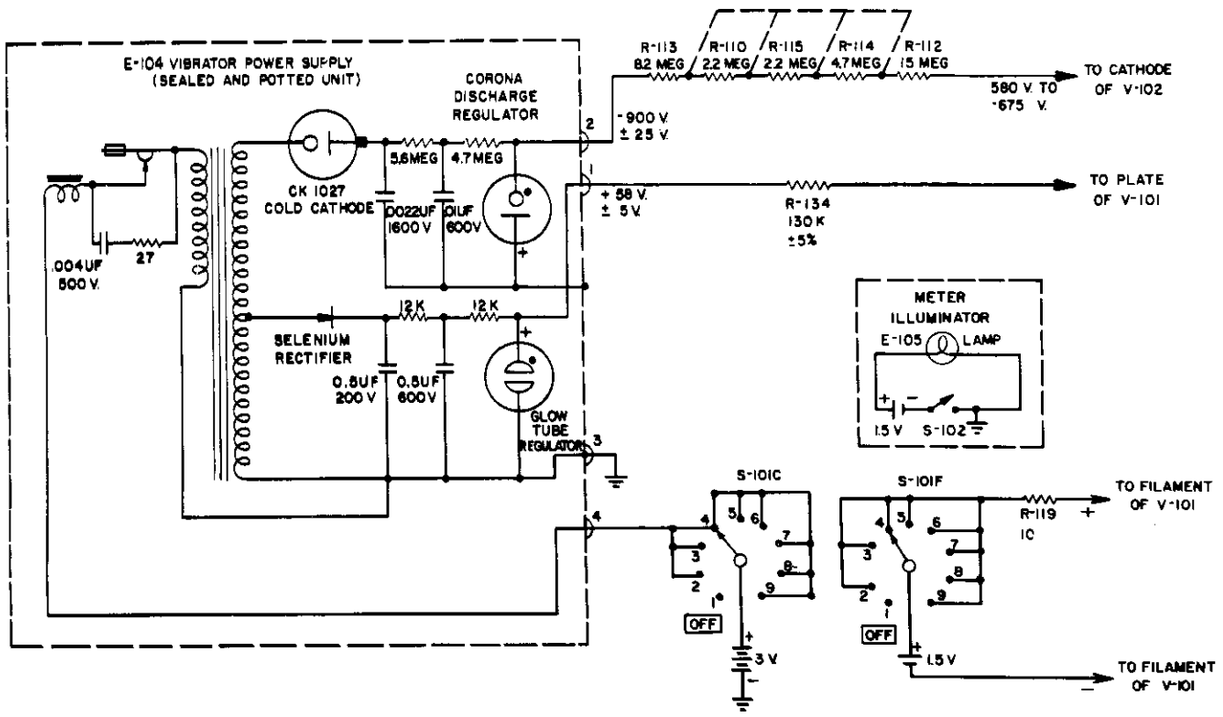


Figure 2–3. Radiacmeter IM–75/PDR–18A, Power Supply Circuits, Simplified Schematic Diagram

SECTION III

INSTALLATION

1. UNPACKING.

a. Unpack the equipment as directed in figure 3–1, following the numbered steps in sequence.

2. INSTALLATION.

a. Radiac Set AN/PDR–18A is a portable unit that requires no interconnection to any additional apparatus. Installation procedure is therefore limited to installing the batteries, and performing a routine check of over-all operation.

b. Install batteries in the battery box as directed in Section V, paragraph 1*b*. A quantity of six JAN type BA–30/U batteries are required.

3. INITIAL ADJUSTMENTS.

In order to check the over-all operation of the equipment after installing batteries, perform the tests directed in Section V, paragraph 1*a*, and in Table 5–1, Routine Check Chart.

