draw a line from X toward Y. This is the first cut. Where this cut line intersects the centerline, draw a perpendicular. This will be the second cut.

B. Top Shore - Other End (See Sketch D).

You have already determined that the shore should be $8\frac{1}{2}$' long. Measure this off along its centerline and lay off a squared line at $8\frac{1}{2}$'. Where this square line intersects the centerline, mark it point K. Now reverse the square with the vertex (point Y) pointing downward. Once again, line up points X and Z with the edge (upper edge this time). Slide the square along the edge until side XY of square is flush with point K. Draw the first cut line. Then draw a perpendicular from point K. This will be the second cut line. Note that by reversing the square for the other end, the opposite beveled edges of the shore are exactly parallel.

C. Bottom Shore.

Repeat the above process except as follows: -

1. When laying off length of shore, deduct $\frac{1}{2}$" from its over-all length in order to allow for wedges.

3. Q. Reach rods are which type of remote-operating gear?
A. Mechanical.

4. Q. What are the reasons for using remote control systems?
A. They may be used without violating watertight integrity; they save time; they can be used in unmanned compartments, and in locations difficult to reach.

5. Q. Which type of system is used to close watertight and fire screen doors?
A. An electrical system.

B. Application. Have individuals look up locations of remote controls on the ship's station bill or plans. Take the group there, operate the remote control, and explain its effect.


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CHAPTER 3

ADVANCED DAMAGE CONTROL - For Deck and Engine Personnel (Lesson Plans)

Section 3.10

PRINCIPLES OF SHORING

I	Objectives	IV	Presentation
II	Material	V	Summary
III	Introduction	VI	Test and Application
		VII	Handout

I. OBJECTIVES.

A. To develop an understanding of the principles of shoring, its uses and its importance to watertight integrity.

B. To acquaint personnel with shoring techniques.

C. To develop skill in planning, cutting and erecting shoring.

II. MATERIAL.

A. Training Aids.

1. Film MN-61AA, Damage Control--Principles of Shoring, 20 minutes.

B. References.

1. BUSHIPS Manual, Chapter 88, Section II, Part 13, "Shoring".

2. NAVPERS 170611 "Shoring" - set of 8 22"x26" charts.

3. Handout, Instructions for Use of Carpenter's Steel Square in Shoring.

III. INTRODUCTION.

A. Introduce self and subject (Principles of Shoring).

B. By definition, shoring is the process of placing supports against the side of, beneath or above a structure to counteract metal fatigue, sagging and bulging.

C. Shoring, as an emergency temporary measure is used to:

1. Strengthen or brace weakened bulkheads.

2. Support weakened decks.

3. Seal off sprung watertight doors or hatches.

4. Support, and apply pressure to, a strongback over a patch.

5. In short, any time a part of the ship's structure has sustained damage and you think it needs support, shore it. However, never try to eliminate bulges by shoring.

D. Some common terms used in shoring are:

1. Shore - A portable wood beam. Its length should never exceed 30 times its minimum thickness. For example, a 6" timber, multiplied by 30 equals 180" or 15 feet. The best shoring is Douglas fir or yellow pine. All shores are treated with a fire-resisting chemical.

2. Wedges - triangular on the sides, rectangular on the butt end; length should be six times the thickness. Wedges are of straight grained soft wood, unpainted to permit absorption of water.

3. Plugs - Of hard wood for plugging cracks, mall holes and leading seams.

4. Shole - A flat plate or section of wide plank placed under the end of a shore to distribute weight or pressure.

5. Strongback - A bar or beam of wood or metal used to distribute weight or pressure or serve as an anchor for a patch.

E. Type of gear and materials used in shoring.

1. Tools - Mostly standard carpenter's tools and measuring batten.

2. Materials - Wood treated with fire retardent chemicals.

IV. PRESENTATION.

A. Rules for Applying Shoring. Since shoring is simply the bracing of ships members to withstand excessive pressure, it is obvious that no two shoring jobs will be handled in exactly the same manner. Available and "make-do" equipment and the situation will govern the methods used. However, the following principles will serve as guides:

1. Pressure must be taken up over a wide area.

2. Each horizontal shore must be backed up by more shores exerting pressure at right angles to the bulkhead.

3. Butt ends of shores must rest snugly against the undamaged strength members.

4. Support the weakened area from the deck beneath, or all the way down to the tank tops, if necessary.

5. Shores must form a considerable angle with the bulkhead they are supporting. The larger the angle up to 90°, the greater the shore's effectiveness.

6. Use sholes under ends of shores, where they must be placed against riveted joints, with pockets chiseled out to take exposed rivet heads and thus prevent splitting of shore ends.

7. Methods of applying wedges.

a. Always use two wedges, driven simultaneously from both sides to prevent tilting of the shore.

b. Use a block of wood or a batten between the butt of the wedge and the maul to prevent splitting wedges.

c. If the deck is slippery, as from fuel oil, throw sand under the wedge to reduce its tendency to slip.

d. When setting up wedges before driving, insert them with their slanting sides together so they will form a rectangular shape when driven up.

e. If there is not enough room to swing two mauls, the same effect can be obtained by holding a maul hard against the butt of one wedge and driving on the other.

f. Cleats may be nailed behind the butts of wedges after driving them up hard to prevent them from slipping.

8. Never notch the ends of shores as this will cause the shore to split under pressure. Instead, cut a socket or chamfer in the strongback into which to set the butt of the inclined shore.

9. Avoid the use of nails wherever possible.

10. Set shoring up tight; post a man to take up on wedges as the ship works when underway; re-check frequently and take up any slack that develops.

B. Tools and Equipment for Shoring.. MSTS ships have standard allowances of shoring, wedges and tools. Shoring is stowed in at least two locations in the ship, forward and aft. Tools include:

1. Hammers, mauls and sledges.

2. Hatchets, axes, chisels.

3. Hand saws (rip and crosscut).

4. Lumberjack's (two man) crosscut saw.

5. Battens, wooden plugs, clamps.

6. Turnbuckles, chainfalls, jacks.

7. Mattresses, pillows, canvas and rope.

8. Bolts, nuts and washers.

9. Cutting and welding equipment.

10. Measuring battens, a six foot rule and carpenter's steel square.

11. Cement is also necessary for erection of a coffer dam.

C. Demonstrations.

1. Demonstrate the proper use of the measuring batten.

2. Demonstrate use of the carpenter's steel square to get correct angles on ends of shore.

3. Study diagrams in BUSHIPS Manual, Chapter 88, Section II, Part 13. Point out the principal types of shoring structures and how stresses are distributed. Give examples of poor and effective shoring techniques.

D. Preparation and Stowage of Shoring Material.

1. Keep full allowance of shoring material on hand. Use dunnage for instruction and drill purposes.

2. Never attempt to cut or prepare shores in advance of need.

3. Stow materials where easily accessible, in pockets between frames and girders and secured with lines or metal clips. Shoring must be secured so that it cannot break and must be easily removable when needed.

4. Wooden wedges should be made up into blocks by nailing a batten on their sides.

5. Plugs should be kept in a canvas bag secured to a beam or stanchion or stowed in metal boxes.

E. Emergency Shoring Material. In an emergency, any equipment aboard ship which will serve the purpose should be used to effect temporary repairs.

Metal plates, pipe, bars and I beams can be used for more semi-permanent shoring when there is time to weld it in place and a repair facility is not available. (See Section 7.7 USNS Marine Corps for an example of temporary and semi-permanent repairs.)

V. SUMMARY.

A. Purpose of shoring - to support weakened structures, not to eliminate bulging.

B. Descriptive terms in shoring.

C. Rules for applying shoring.

D. Principal types of shoring structures.

E. Tools and equipment required for shoring.

F. Stowage and accessibility of shoring materials.

G. Emergency and semi-permanent repairs.

H. Reproduce and distribute the handout in VII or demonstrate the key points in the use of the carpenter's square in shoring.

VI. TEST AND APPLICATION.

A. Test. Use these and additional questions as an oral quiz:

1. Q. What is the purpose of shoring?
A. To offset metal fatigue, sagging or bulging; to strengthen weakened bulkheads and decks; and to support hatches, doors or equipment that has broken loose.

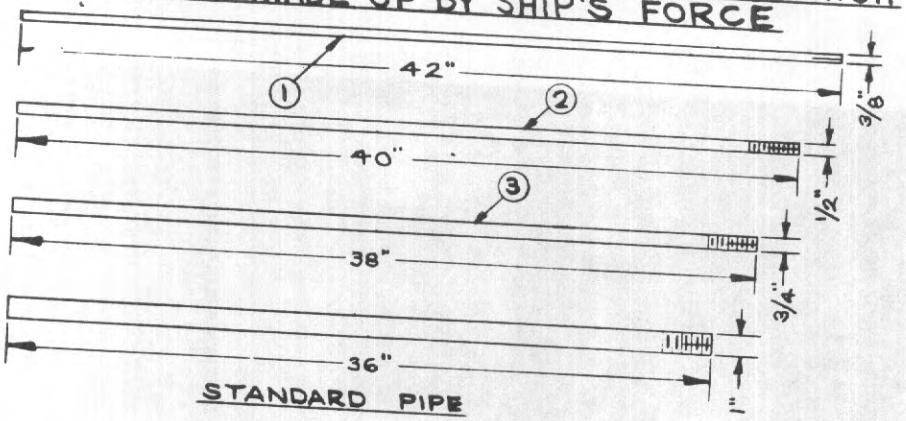
2. Q. How far in advance should shoring materials be prepared?
A. Never cut or prepare shoring timbers in advance. Since each situation is different, there would be too much waste in advance preparation.