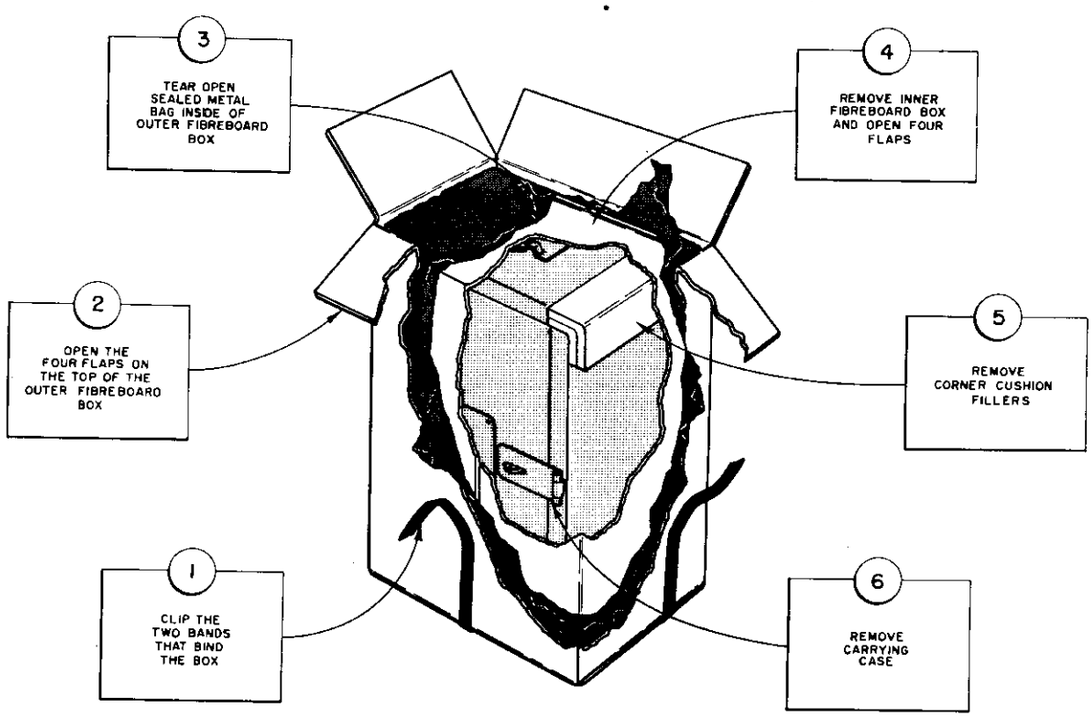


Figure 3–1. Radiac Set AN/PDR–18A, Unpacking Procedure

SECTION IV

OPERATION

1. CAPABILITIES AND LIMITATIONS.

a. The Radiacmeter IM–75/PDR–18A is designed to measure high intensities of gamma radiation. Four ranges of operation are provided: 0.5, 5, 50, and 500 roentgens per hour full scale. Power for Radiacmeter IM–75/PDR–18A is supplied by dry cell batteries. Since the life of these batteries is limited, the Radiacmeter IM–75/PDR–18A should be recalibrated to the internal standard each time it is used. A check of the condition of the batteries should be made at each calibration. The scale of microammeter M-101 for various ranges is colored to indicate the relative danger of the radiation being measured. Thus, the 500 roentgen-per-hour scale is bright red (*mortally dangerous*), the 50 roentgen-per-hour scale is pink (extreme danger), the 5 roentgen-per-hour scale is orange (slight danger), and the 0.5 roentgen-per-hour scale is yellow (negligible).

2. OPERATING CONTROLS.

The operating controls for Radiacmeter IM–75/PDR–18A are shown in figure 4–1.

a. RANGE SELECTOR SWITCH (S-101)—This switch is a nine position switch that is mechanically geared to the meter dial. When the range selector switch S-101 is in the OFF, A, B, ZERO, or CAL position, a plain white dial marked with ZERO, A, B, and CAL shows on the meter face. When the range selector switch S-101 is in the A position, the condition of the filament battery is indicated by the position of the meter needle with respect to the marker A on the meter dial. When the range selector switch S-101 is in the B position the voltage of the primary voltage supplying the vibrator power supply batteries for the vibrator power supply is indicated by the position of the meter needle with respect to the marker B on the meter dial. When the range selector switch S-101 is in the ZERO position, the meter needle may be adjusted to zero with the ZERO control R-129. When the range selector switch S-101 is in the CAL position, Radiacmeter IM–75/PDR–18A may be calibrated by adjusting CAL control R-121 for full scale deflection. The remainder of the positions of range selector switch S-101 provide different dial scales on microammeter M-101 for the different ranges of operation of the Intensity Meter IM–75/PDR–18A. In the 500 position, a red dial face that indicates 500 roentgens-per-hour full scale is shown; in the 50 position, a pink dial face that indicates 50 roentgens-per-hour full scale is shown; in the 5 position, an orange dial face that indicates 5 roentgens-per-hour full scale is shown; and in the 0.5 position a yellow dial face that indicates 0.5 roentgens-per-hour full scale is shown.

b. ZERO CONTROL (R-129) — This control adjusts the needle on microammeter M-101 to zero when range selector switch S-101 is in the ZERO position.

c. CAL CONTROL (R-121) — This control adjusts the needle on microammeter M-101 to full scale when the SELECTOR switch S-101 is in the CAL position.

d. METER ILLUMINATOR SWITCH (S-102) — This switch provides a pushbutton type control for the illumination of the face of microammeter M-101.

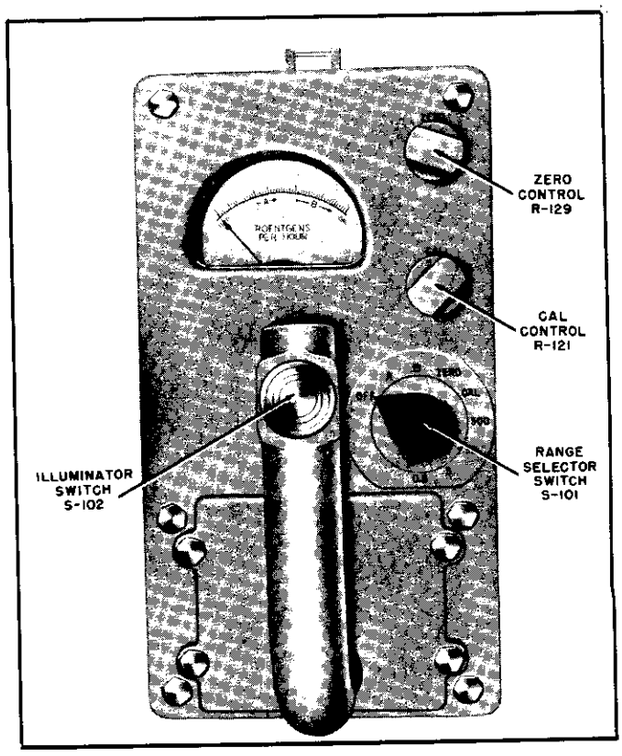


Figure 4–1. Radiacmeter IM–75/PDR–18A, Operating Controls

3. OPERATION.

a. To place Radiacmeter IM–75/PDR–18A in operation, refer to figure 4–1 and turn range selector switch S-101 from the OFF to the A position. The meter needle should be deflected to the right of the marker A on the meter scale. Next, turn range selector switch S-101 to the B position. The meter needle should be deflected to the right of the B marker on the meter face. Turn range selector switch S-101 to the ZERO position and adjust ZERO control R-129 for zero deflection on the scale of microammeter M-101. Turn range selector switch S-101 to the CAL position and adjust CAL control R-121 until full scale deflection is obtained.

CAUTION

When turning the range selector switch S-101 to the CAL position, make sure that the switch shaft is fully engaged in the detent provided for that position. Failure to do this may cause inaccurate calibration when CAL control R-121 is adjusted for full scale deflection.

Turn range selector switch S-101 to the 500 position. Radiacmeter IM–75/PDR–18A is now ready for measuring radiation.

b. The sensitive phosphor in Radiacmeter IM–75/PDR–18A is shielded in such a manner that radiation from any direction causes the same amount of light emission. Place Radiacmeter IM–75/PDR–18A in any convenient position in the field of the radiation to be measured and read microammeter M-101. Full scale deflection represents 500 roentgens-per-hour. If the meter does not show sufficient deflection to read the radiation accurately, shift to the 50 position of range selector switch, S-101. If deflection sufficient for an accurate reading is not yet obtained, continue to reduce the setting of range selector S-101 until a range position is found where a satisfactory reading is obtained.

4. SUMMARY OF OPERATION.

a. Refer to figure 4–1 for the locations of the controls used in the following procedure:

(1) Place range selector switch S-101 in its A position. Meter M-101 should be deflected past marker A.

(2) Place range selector switch S-101 in its B position. Meter M-101 should be deflected past marker B.

(3) Place range selector switch S-101 in its ZERO position and adjust ZERO control R-129 for zero deflection on meter M-101.

(4) Place selector switch S-101 in its CAL position and adjust CAL control R-121 for full-scale deflection on meter M-101.

(5) Turn selector switch S-101 to the desired range (500, 50, 5, and 0.5) and measure the radiation intensity.

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest District Printing and Publications Office.

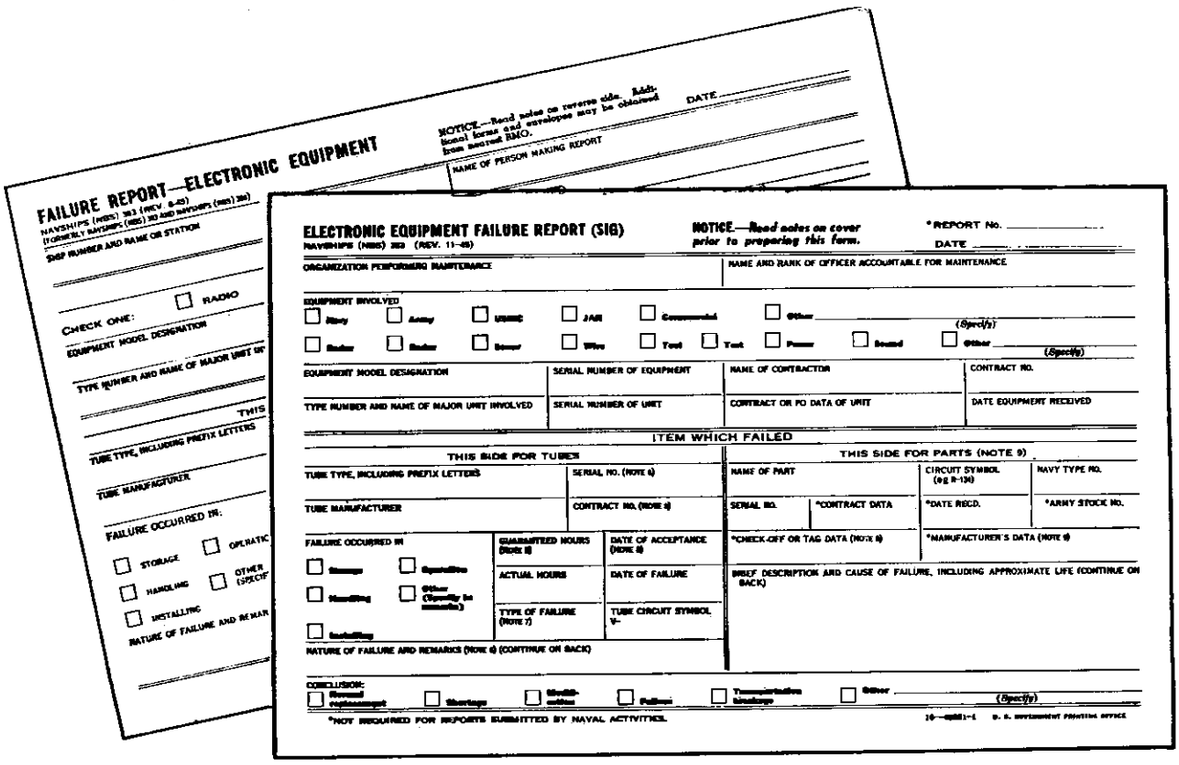


Figure 5–1. Failure Report, Sample Form

SECTION V

MAINTENANCE

1. OPERATOR'S MAINTENANCE.

a. The maintenance procedures described in this paragraph are for use and guidance of operating personnel. They are supplementary to the corrective maintenance procedures that must be performed by the maintenance personnel. Operating personnel should not attempt any extensive or complicated repairs since a high degree of technical skill, knowledge, and experience are required. By means of simple tests and procedure, the operator can perform simple preventive maintenance, and in case of emergencies, effect certain repairs. Routine checks consisting of tests to determine whether the equipment is performing satisfactorily should be made each time the equipment is used. Table 5–1 shows the checks that should be performed. Any maintenance by operating personnel which results from these checks should be limited to the replacement of batteries. Troubles which are not eliminated by the replacement of the batteries should be referred to maintenance personnel.

b. Figure 5–2 shows the method of replacing the batteries in Radiacmeter IM–75/PDR–18A. Loosen the four battery box cover retaining screws, (3/8 in. hex), H-107, which fasten the battery box cover, A-102, to instrument cover, A-101. Remove battery box, BT-101, and place alongside instrument, as shown in figure 5–2. Remove the battery box cover plate, A-108, by removing the cover plate retaining bolt. Remove the batteries from the battery box, BT-101, by inserting a finger in the slot in side plate, A-112, and pushing the batteries, one by one, out of the open bottom of the battery box, BT-101. When replacing with new batteries, JAN type BA–30/U batteries are recommended for replacement purpose. Insert the new batteries in the battery compartment. When inserting the batteries, be careful to observe the specified polarity, which is stamped on the side plates, A-112. Note that the three batteries in the top row, as illustrated in figure 5–2, are installed with their positive terminals on the left side and the three batteries in the bottom row are installed with their positive terminals on the right side. Before replacing the battery box cover plate, A-108, check the battery voltages as described in Table 5–1. If these voltages do not check correctly, first examine for correct battery polarity inside the battery box, and then try different batteries. If the voltages then fail to appear, the set should be referred to maintenance personnel for corrective maintenance.

When reinstalling the battery box, BT-101, in the recess provided in the instrument case cover, A-101, carefully coil the connecting cable in a single vertical loop alongside contact mounting plate BT-103. Do not allow the connecting cable to coil up at the bottom of the recess.