3. Q. Why are pillows unsatisfactory for use as patches?
A. When the feathers get wet, they collect in a lump and the patch collapses. If the casing rips, the feathers clog pumps and strainers.

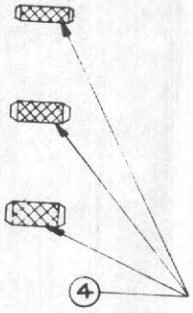
4. Q. Why should shoring timbers, plugs and wedges be left unpainted?
A. The unpainted wood absorbs water and grips better. Paint would seal the pores of the wood, stopping or slowing down water absorption.

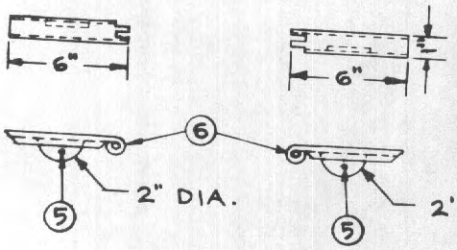
5. Q. How should wedges be set up and driven?
A. Set up two wedges, hypotemuse to hypotemuse, so they will form a shape like the block from which they were cut. Drive simultaneously against both wedge butts.

DETAILS OF MEASURING BATTEN WHICH CAN BE MADE UP BY SHIP'S FORCE



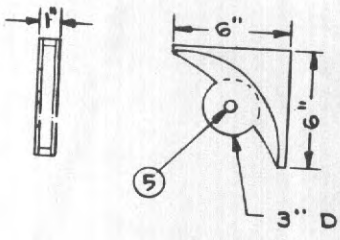
STANDARD PIPE

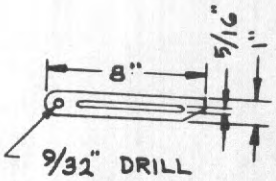




MATERIALS

Pipe to be steel.
Knurled nuts to be brass.
Angle measuring heads to be fabricated from galvanized sheet metal.



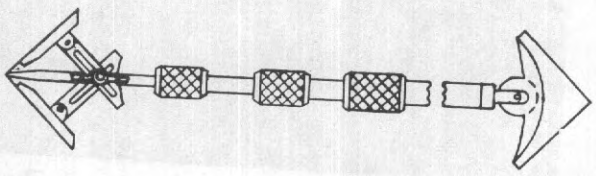


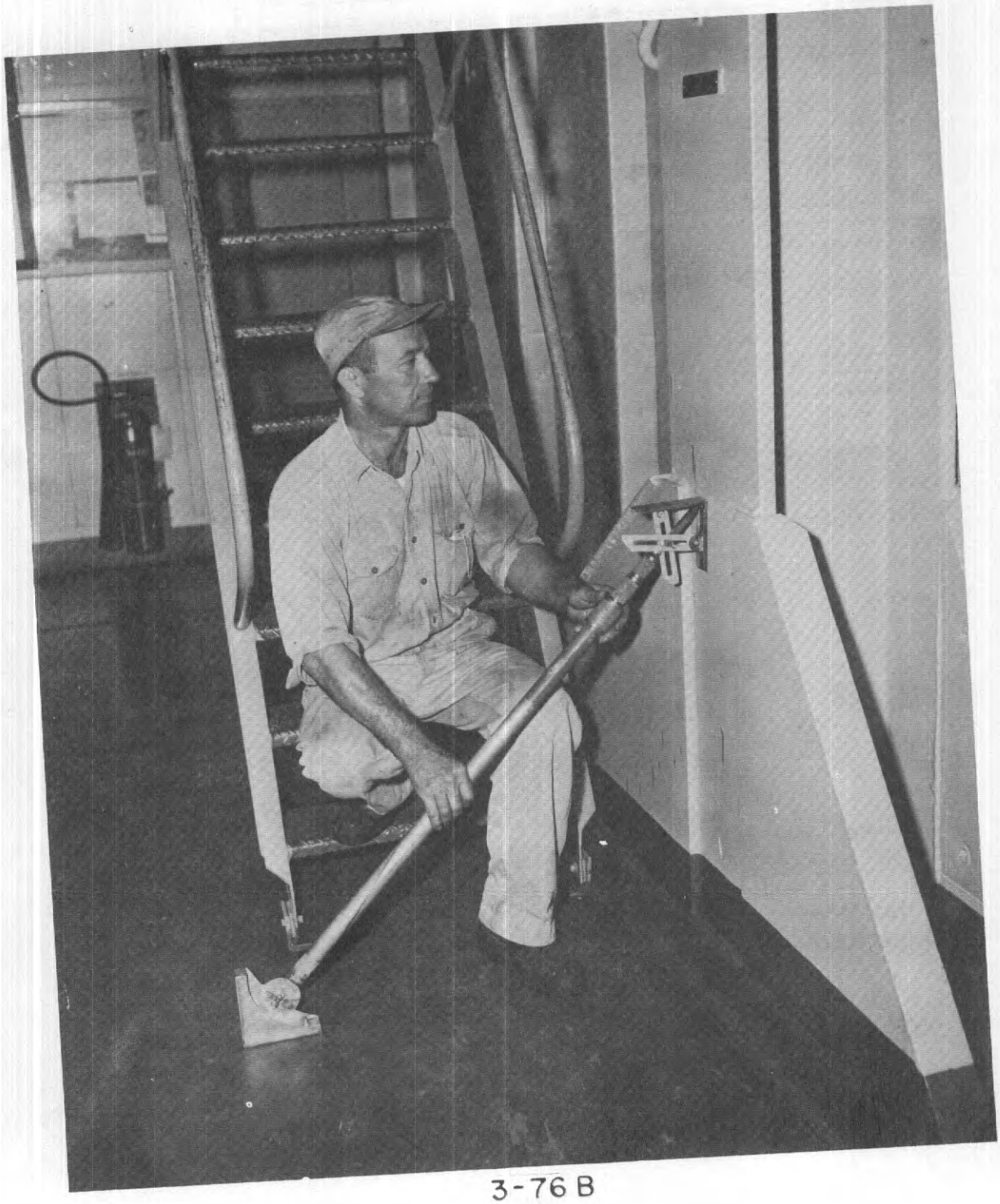
2 PIECES REQ.

WING NUT & BOLT - 1/4"

NOTES:

1. 3/8" D. PIPE MUST BE MACHINED APPROXIMATELY 1/16" TO FIT INSIDE 1/2" D. PIPE.
2. 1/2" D. PIPE MUST BE MACHINED APPROXIMATELY 1/32" TO FIT INSIDE 3/4" D. PIPE.
3. 3/4" D. PIPE MERELY REQUIRES A CLEAN SURFACE TO FIT INSIDE 1" D. PIPE.
4. BRASS STOCK DRILLED & KNURLED & THREADED TO SUIT RESPECTIVE PIPE.
5. DRILL TO PROVIDE FOR BOLT.
6. FOLD METAL FOR HINGE EFFECT - 1/4"
7. COMPLETED BATTEN IS AS SHOWN BELOW WHEN ASSEMBLED





3-76 B

STEEL DAMAGE CONTROL SHORES

(BUSHIPS Journal, November 1960)

The Bureau of Ships is taking steps to replace some of the wooden damage control shores, now used on surface ships, with adjustable steel shores. The change is expected to result in decreased cost as well as a number of other advantages.

The cost of steel shores initially will be higher than wood shores. A set costs about $80, but this figure will be reduced somewhat by the savings realized from the proposed reduction in the allowance of wooden shores. The difference will be offset over a period of years since the steel shore is reusable.

Since the large 11-foot size telescopes down to 6 feet, steel shores can be stowed in repair stations, where they are more readily available to repair personnel. They can be installed more rapidly than wood shores since no cutting or measuring is needed. The ones furnished the ships will have swivel tops and bottom plates so that they can be used vertically, horizontally, or at any angle. The plates can be secured by nails, screws, or tack welding and by wedging them against ship bulkhead or hatch coaming.

The steel shore requires less storage space than the wood shore and they are lighter weight. The 6-foot steel shore (which extends to 11 feet) weighs 40 pounds less than a 6-inch by 6-inch by 11-foot wood shore.

The steel shores have other advantages, they do not burn. They are not as bulky as wood shores, hence they are more easily handled, particularly in confined spaces. They can be used where pressure is required, as in driving plugs against water pressure. Their use makes it easy to adjust pressure without wedges, and less time is required to install the shores.

Benefits also will derive from using the steel shore for training, since they can be reused in shoring drills. Because their use eliminates cutting wood shores, they have greater training potential without increased cost. Their use elimates the loss of time and expensive material which results from mistaken measurements or cuts.