Notice to Operators

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

c. If improper operation of Radiacmeter IM–75/PDR–18A persists after routine checks are made or after the batteries have been replaced, repairs must be made by qualified personnel. However, if emergency conditions exist, certain repairs may be effected by operating personnel not trained in maintenance procedures. These repairs consist of changing the tubes in Intensity Meter IM–75/PDR–18A that are easily replaced, and in replacing Vibrator Power Supply, E-104.

Note

After replacement of tubes or vibrator the equipment should be recalibrated. Any readings taken without recalibration should not be relied upon and should be taken for comparison purposes only.

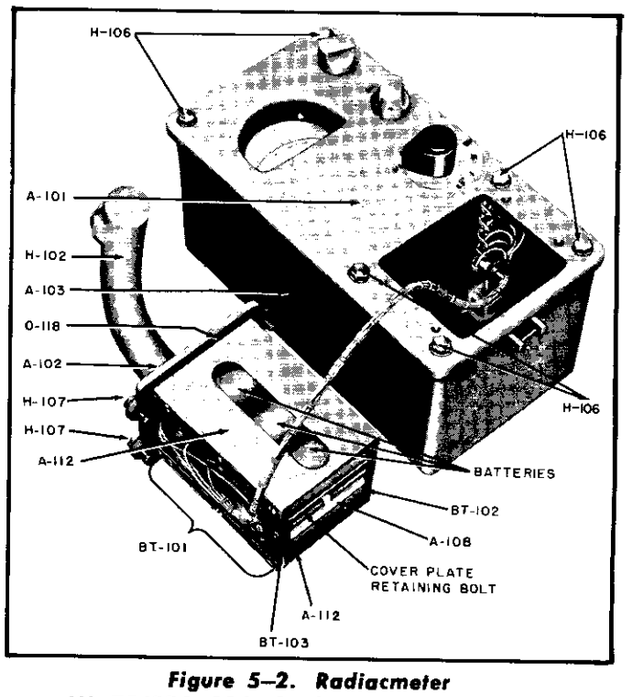
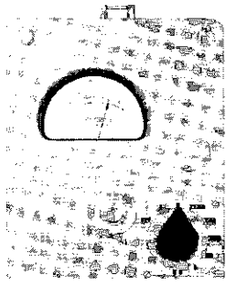
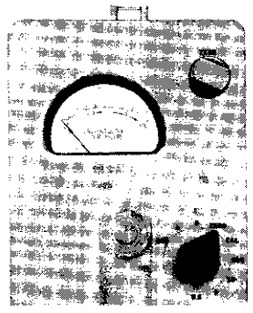
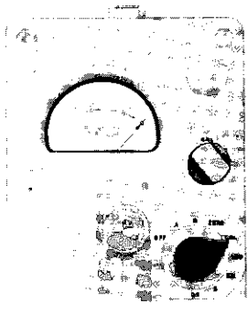


Figure 5–2. Radiacmeter IM–75/PDR–18A, Replacement of Batteries

TABLE 5–1. ROUTINE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS
Filament Battery Voltage 	Range selector switch S-101 in A position. Read microammeter M-101.	Reading should not be to left of A marker.
Vibrator Power Supply Primary Voltage 	Range selector switch S-101 in B position. Read microammeter M-101.	Reading should not be to left of B marker.
Zero adjustment 	Range selector switch S-101 in ZERO position. Read microammeter M-101, adjust ZERO control R-129.	ZERO reading on microammeter M-101 should be obtained.
Calibration adjustment 	Range selector switch S-101 in CAL position. Read microammeter M-101, adjust CAL control R-121.	Set full scale deflection on microammeter M-101. CAUTION: when turning the range selector switch S-101 to the CAL position, make sure that the switch shaft is fully engaged in the detent provided for that position.

A soldering iron is required to replace any tubes, or Vibrator Power Supply, E-104, in Radiacmeter IM–75/PDR–18A.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

d. The replacement of tubes in Radiacmeter IM–75/PDR–18A necessitates removal of the front panel assembly from the instrument case. Refer to figure 5–2 and loosen the six retaining bolts (⅜ in. hex) marked H-106 on the front cover. Make sure that the front panel range selector switch, S-101, is in the OFF position. Lift these bolts up until they reach the stop washer, let them hang to one side, and lift the front panel assembly of Radiacmeter IM–75/PDR–18A out of the instrument case. Place front panel assembly on table top with carrying handle on the bottom as in figure 5–3. The cathode follower tube V-101 is located on terminal board E-101 mounted under the sub-assembly chassis, A-105. Remove the four sub-assembly chassis retaining screws and the meter linkage pivot screw H-109, identified in figure 5–3. Lift the sub-assembly chassis A-105 and swing it back on the hinges in the mounting brackets, A-106, as in figure 5–4. Remove tube V-101 from terminal board, E-101, by removing tube clamp, H-104, and unsoldering the leads. Observe lead connections and position of red dot on base of V-101 carefully. Replace with new type CK522AX tube, with red dot and leads in the same position as old tube.

e. Vibrator power supply E-104 is mounted on sub-assembly chassis, A-105. To replace, remove the panel assembly from the instrument case and swing back the sub-assembly chassis on its hinges, as directed in paragraph 1*d* of this Section. Remove the four hexagonal head retaining nuts on each end of terminal board E-101 and swing it back out of the way. Carefully note color code of each lead connected to the four numbered terminal posts on base of vibrator power supply, E-104, and unsolder leads. Remove the four hexagonal spacing posts, H-113, that anchor vibrator power supply, E-104, to sub-assembly chassis, A-105. Remove vibrator power supply E-104 and replace it with a new unit. Reverse the above procedure to install vibrator power supply E-104. Return sub-assembly chassis, A-105, to its normal position. Replace the sub-assembly chassis retaining screws and the meter linkage pivot screw, H-109.