Since the steel shore will be stowed in repair stations in lieu of living spaces, habitability is improved. Maintenance of steel shores is easier also, since all they need is an occasional greasing of threads.

6. Q. What kinds of lumber are best for shoring?
A. Douglas fir or yellow pine.

7. Q. What should be the maximum length of a shoring timber?
A. Not more than 30 times its minimum width.

8. Q. How would you measure for the required length of a shoring timber and the angles the ends should be cut to?
A. By means of the measuring batten.

9. Q. Define the following: (a) shore, (b) wedge, (c) shole, (d) strongback.
A. (a) A shore is a portable beam.
(b) A wedge is a block, triangular on the sides and rectangular on the butt end.
(c) A shole is a flat plate which may be placed under the end of a shore to distribute weight or pressure.
(d) A strongback is a bar or beam used to distribute pressure.

10. Q. To what extent are nails used to secure shores?
A. Nails should be used only where necessary or to secure blocks behind wedges to prevent their slipping.

B. Application. Assume a practical shoring situation and have the group erect the proper shore.

VII. HANDOUT. Instructions for Use of Carpenter's Steel Square in Shoring. There may be times when a measuring batten is not available or, if it is, it may be too long or too short to measure for shores. In this event, the carpenter's steel square can be used to give flat, snug pressure surfaces.

A. Top Shore - One End (See Sketch A).

1. Measure in feet the horizontal distance from the bulkhead to be shored to the overhead support point. Deduct from this the distance from the bulkhead to the face of the strongback where pressure is to be applied. (In Sketch A., measurement 1 , the net measurement is $7\frac{1}{2}$'.)

2. Measure in feet the vertical distance from the overhead deck plating to the horizontal centerline of the strongback. This is 4' in measurement 2 .)

3. Using a scale of 1" = 1', reduce these measurements to inches. Thus, $7\frac{1}{2}$' becomes $7\frac{1}{2}$" and 4' becomes 4". Lay these two measurements off on the legs of the square from the outside corner or vertex, giving you points X and Z (see sketch B). With a straight edge, connect X and Z. This line (hypotenuse) will give you correct length of the shore. Thus an $8\frac{1}{2}$" hypotenuse means that the shore should be $8\frac{1}{2}$' long.

4. Now lay the square, vertex up, on the flat side (if any) of the timber so that points X and Z coincide with the edge (see sketch C). Slide the square along the edge until X is at the end of the timber. Then

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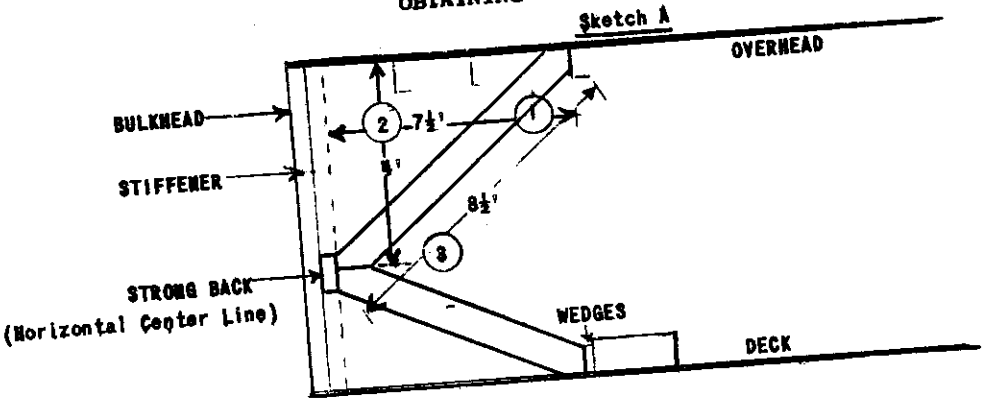
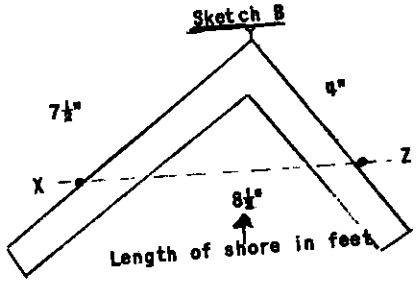
OBTAINING CORRECT ANGLES IN SHORING

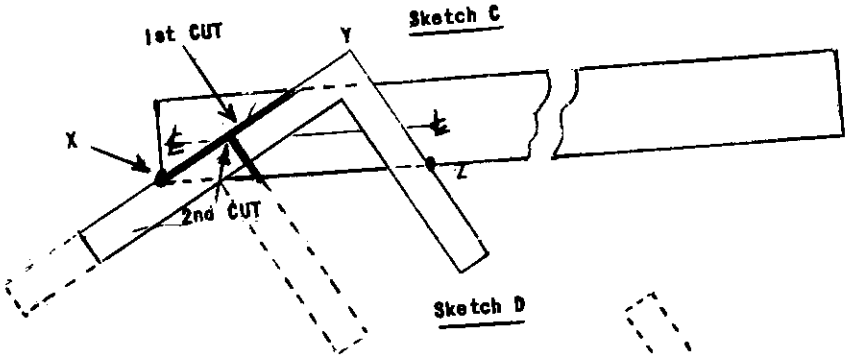
Sketch A



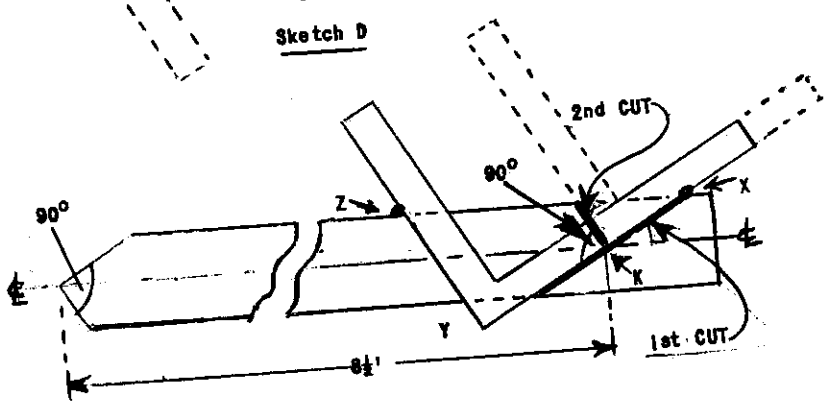
Sketch B



Sketch C



Sketch D



CHAPTER 3

ADVANCED DAMAGE CONTROL - For Deck and Engine Personnel (Lesson Plans)

Section 3.11

OXYGEN-ACETYLENE CUTTING UNIT

I Objectives	IV Presentation
II Material	V Summary
III Introduction	VI Test and Application

I. OBJECTIVES.

A. To familiarize repair party personnel with the operation, maintenance, and safety precautions for the oxygen-acetylene cutting unit.

B. To instruct personnel in the operation of the unit and its advantages and limitations.

II. MATERIAL.

A. Training Aids.

1. Cutting unit, including the manufacturer's instructions.

2. Film strip, SN 137, Oxyacetylene Cutting (for use with film strip projector).

B. References.

1. BUSHIPS Manual, Chapter 92, Sections IV and V, Welding and Allied Processes.

2. BUSHIPS Manual, Chapter 93, Firefighting, Ship.

3. NAVSHIPS 392-0003 - Instruction Manual for Operation of Pack-Type Oxy-acetylene Emergency Cutting Outfit.

4. NAVPERS 10133 - Metalsmith 3 & 2.

5. NAVPERS 10571-B, Damage Controlman 3 & 2.

III. INTRODUCTION.

A. Introduce self and subject (Oxygen-Acetylene Cutting Unit).

B. Uses of the Emergency Cutting Unit:

1. To cut holes in decks or bulkheads so that applicators equipped with fog heads may be inserted. The engine room fire in USNS ROSE in July 1952 when two applicators for fire fighting were inserted to overcome a serious fire after the CO_2 had failed to extinguish the fire is an example. (See Section 8.5)

2. To cut away debris. For example, the case of the woman in the ANDREA DORIA who was pinned in her bunk and lost, whereas she would have been freed if a cutting unit was available.

C. Advantages of the Unit.

1. Is comparatively light and can be carried by one man.

2. Regulators are pre-set and ready for use.

3. It will cut continuously for 25 minutes.

4. The torch will cut through up to 1" of steel.

D. Larger Unit. A large, two-man unit, is also available. This will weld as well as burn. It will not be covered in this lesson, though it could be used in an emergency.

IV. PRESENTATION. (Show the unit, its parts, and its operation while describing it.)

A. Location. The emergency cutting unit is stowed in the repair locker. It is kept in its fast-opening metal cabinet in an upright position.

B. Description. The pack contains two oxygen cylinders of 22 cubic feet capacity each and one acetylene cylinder of 10 cubic feet. Also, cylinder pressure gauges, working pressure gauges, a regulator for each gas, a cutting torch with two adjusting valves, a high pressure lever-type oxygen valve, a cutting tip, two five foot lengths of hose, a spark lighter, gloves, goggles, and a wrench. The unit is carried in a fire-resistant canvas carrying pack.