f. Photomultiplier tube V-102 is mounted in a socket which is part of sub-assembly O-102. To replace V-102, remove the two retaining screws that secure sub-assembly O-102 to the photomultiplier tube housing A-104. Lift the sub-assembly, O-102, away from the housing, A-104, thereby removing photomultiplier tube V-102 from inside the shutter E-111 located inside photomultiplier tube housing A-104. Remove photomultiplier tube V-102 from sub-assembly O-102, and replace it with a new tube. When placing the new tube in the socket, first wipe the pin area, the base and the tube envelope with a dry cloth. When placing photomultiplier tube V-102 in sub-assembly O-102, handle it with a clean dry cloth. Place photomultiplier tube V-102 in sub-assembly O-102 and then place V-102 in shutter E-111. Secure sub-assembly O-102 to housing A-104 with its retaining screws. The replacement of V-102 necessitates an adjustment of the high voltage applied to V-102. For this adjustment refer to paragraph 5*a* of this Section.

g. After replacement of tubes or vibrator power supply E-104, place the front panel assembly of Radiacmeter IM–75/PDR–18A in the instrument case and secure it with retaining bolts. Use care when placing the front panel assembly in the instrument case. Make sure that the cabled power leads are clear of the components on the assembly in order to remove the danger of binding or fraying of the leads, or interference with the meter scale changing mechanism. Make the routine checks listed in Table 5–1.

2. PREVENTIVE MAINTENANCE.

a. The object of preventive maintenance is to anticipate as far as possible the occurrence of troubles and to take steps to prevent them. Preventive maintenance includes periodic cleaning, painting and inspection.

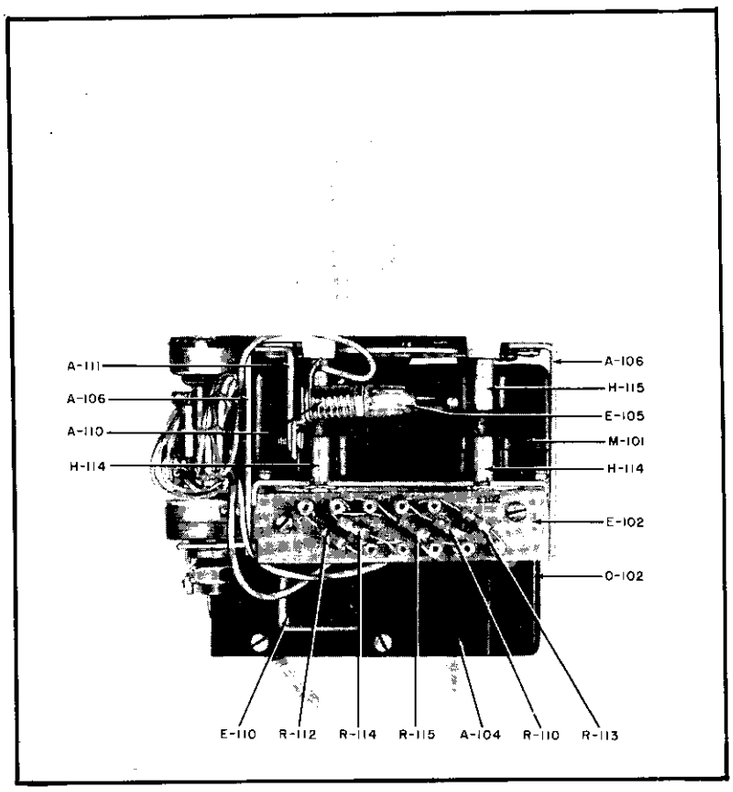
b. The front panel assembly and main housing should be checked for cleanliness and scratches. Any scratches in the paint should be retouched with a brush. The screws that secure the front panel to the instrument case and the screws that secure the battery box assembly to the front panel, should be checked to see that they are tight.

Note

In all cases where the fungus-proofing film is broken during adjustment of the apparatus, recoat the break with fungus-proofing compound, Specification MIL-V-173, by brush application.

3. RETROPICALIZATION.

a. Certain parts in Radiacmeter IM–75/PDR–18A which contain organic materials subject to mold growth are coated with fungus-proofing compound. This compound is subject to deterioration with age and must be renewed every 12 months. To renew this coating, first remove the front panel assembly Radiacmeter IM–75/PDR–18A from the instrument case as directed in paragraph 1*d*. Refer to figure 5–3 and remove the four sub-assembly chassis retaining screws and the meter linkage pivot screw H-109. Refer to figure 5–4 and lift the sub-assembly chassis A-105 and swing it back on the hinges in the mounting brackets, A-106. Clean all surfaces to be coated, using Federal Specification cleaner TT-T-291 or TT-M-95. If perceptible moisture is present, dry Radiacmeter IM–