C. Preparation for Use.

1. Before strapping the carrying pack to operator's back, crack the oxygen cylinder valves slowly to permit high pressure to build up in the regulator; then open the valves wide.

2. Next open the acetylene cylinder valve slowly, about one quarter turn. Use the key attached to the regulator with a chain. Help

the operator adjust the pack on his back.

3. To ready the torch for use, open the preheating flame acetylene valve one quarter turn. Immediately, light the flame with the spark lighter. Never use a match. Next, open the preheating oxygen valve one quarter turn. Adjust the oxygen valve until you have individual clear, blue-white flames with sharp edges.

D. Cutting. The metal must be preheated with the above flame. Hold the burner tip at right angles to the surface. Heat to a bright cherry red at one point only. Then press the cutting lever, holding the torch so that the ends of the flame cones just touch the metal. After burning through, move to the adjoining point. Moving too fast will lose the cut; moving too slow will fuse the cut. To prevent slag from blowing toward you, tilt the torch to one side and back the torch off slightly from the plate.

E. Securing Torch.

1. Turn off the acetylene valve.

2. Turn off the preheating flame oxygen valve.

3. Close both oxygen and acetylene cylinder valves tightly.

4. Test cylinder valves for tightness.

F. Safety Precautions.

1. See that hose connections are tight and that there are no leaks. Test for leaks with soap and water.

2. Do not submerge the tip end of the torch into molten metal!

3. Do not let unburned acetylene gas accumulate in a confined space.

4. Keep oil and grease away from the cutting unit. These substances ignite violently in the presence of oxygen under pressure.

5. Always wear goggles, leather gloves and protective clothing when cutting.

6. Never depress the cutting oxygen lever unless actually cutting or adjusting the flame.

7. Do not undertake repair of any part of this unit. Send it ashore for proper repair.

G. Stowage. Remember that this is an emergency unit and must be ready for instant use. It will be ready for use if maintained as follows:

1. Determine the oxygen content.

a. Remove oxygen regulator from manifold.

b. Attach pressure test gauge in place of regulator.

c. Open both oxygen cylinder valves slowly, one at a time.

d. Read the pressure on the gauge. This will be for both cylinders. If the pressure is less than 500 lbs., replace all three cylinders.

e. If pressure is more than 500 lbs., close all cylinder valves tightly, remove the test gauge, and replace the oxygen regulator.

f. Acetylene content does not need to be determined because consumption is in proper ratio to the oxygen. The gauge in the bottom of the acetylene cylinder is not a true test of gas content (a full cylinder at 70 degrees will register 250 lbs.)

2. Test for leaks with soap and water.

3. The torch is carried in the torch holster on the right shoulder strap. Stow the unit in the repair locker in upright position away from any steam lines or other sources of heat.

4. If, on opening the locker, you smell acetylene gas, leave the door open, post a guard to prevent smoking, and notify the First Officer at once.

H. Re-ordering Cylinders.

1. Ignore directions for change-over appearing on page 18 of NAVSHIPS 392-0003, Instruction Manual.

2. Remove the manifold; remove all 3 cylinders from their cradle.

3. Turn in only the empty cylinders for credit, using the appropriate shipping form.

4. Order the following replacements, using the appropriate requisition form:

2 Oxygen cylinders
1 Acetylene cylinder
44 Cubic feet of oxygen
10 Cubic feet of acetylene

5. Indicate at the bottom of the requisition that empty cylinders are being turned in.

V. SUMMARY.

A. Give practical demonstrations of:

1. Breaking out the cutting unit.

2. Lighting.

3. Cutting.

4. Determining oxygen content.

5. Securing.

B. Review the key points of lesson.

C. Review safety features.

VI. TEST AND APPLICATION.

A. Test. Use these and additional questions as an oral quiz.

1. Q. Name the parts of the oxygen acetylene cutting unit.
A. a. One fire resistant canvas carrying pack and harness.
b. Two oxygen cylinders.
c. One acetylene cylinder.
d. Two 5' lengths of hose (one oxygen and one acetylene) with preset pressure regulators for each.
e. One type "E" hand cutting torch.
f. One oxygen cylinder manifold.

2. Q. What valves must be opened before the operator puts the oxygen-acetylene cutting unit on his back?
A. The valves on the oxygen and acetylene cylinders.

3. Q. What is the most important limitation placed on the use of the oxygen-acetylene cutting unit?
A. It is for emergency use only, and must be maintained in readiness for this purpose.

4. Q. Where is the oxygen-acetylene cutting unit stowed?
A. It is stowed in the repair locker.

5. Q. What is the gas capacity of the oxygen-acetylene cutting unit?
A. Gas capacity of the oxygen-acetylene cutting unit is 44 cubic feet of oxygen in two cylinders and a 10 cubic foot acetylene cylinder.

6. Q. When is the oxygen lever pressed down?
A. The lever is pressed down when ready to start cutting.

7. Q. What is the chief precaution that must be taken when cutting?
A. Do not submerge the tip of the torch into molten metal.

8. Q. Would you lubricate any part of the outfit? Give the reason for your answer.

A. No, it is dangerous to use oil or grease in the presence of oxygen under pressure.

9. Q. What is the pressure level under which all cylinders must be replaced?

A. 500 lbs.

10. Q. Why is it not necessary to check the acetylene pressure?

A. Because due to the pre-set regulators, both gases are used in the proper ratio.

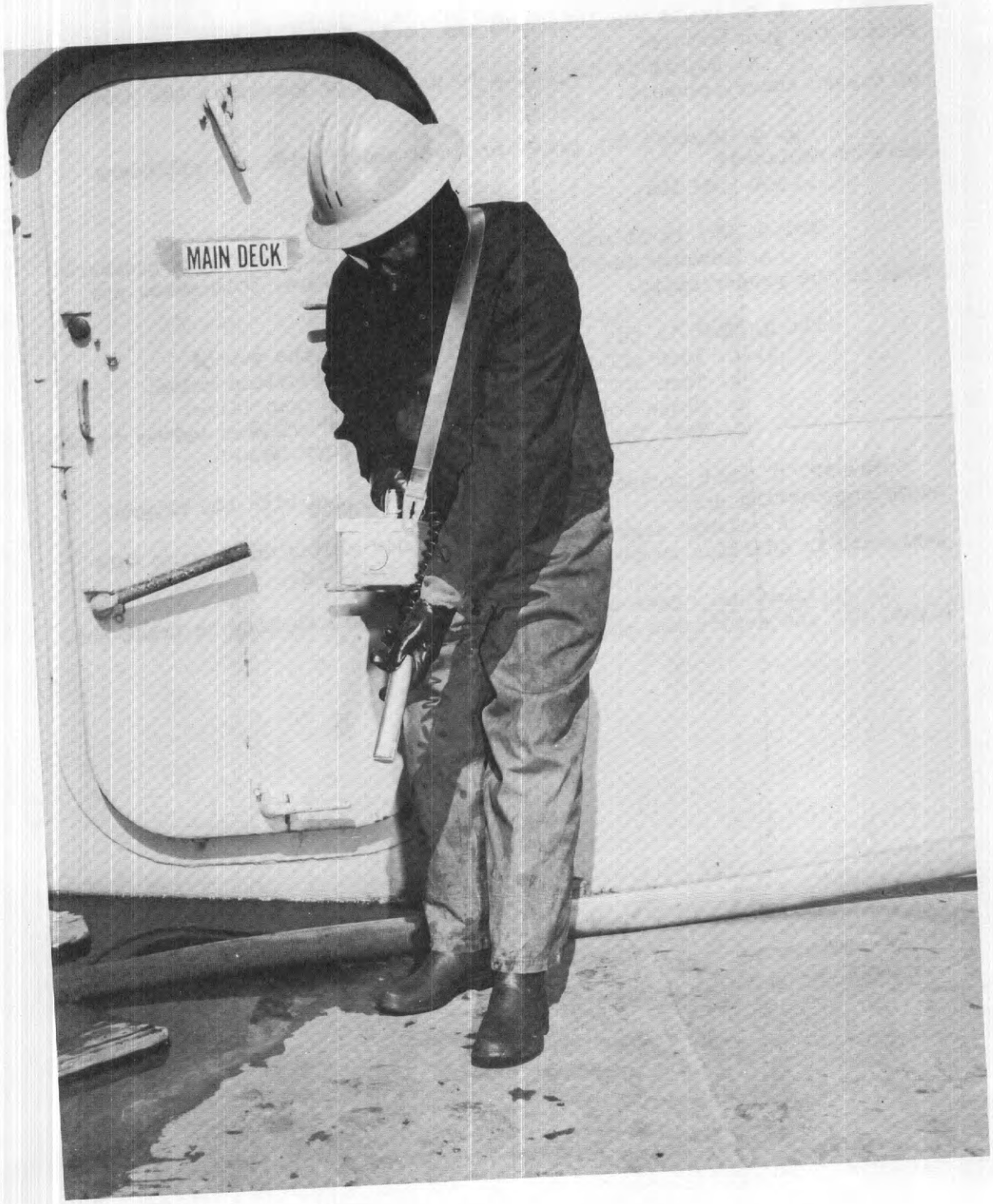
11. Q. What is the procedure for securing the torch?