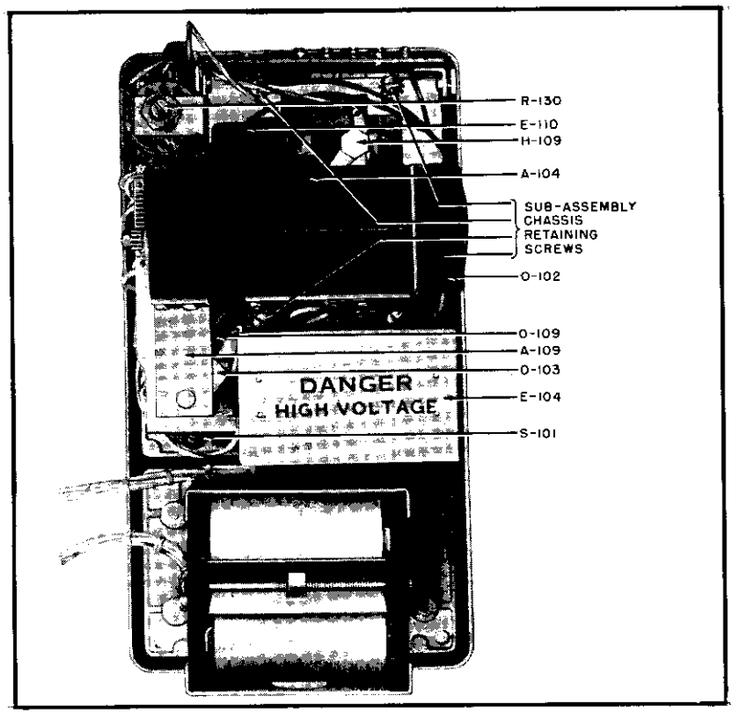


Figure 5–3. Radiacmeter IM–75/PDR–18A, Replaceable Parts on Top and Rear Sides

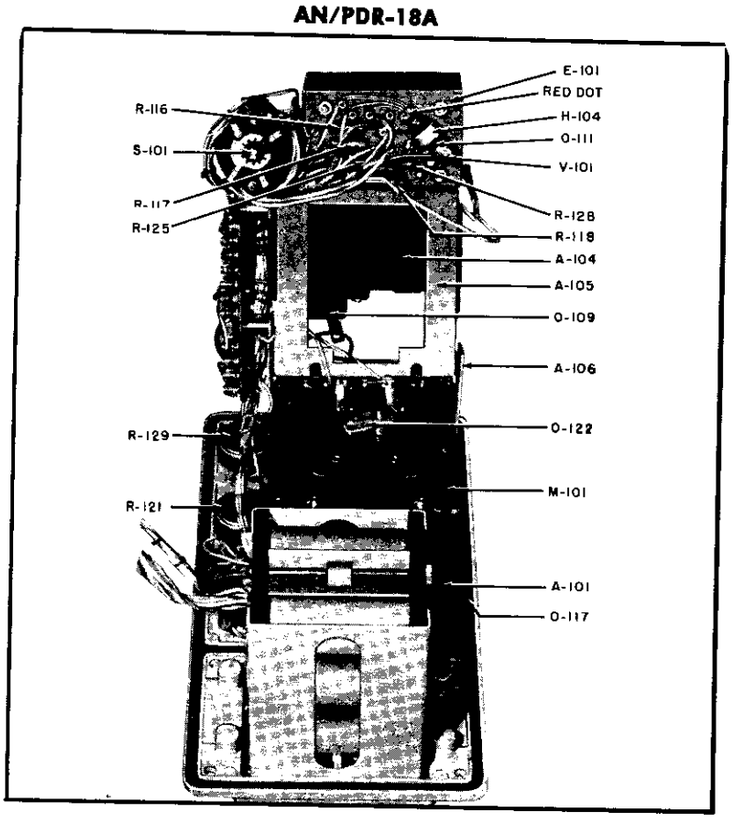


Figure 5–4.
Radiacmeter IM–75/PDR–18A, Sub-Assembly Chassis Swung Back on Hinges, with Replaceable Parts Identified

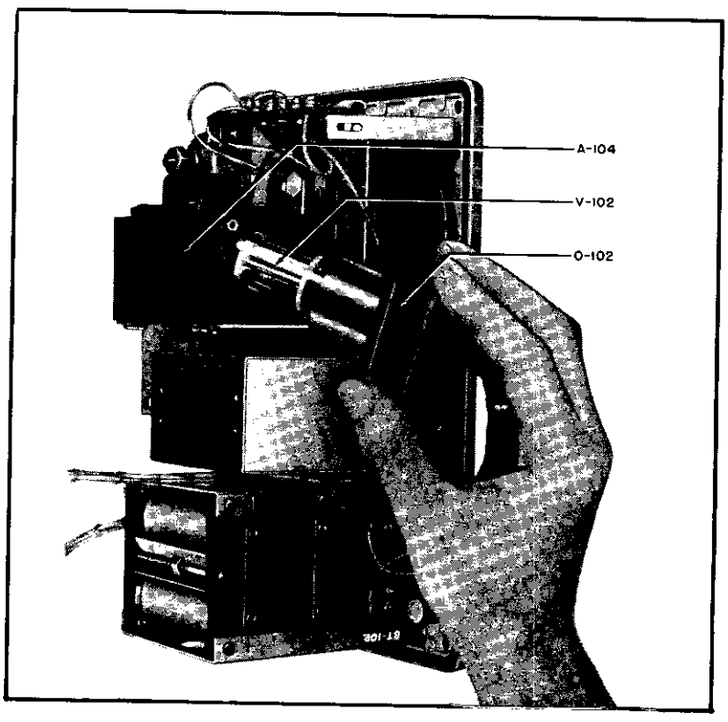
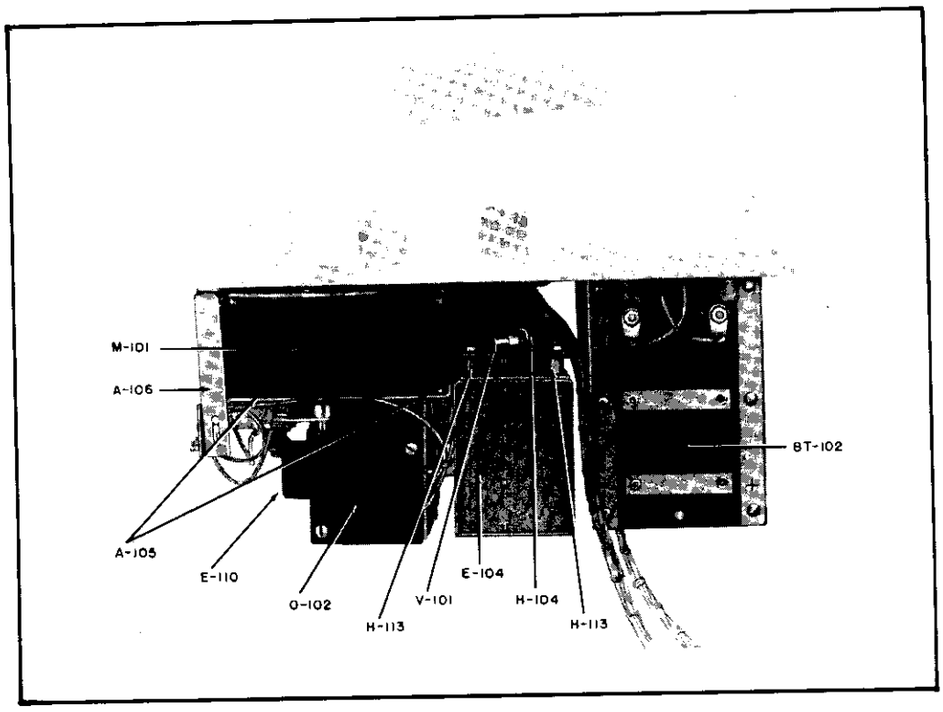