A. a. Turn off the preheating flame acetylene valve.
b. Turn off the preheating flame oxygen valve.
c. Close both oxygen and acetylene cylinder valves tightly.
d. Test the cylinder valves for tightness.

12. Q. What protective clothing is required with the oxygen-acetylene cutting unit?

A. Always wear goggles and leather gloves when using this equipment in addition to ordinary protective clothing.

B. Application. Have each man demonstrate his ability to break out, light, use and secure the cutting unit.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CHAPTER 3

ADVANCED DAMAGE CONTROL - For Deck and Engine Personnel (Lesson Plans)

Section 3.12

RADIAC INSTRUMENTS

I Objectives	IV Presentation
II Material	V Summary
III Introduction	VI Test and Application

I. OBJECTIVES.

A. To familiarize repair party personnel and members of monitoring teams with radiac instruments.

B. To show personnel how to operate radiac instruments.

C. To develop an understanding of the capabilities, limitations, maintenance, and safety precautions to be observed in handling radiac instruments.

II. MATERIAL.

A. Training Aids.

~~1. Film MA-6730A, An Introduction to Radiation Detection Instruments (18 minutes).~~ Ch # 8

2. Film MN 8694, Radiac Equipment (New film series to be released).

3. Survey Meter, Gamma High Intensity - AN/PDR-18.

4. Survey Meter, Beta-Gamma Low Intensity - AN/PDR-27.

5. Survey Meter, Alpha - AN/PDR-10 (Passenger ships only).

6. Phosphor-Glass Dosimeter - DT-60/PD.

7. Pocket Dosimeter IM-9/PD.

8. Computer - Indicator - CP-95/PD.

B. References.

1. Radiological Defense, Volume IV.

2. Nucleonics for the Navy, NAVPERS 10850, Part 2.

III. INTRODUCTION.

A. Introduce self and subject (Radiac Instruments).

B. "Radiac" is the term given to all radiological detection instruments. It stands for Radiological Activity Detection, Identification and Computation.

C. AN/PDR is an abbreviation for "Army - Navy, Portable, D for radiac, Receiving". The number indicates the model. DT-60/PD stands for a "detecting portable radiac" and CP-95/PD is a "computer, portable radiac".

D. Nuclear radiation cannot be seen or felt. Nor can it be detected by any of the five natural senses. It is necessary to have special instruments for its detection, and for determination of the dosage rate.

E. Nuclear radiations given off by radioactive elements consist of 3 basic types - alpha particles, beta particles and gamma rays.

F. In monitoring for nuclear radiation, we must determine its presence, location, intensity, and the dose rate to which exposed personnel have been, or will be, subjected.

G. Improvement and development of new radiac equipment is a continuing project and progress is rapid in this field. Currently-available equipment is described herein. Improved equipment will be furnished ships when available, together with instructions regarding its use.

IV. PRESENTATION. Various instruments are required to determine the type, location and intensity of radiation, usually in the form of radioactive "fallout" material, after an atomic explosion. For this purpose "dose-rate" meters are used (similar to "miles per hour" on a speedometer). For determination of the amount of exposure to which personnel have been exposed, "dosimeters" are used (similar to "total mileage" on a speedometer). (Show each instrument as you describe it and explain its use).

A. Dose-Rate Meters (or Survey Meters). These come in three different types: Lo-Rate Survey Meter, Hi-Rate Survey Meter, and Alpha Survey Meter.

1. Lo-Rate Survey Meter - AN/PDR-27 Series (Geiger Counter). The AN/PDR-27 series radiac set is a portable, watertight survey instrument consisting of a low range Geiger-Mueller tube located in a probe, a higher range Geiger-Mueller tube located inside the case, an electronic amplifier, a battery power supply, a meter and earphones. This instrument is used

for low intensity surveys and all personnel monitoring.

a. This device is capable of detecting and measuring beta and gamma radiations together, or gamma radiation alone. (See Section 2.13 for definitions.)

b. The main unit of this radiac set, the radiac-meter, is equipped with a carrying handle and it may also be carried by its shoulder harness. The detector unit is contained in a probe which is attached to the meter by means of a flexible cable. The probe is normally carried in a "well" on the outside of the meter from which it can easily be removed. When measuring gamma radiation, the detector can be used in or out of the well; beta radiations, however, can be detected only when the detector is removed from the well and the beta shield on the probe is moved aside.

c. When the Geiger-Mueller tubes are exposed to gamma and beta radiation, they produce short voltage pulses at an average rate which depends upon the radiation intensity in the vicinity of the tubes. The meter gives a visual indication of the radiation; earphones in which a click is heard for each pulse received are also provided to give an audible indication.

d. Only the Geiger-Mueller tube in the probe is used for the two most sensitive ranges, 0 to 0.5 mr/hr and 0 to 5 mr/hr. Only the Geiger-Mueller tube in the case is used for the two least sensitive ranges, 0 to 50 mr/hr and 0 to 500 mr/hr.

e. This set has a six-position, rotary selector switch mechanically geared to the meter dial. Range scales are color coded.

f. Only gamma radiation field strengths can be measured on the two <u>less sensitive</u> ranges (0 to 50 mr/hr and 0 to 500 mr/hr).

g. The meter can be illuminated by tilting the radiac set case at an angle of about 45 degrees.

h. The following is a general description and operating instructions for the AN/PDR-27C, Lo-Rate Survey Meter.

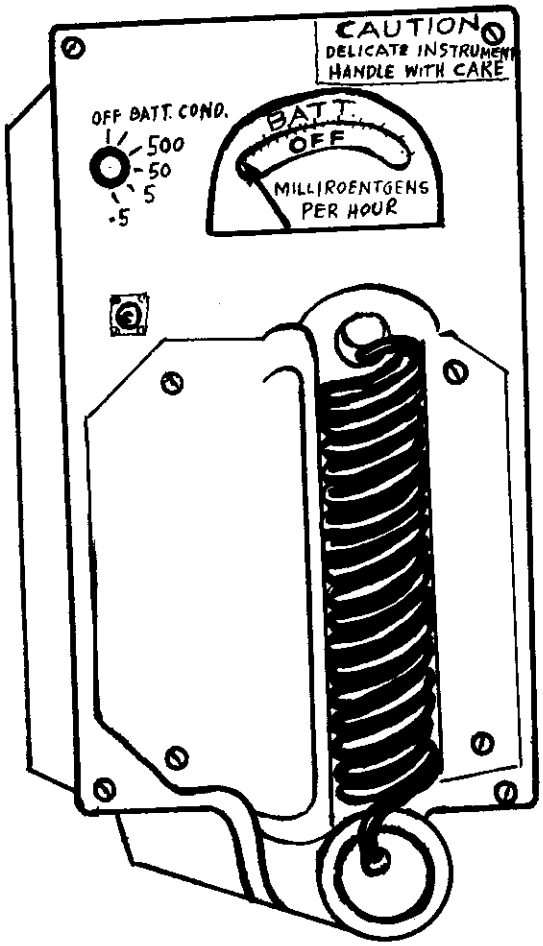
(1) General Description of the AN/PDR-27C. (See illustration).

(a) Meter design.

(1) Lo-R. Geiger-Mueller type survey meter.

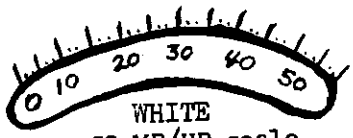
(a) Measures GAMMA rays for 0 to 500 mr/hr.

(b) Will detect BETA rays with shield off probe end. (Close to surface.)



WHITE
OFF & BATT check

YELLOW
500 MR/HR scale



WHITE
50 MR/HR scale

GREEN-YELLOW
5 MR/HR scale

LIGHT BLUE
.5 MR/HR scale

LO-RATE SURVEY METER - AN/PDR - 27C
(BETA - GAMMA LOW INTENSITY)

(2) Color code and range scale.

(a) Yellow -- 0 to 500 mr/hr.

(b) White -- 0 to 50 mr/hr.

(c) Green-yellow -- 0 to 5 mr/hr.

(d) Light blue -- 0 to .5 mr/hr.

(3) Meter range selector (Six positions).

(a) OFF position - indicates batteries disconnected, set inoperative.

(b) BATT position - indicates condition of battery charge.

(c) 500 mr/hr position.

(d) 50 mr/hr position.

(e) 5 mr/hr position.

(f) .5 mr/hr position.

(4) Headset is provided for audible signals.

(a) To source of clicks.

(b) Rapidity of the clicks indicate increase in intensity.

(b) Power supply.

(1) One 135 volt battery.

(2) One 22.5 volt battery.

(3) Two $1\frac{1}{2}$ volt batteries.

(c) Chassis design - portable battery operated. Batteries are contained beneath the handle casting in a separate chamber. They can be removed and replaced without exposing the circuit.

(1) Simplicity of reading.

(a) When ranges are changed, numerals and colors change.