Figure 5–5.
Radiacmeter IM–75/PDR–18A, Rear Side with Photomultiplier Tube V-102 Removed



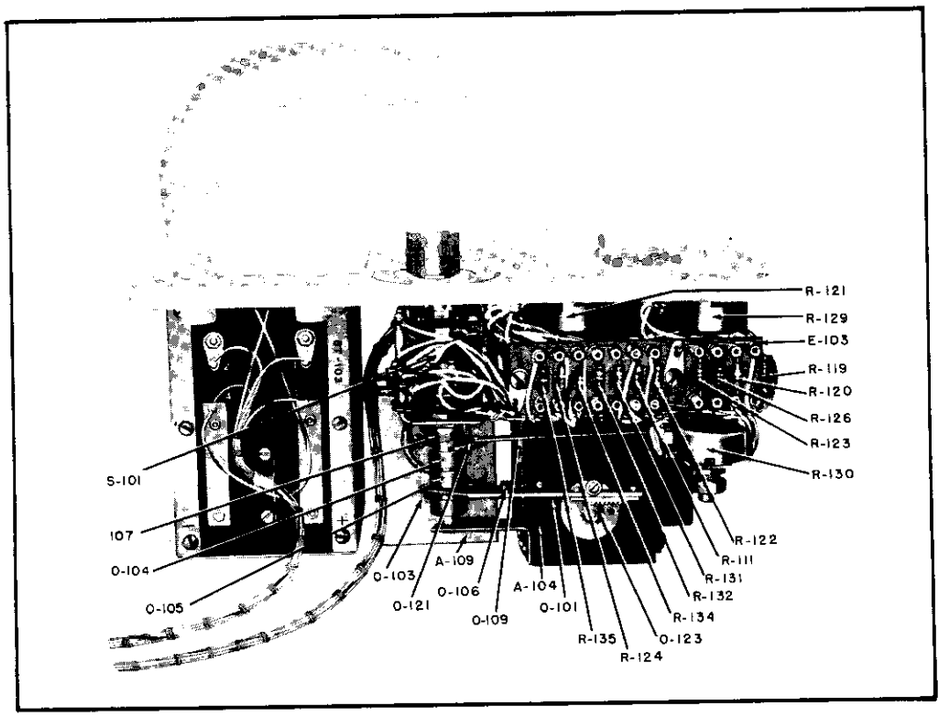


Figure 5–6.
Radiacmeter IM–75/PDR–18A, Replaceable Parts on Lefthand and Righthand Sides

75/PDR–18A at 60°C. (140°F.) for three hours before applying the compound. Mask off all areas that were not covered by the old compound. These areas include the face of microammeter M-101, all gears and movable mechanical parts, the contacts on range selector switch S-101, lamp E-105 and its receptacle A-110, springs O-106 and O-107, phosphor E-110, shutter E-111, tube V-102, and all taped holes and bearings in the chassis and all pin holes in the tube socket X-101 located in housing A-104. For the locations of these parts see figures 5–2 through 5–7. Apply, by spraying or brushing, a uniform coat of Specification MIL-V-173A compound to Radiacmeter IM–75/PDR–18A. For spraying, thin the compound to a viscosity of 28 to 40 seconds at 25°C. (72°F.) with toluene (Federal Specification TT-T-548 thinner) and regulate the spray gun to give a round, wet spray of small diameter. For brushing, thin the compound with the same thinner if necessary, to a viscosity of 34 to 60 seconds at 25°C. (72°F.).

b. Dry the compound at room temperature for 45 minutes or preferably, force dry it at 49° to 54°C. (110° to 129°F.) for at least 10 minutes but not more than 45 minutes. Do not bake the fungus-proofed apparatus at temperatures in excess of 57°C. (136°F.).

c. After the fungicidal coating is dry, inspect Radiacmeter IM–75/PDR–18A for parts which did not receive a proper coating. Recoat any areas which are not coated properly or completely. Test Radiacmeter IM–75/PDR–18A to obtain optimum operation. In all cases where the compound film is broken during testing, recoat the break by a brush application. After completion of the retropicalization process, change the reference date stamped on the chassis to the date on which this process was performed.

4. TROUBLESHOOTING.

a. GENERAL.

(1) The recommended test equipment for troubleshooting and repair of Radiacmeter IM–75/PDR–18A is listed in Table 5–2. For troubleshooting in Radiacmeter IM–75/PDR–18A, the set must be removed from its case. Make sure that the front panel range selector switch, S-101, is in the OFF position. Refer to figure 5–7 and loosen the six retaining bolts that secure the front panel assembly to the instrument case, A-103. Lift these bolts up until they reach the stop washer, let them hang to one side, and lift the front panel

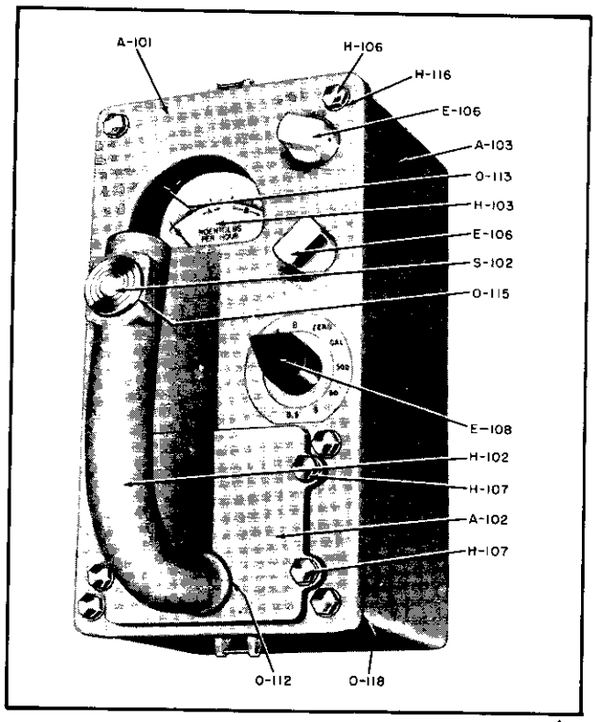


Figure 5–7. Radiacmeter IM–75/PDR–18A, Replaceable Parts on Front Panel, and Rear of Front Panel