(b) Meter is read directly in mr/hr.

(2) Smooth painted surfaces for easy decontamination. (Do not repaint).

(3) Shoulder strap lugs for carrying.

(2) Procedures for placing instrument into operation. Note: It should be checked out at least monthly, since it cannot be checked out in any area containing radio-activity.

(a) Turn switch to BATT COND position. The indicator should point to right of line marked BATT on meter dial. This line is the point below which operating voltage is insufficient.

(b) Check operation of the circuits, using the test sample.

(1)-On 500 scale, meter should read "0". (Chassis tube only on 500 scale.)

(a) Place colored end of test sample in dimple on bottom of chassis.

(b) Meter should read 10 to 30 mr/hr.

(2) Turn switch to 50 range scale.

(a) Place colored end of test sample in dimple on chassis bottom.

(b) Meter should read 5 to 15 mr/hr.

(3) On 50 and 500 ranges, tube in chassis is in use.

(a) Detects and measures GAMMA radiation only.

(b) For survey on these ranges, instrument is turned facing toward the source. Probe well should be against body of operator.

(4) Turn switch to 5 range. Use probe.

(a) Place colored end of test sample against the center of the probe.

(b) Meter should read 1 to 3 mr/hr.

(5) Turn switch to 0.5 range.

(a) Place clear end of test sample against probe to prevent overloading of the tube.

(b) Meter should read .1 to .3 mr/hr.

(c) Prior to use for monitoring:

(1) After check-out, put on 500 scale and allow to set for 5 minutes to warm up all electronic components.

(2) Put on harness.

(3) Connect the headset to its jack.

(4) Check BATT condition.

(5) Start survey readings on highest scale and work down. Stop at range scale where meter gives indication of radiation.

(6) For GAMMA survey, carry instrument at waist level.

(a) Maintain meter or its probe at same distance from surface.

(b) Turn instrument so tube in use is facing source or highest indication.

(7) For BETA indication (Food or food preparation areas mainly):

(a) Use probe with meter on 5 or .5 mr/hr range.

(b) Leave BETA shield in place for initial reading.

(c) Remove shield, take reading and calculate BETA contribution.

(8) To illuminate for use at night or in dark areas, tilt instrument to about 45 degrees and small lamp inside will illuminate dial.

(9) Calibration:

(a) Performed at authorized shore establishments only.

(b) Must be performed in an area free of large metallic objects to avoid inaccuracies.

(c) Instrument should be recalibrated whenever error is plus or minus ten percent.

(d) To secure instrument:

(1) Be sure instrument switch is OFF.

(2) Replace in case and secure fasteners.

(3) For prolonged storage, remove batteries.

(3) Maintenance. At first opportunity send instrument ashore to nearest authorized shore maintenance activity.

2. Hi-Rate Survey Meter - AN/PDR-18 Series (Scintillation Counters).

a. The AN/PDR-18 series radiac set is a portable survey instrument consisting of a detector with a sensitive phosphor crystal element which fluoresces, or scintillates, when exposed to gamma radiation, a photo-multiplier tube which multiplies the extremely small current caused by the radiation, an electronic amplifier circuit, a rate meter and a combination battery and vibrator power supply. This device is designed to detect and measure gamma radiation only.

b. It measures high intensity gamma radiation over four ranges: 0 to .5r/hr, 0 to 5r/hr, 0 to 50r/hr, and 0 to 500r/hr.

c. It has a nine-position rotary selector switch mechanically geared to the meter dial. The position of the switch at any particular time shows through an opening in the meter face. The first five positions are from OFF through battery checks and calibrations; the background for these positions is white. The last four positions are for the range scales; their backgrounds are color coded according to the degree of danger represented by readings in each range.

d. A push-button illumination switch on the handle turns an internal lamp on to illuminate the meter face at night or in dark areas.

e. General description and operation of the AN/PDR-18A, Hi-R GAMMA survey Meter (See illustration).

(1) Meter design.

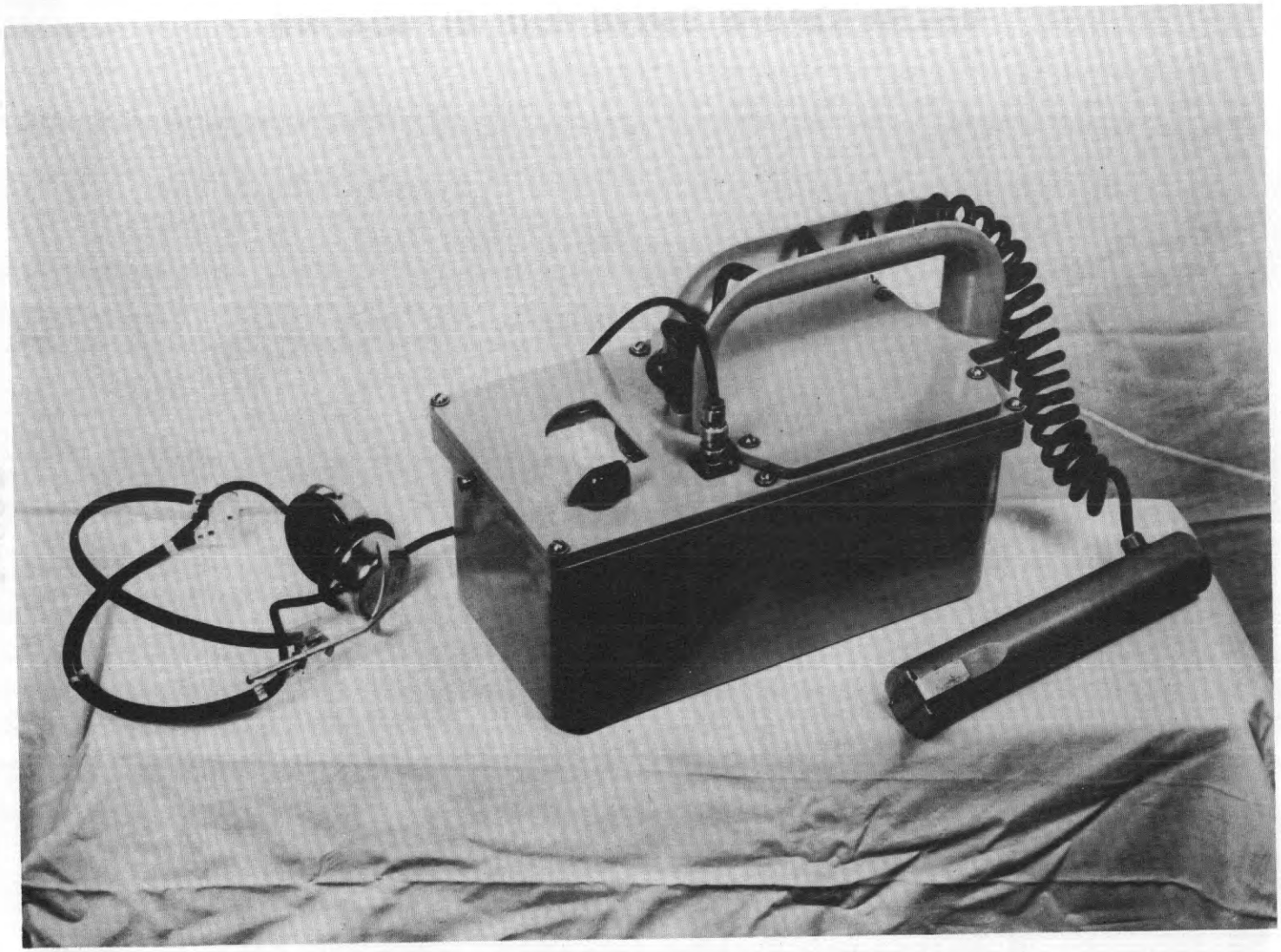
(a) High intensity scintillation counter.

(1) Gamma Survey Meter ONLY.

(2) Range 0 to 500 Roentgens per hour (r/hr).

(b) Range scale color code of the meter.