TABLE 5–2. RECOMMENDED TEST EQUIPMENT AND TOOLS

NAME OF EQUIPMENT	NOMENCLATURE	FOR USE WITH RADIAC SET	REMARKS
Volt-Ohm-Milliammeter	Multimeter TS–352/U	AN/PDR–18A	0-250 ma; 0-1000 V D-C; 0-1000 V A-C; 0-30 megohms
Standard Calibration Source		AN/PDR–18A	Between 10 and 100 milligrams of radium
Set of Allen Wrenches		AN/PDR–18A	Sizes 4 through 10
Nut Driver		AN/PDR–18A	Size ⅜" hexagonal nut

assembly of Radiacmeter IM–75/PDR–18A out of the instrument case. For some troubleshooting procedures in Radiacmeter IM–75/PDR–18A, it will be necessary to swing back the sub-assembly chassis, A-105. Whenever this step is directed, remove the four sub-assembly chassis retaining screws, and the meter linkage pivot screw H-109, identified in figure 5–3. Lift the sub-assembly chassis A-105 and swing it back on the hinges in the mounting brackets, A-106, as in figure 5–4.

(2) Figures 5–3, 5–4, 5–6 and 5–7 show the locations of replaceable parts on Radiacmeter IM–75/PDR–18A. Where possible, potted assemblies have been used in Radiacmeter IM–75/PDR–18A, thus simplifying the location of troubles. Figure 5–8 gives a chart of the troubles that may be encountered in Radiacmeter IM–75/PDR–18A. Figure 5–9 gives a chart by which pin voltages and resistances of the tubes in Radiacmeter IM–75/PDR–18A may be checked. Both figure 5–8 and figure 4–7 may be helpful in the location of troubles. The following discussion of troubleshooting in Radiacmeter 1M–75/PDR–18A is broken down into a discussion of the switching circuits, the detection circuits, the amplifier-meter circuits and the power supply circuits.

b. SWITCHING CIRCUITS.

(1) Switching circuit troubles are usually indicated by a lack of deflection or erratic deflection of meter M-101 for any positions of the range selector switch S-101. When checking the range selector switch S-101, watch for corroded or dirty contacts, loose contacts or loose terminal connections.

c. DETECTION CIRCUITS.

(1) The detection circuit consists of the photomultiplier tube V-102 and its associated circuitry. Troubles in these circuits are generally indicated by an absence of indication on meter M-101 for all positions of range selector switch, S-101, *except* A, B and ZERO, and are caused by faulty photomultiplier tube V-102. Failure to indicate on certain ranges may be caused by an open load resistor R-118, R-117 or R-116. Erratic indication for all ranges may be caused by a faulty photomultiplier tube socket assembly, O-102. Erratic indication on the most sensitive range may be caused by a dirty or defective photomultiplier tube V-102. When this trouble is encountered, first try cleaning V-102 in accordance with the instructions in paragraph 1*f* of this Section. If this does not eliminate the trouble, try replacing photomultiplier tube V-102, in accordance with instructions in paragraph 1*f* of this Section.

d. AMPLIFIER-METER CIRCUITS.

(1) With the exception of the ZERO potentiometer R-129, the CAL potentiometer R-121 and the sub-panel zero potentiometer R-130, the components for the amplifier-meter circuits are located on terminal board E-103, identified in figure 5–6 and on terminal board E-102, identified in figure 5–3. When it is impossible to zero or to calibrate meter M-101, there is trouble in the parts comprising the amplifier-meter circuit, provided that the power supply circuits are functioning properly.

e. POWER SUPPLY CIRCUITS.

(1) Trouble in the power supply circuits is indicated by lack of indication on meter M-101, by low or high output voltage to photomultiplier tube V-102, by low or high plate voltage to amplifier tube V-101, by damage to photomultiplier tube V-101, and by rapid discharge of the batteries. All the components of the power supply circuits are contained in the potted unit E-104.

5. ELECTRICAL ADJUSTMENTS.

a. When it becomes necessary to change photomultiplier tube V-102, the high voltage applied to V-102 must, under most conditions, be changed because of the wide variety of operating characteristics between different photomultiplier tubes. After installing a new photomultiplier tube, remove any short circuits that may have been placed across one or more of the resistors R-111 through R-115 at points A to D as shown in figure 2–2. Resistors R-111 through R-115 are located on terminal board E-102, identified in figure 5–3. To make the adjustment of the high voltage supply, first check the A and B voltages and make the ZERO adjustment as directed in Table 5–1 of this Section. Place CAL potentiometer R-121 in its full counterclockwise position. Turn the range selector switch S-101 to the CAL position and observe the indication on microammeter M-101. Turn the CAL potentiometer R-121 clockwise and attempt to set microammeter M-101 at full scale deflection. If full scale deflection cannot be obtained, turn range selector switch S-101 to the OFF position, and connect a wire across terminals C and D so as to short-circuit resistor R-110. After soldering the wire, repeat the calibration procedure. If meter M-101 does not give approximately full-scale deflection with the CAL potentiometer R-121 in the center of its range, remove the short circuit from R-110 and short-circuit resistor R-114 between points A and B; again repeat the calibration procedure. If necessary, also short-circuit one or both of resistors R-115 and R-110 until meter M-101 gives approximately full-scale deflection with the CAL potentiometer R-121 in the center of its range. When replacing photomultiplier tube V-102, it is also frequently necessary to compensate for the dark current by adjustment of R-130 as described in the following paragraph.

b. After replacing photomultiplier tube V-102 and adjusting the high voltage supply, as directed in paragraph 5*a*, place the range selector switch S-101 in the 0.5 position. With Radiacmeter IM–75/PDR–18A placed in a location where there is no gamma radiation field, place the range selector switch S-101 on the 0.5 position and adjust the ZERO potentiometer R-129 until meter M-101 reads zero. Without disturbing the position of the ZERO potentiometer R-129, place the