Color	Degree of dnager	Range of scale
(1) Red	Mortally dangerous	0 to 500 r/hr
(2) Pink	Extreme danger	0 to 50 r/hr
(3) Orange	Slight danger	0 to 5 r/hr
(4) Yellow	Negligible	0 to .5 r/hr



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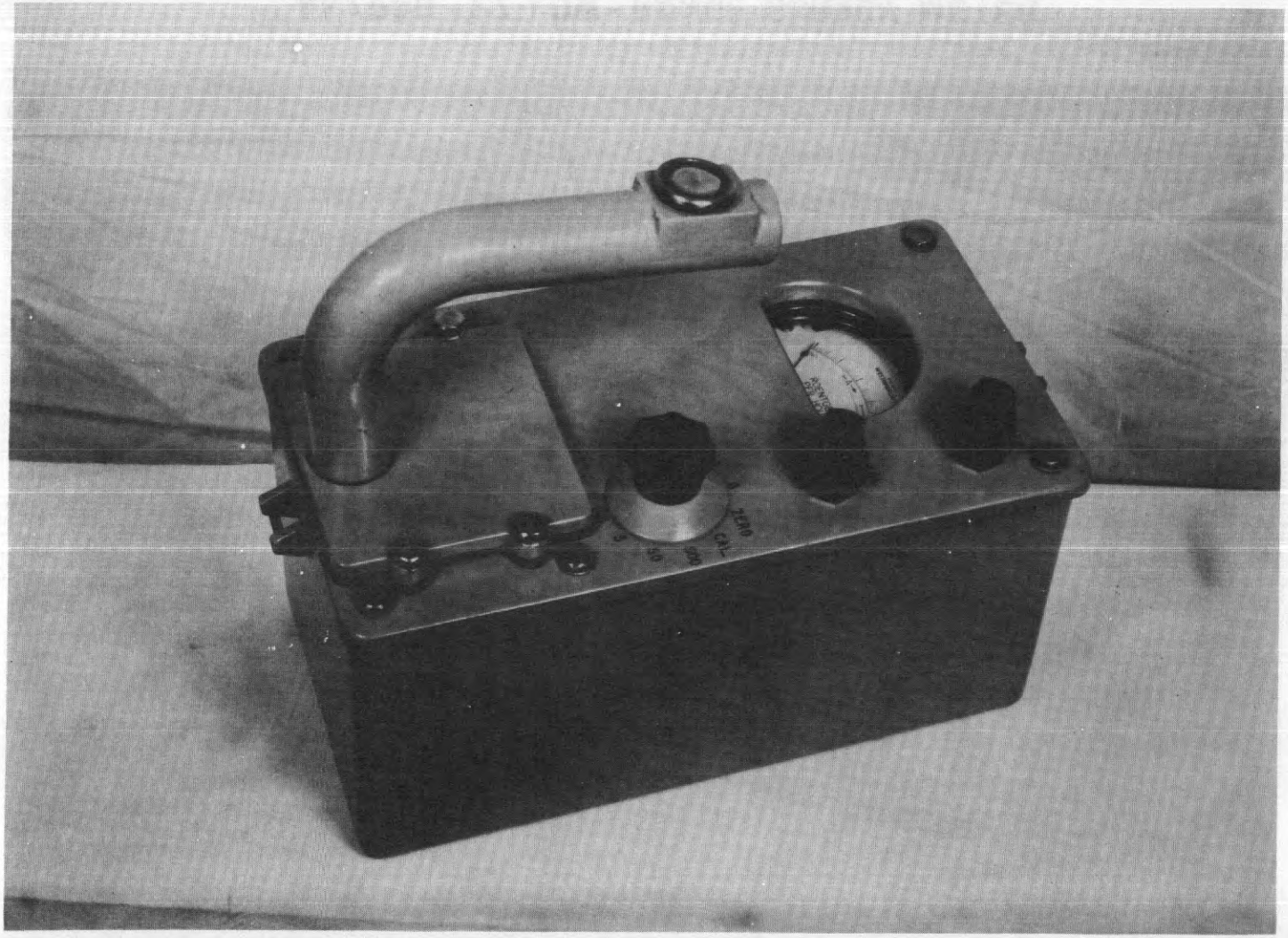
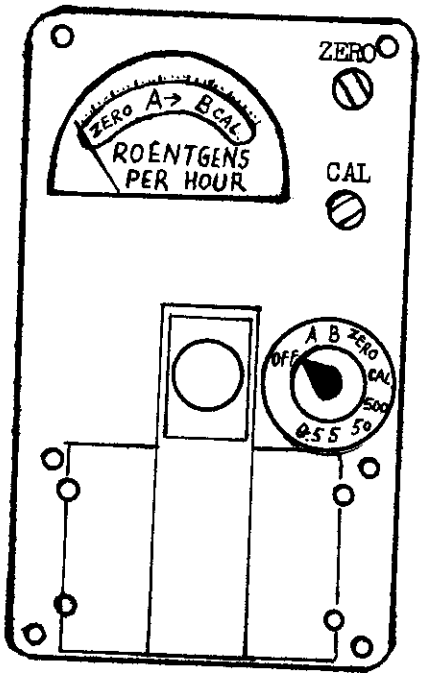
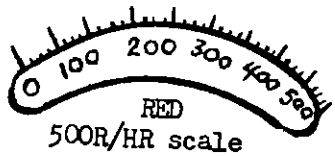
AN/PDR-27 LOW-RANGE SURVEY METER

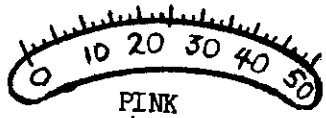


AN/PDR-18 HIGH RANGE SURVEY METER

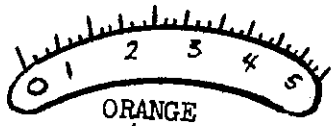




RED
500R/HR scale



PINK
50 R/HR scale



ORANGE
5 R/HR scale

YELLOW
.5 R/HR scale

HI-RATE SURVEY METER - AN/PDR-18A (GAMMA HIGH INTENSITY)

(c) Meter range selector.

(1) Located to the right of the handle.

(2) The selector knob has nine positions.

OFF	Zero adjustment	50 r/hr
A-Batt check	Cal adjustment	5 r/hr
B-Batt check	500 r/hr	0.5 r/hr

(a) The above positions are printed on the dial.

(b) In the first five positions the dial background is white.

(c) The remaining four positions are for the range scales of the meter.

(d) Zero Adjustment Knob.

(1) It is used to set the instrument needle on zero prior to use.

(2) It must be set prior to calibration.

(e) Calibration Knob.

(1) Used to adjust the sensitivity of the instrument.

(2) The sensitive element is exposed to a source within the instrument.

(2) Power Supply.

(a) Six dry cell 1½ volt batteries. (Do not use photo-flash batteries).

(b) Limited battery life requires zero and sensitivity checks.

(3) Chassis Design.

(a) Watertight.

(b) Portable.

(c) Smooth hard finish for easy decontamination. (Do not repaint.)

(d) Simple operation.

(e) Easily operated with gloves.

(f) Lugs on instrument for shoulder strap attachment.

(g) Push button on the handle for dial illumination at night.

(4) Operating Procedures.

(a) Routine check prior to using the instrument on a survey.

(1) Turn the range selector knob from "OFF" to "A" position.

(a) It should read on or to the right of "A" marker.

(b) This indicates proper functioning of the filament current supply.

(2) Turn the selector knob to "B" position.

(a) It should read on or to the right of "B" marker.

(b) This indicates an ample power supply.

(3) Turn the selector knob to "ZERO" position.

(a) Adjust needle to ZERO by means of the ZERO adjustment knob.

(b) Essential to check ZERO frequently, especially in the field.

(4) Turn selector knob to "CAL" position.

(a) Adjust needle to calibrate full scale deflection. (Needle must settle on scale division farthest to the right.)

(b) For detection and measurement:

(1) Assure yourself of instrument check.

(2) Attach harness.

(3) Adjust instrument for waist level survey carry.

(a) All readings must be taken at waist level.

(b) Maintaining the same distance from the surface being monitored will provide a true survey picture.

(4) Turn range selector to the highest range scale (0 - 500 r/hr).

(a) Always start at the highest range scale and work down.

(b) Turn down to the next range that will give an indication.

(5) To illuminate the dial at night, press the button on the handle.

(6) To secure the instrument:

(a) Be sure that the selector switch is in the "OFF" position.

(b) Spent batteries cause corrosion. Therefore, for prolonged storage remove the batteries.

(c) Replace the instrument in the case and return to storage place.

(5) Maintenance. Confine maintenance to operating checks on face of instrument.

(a) If the instrument does not satisfy check requirements, turn it in to an authorized shore repair facility at the first opportunity for repairs and recalibration.

(b) Take the instrument to an authorized shore repair facility once every six months for testing, overhaul and recalibration if necessary.

Note: This instrument is used for surveying areas suspected of being contaminated only, never for personnel monitoring.

3. Alpha Survey Meter - AN/PDR-10 Series (Proportional Counter).

a. The AN/PDR-10 series radiac set is a portable device to detect and measure the intensity of alpha radiation. It consists of an ionization chamber detector, an electronic amplifier, a meter, a battery power supply, and earphones. It measures alpha radiation in disintegrations

per minute per 150 square centimeters. This is the area measured by the window in the bottom of the case. Therefore, this meter measures the disintegration of atoms in an area of 150 square centimeters of surface of any object. The indicator reads up to 10,000 counts per minute. Radiations are also indicated by clicks heard in the earphones. Since the range of an alpha particle is 1" to 3" in air, readings must be taken close to the surface of the material checked. Take care not to touch the surface since this would contaminate the face of the ionization chamber and cause an erroneous reading.

b. This set has two switches, a function switch and a discharge switch. The function switch has four positions with the following settings:

POSITION	INDICATES
OFF	Batteries disconnected; radiac set is off.
CHG	Storage capacitor that maintains high voltage across ionization chamber is being charged.
BATT-COND	Indicates condition of the batteries.
READ	Presence of radiation is registered on the meter.

c. The AN/PDR-10 is operated from a storage capacitor, not directly from the battery pack. The batteries are used to charge the storage capacitor only. The discharge switch is used to discharge the capacitor and the ion chamber, which should be done before securing the instrument for stowage.

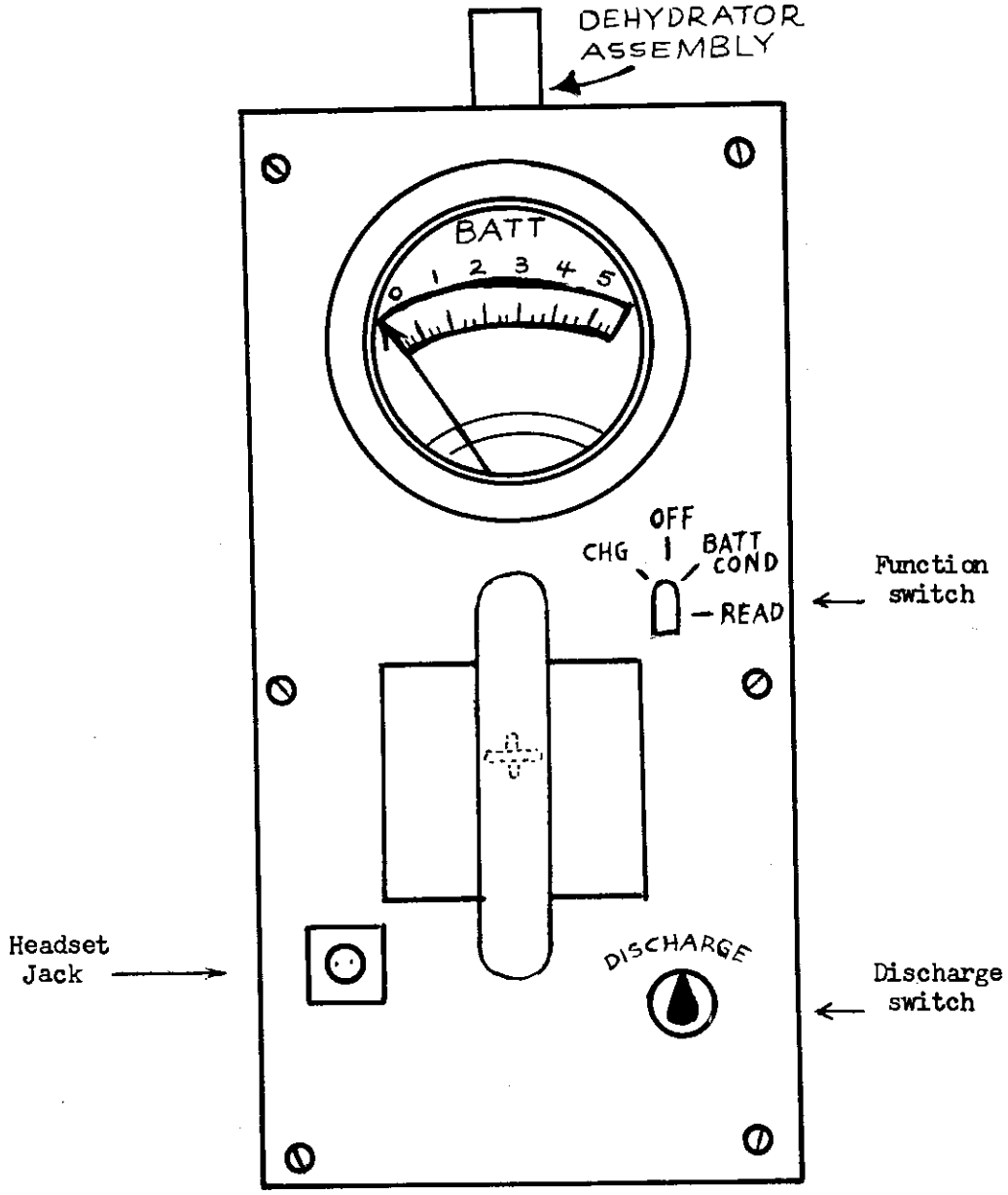
d. To operate the set:

(1) Turn ON/OFF switch to charge for 15 seconds - no more. While charging, a buzzing sound will be heard in earphones.

(2) After charging, a hissing sound will be heard in the earphones. This is called corona, and is caused by an overcharge. Turn the discharge switch briefly until the hissing stops, then turn to "discharge" once more. The instrument is now ready for use.

(3) Allow the instrument to stand undisturbed for 10 minutes. Then repeat step (2). Turn the switch to "READ" and check the background count. Clicks heard should be less than three per minute averaged over a five minute period. If the background count is more than three clicks per minute averaged for five minutes, turn the meter in for repair.

(4) Turn the functional switch to "READ" and allow five minutes to warm up. Then proceed to take your reading.



ALPHA SURVEY METER-AN/PDR-10
(FOR MONITORING FOOD)

(5) When finished with readings, make sure you turn the functional switch to "OFF".

e. In order to permit reading the meter scale in the dark, a light is included in the meter. It is turned on by tilting the meter 45 degrees from the horizontal.

f. Description and operation of the AN/PDR-10 (Used mainly for monitoring food and food preparation areas).

(1) It is a proportional counter for ALPHA contamination.

(a) Detects ALPHA rays in the presence of both BETA and GAMMA radiation.

(b) Intensity shows directly on the meter in ALPHA disintegrations per minute per 150 square centimeters (cm^2) x 1000.

(c) Measures from zero to 10,000 disintegrations per minute (D/M).

(d) Employs theory of ionization measuring pulses caused by burst, or avalanche, of ions from each ALPHA particle entering chamber.

(e) The clicks, heard in the headset, are from pulses before they are smoothed out for the meter.

(f) It is not affected by GAMMA rays because the instrument measures the amount of large pulses or bursts.

(2) The instrument case is of aluminum, it houses all units, and it may be completely disassembled.

(3) The headset provides an audible signal to check on functioning of the instrument and to locate the center of the source.

(4)

(a) Panel components.

(1) Two operating switches.

(2) Headset receptacle or jack receptacle.

(3) Battery compartment cover.

(b) Counter chamber.

(1) Chassis forms the top and thin foil aluminum window the bottom.

(2) The entire instrument is waterproof with the exception of the windows.

(c) Dehydrator.

(1) Its purpose is to dehumidify the counter chamber.

(2) It turns pink when in need of drying out. "Tell-tale" crystals are normally colored blue.

(3) Replace the crystals after three (3) dryings.

(4) Dry out crystals by heating gently.

(d) To illuminate the meter scale for night use, tilt the instrument 45 degrees from the horizontal.

(5) Placing the instrument in operation (See illustration).

(a) Routine check. (Must ALWAYS precede use).

(1) Remove instrument from case.

(2) Connect the headset.

(3) Charge the meter.

(a) Turn function switch to "CHG".

(i) A buzzing sound will be heard in the headset.

(ii) When charged, the buzzing will be followed by a hissing sound.

(b) Meter requires from five to fifteen seconds charging before using. This instrument operates off a charged high voltage capacitor not on direct battery power. (The batteries are only used to place a charge on the capacitor).

(4) Turn function switch to "BATT COND".

(a) Hissing sound will continue.

(b) Meter acts as a voltmeter, indicates condition of the batteries.

(i) If the meter reads to the right of the arrow, the batteries are good.

(ii) If the meter reads to the left of the arrow, replace all batteries.

(5) With function switch remaining on "BATT COND", turn the discharge switch counterclockwise and release immediately. This removes the overcharge, called "corona", from capacitor.

(a) Repeat as many times as necessary to stop the hissing.

(b) When the hissing stops, repeat once more.

(6) Allow the radiacmeter to stand undisturbed for ten minutes. Then repeat the procedures of (3) and (4).

(7) Allow the radiacmeter to stand undisturbed for five minutes. Then turn the function switch to "READ" position.

(a) Check the instrument for background count. With the instrument away from the radioactive source in the case, the average number of clicks heard in the headset should be less than three per minute (averaged over a period of five minutes).

(8) Place meter over source in case.

(a) Meter should indicate reading.

(b) Radioactive source in the case is POTENTIALLY DANGEROUS.

Note: If the instrument has been used in the last five days, steps (6) and (7) may be omitted.

(b) Detection and measurement.

(1) Insure that the meter is charged and checked out.

(2) Turn the function switch to "READ".

(3) Lock the protective cover back to the side of the instrument body.

(4) Place the window close to the surface to be monitored.

(a) Distance from surface should be 1/16" for surface measurements. Legs are provided for use on a flat surface. (Caution- Do not permit the instrument to touch contaminated material as this will contaminate the window and give continuous false readings.)

(b) Be careful of any protruding sharp objects which might puncture the window.

(5) Use the headset to locate the center of the source.

(6) Allow the needle to settle on a meter scale division. Readings will be in disintegrations per minute per 150 cm^2 times 1000.

(c) Additional readings.

(1) For higher readings, no adjustment is necessary.

(2) For lower readings, adjustments will quicken the meter response.

(a) Turn function switch to "BATT COND".

(b) Turn back to "READ". Meter should indicate zero before being exposed to radiation again.

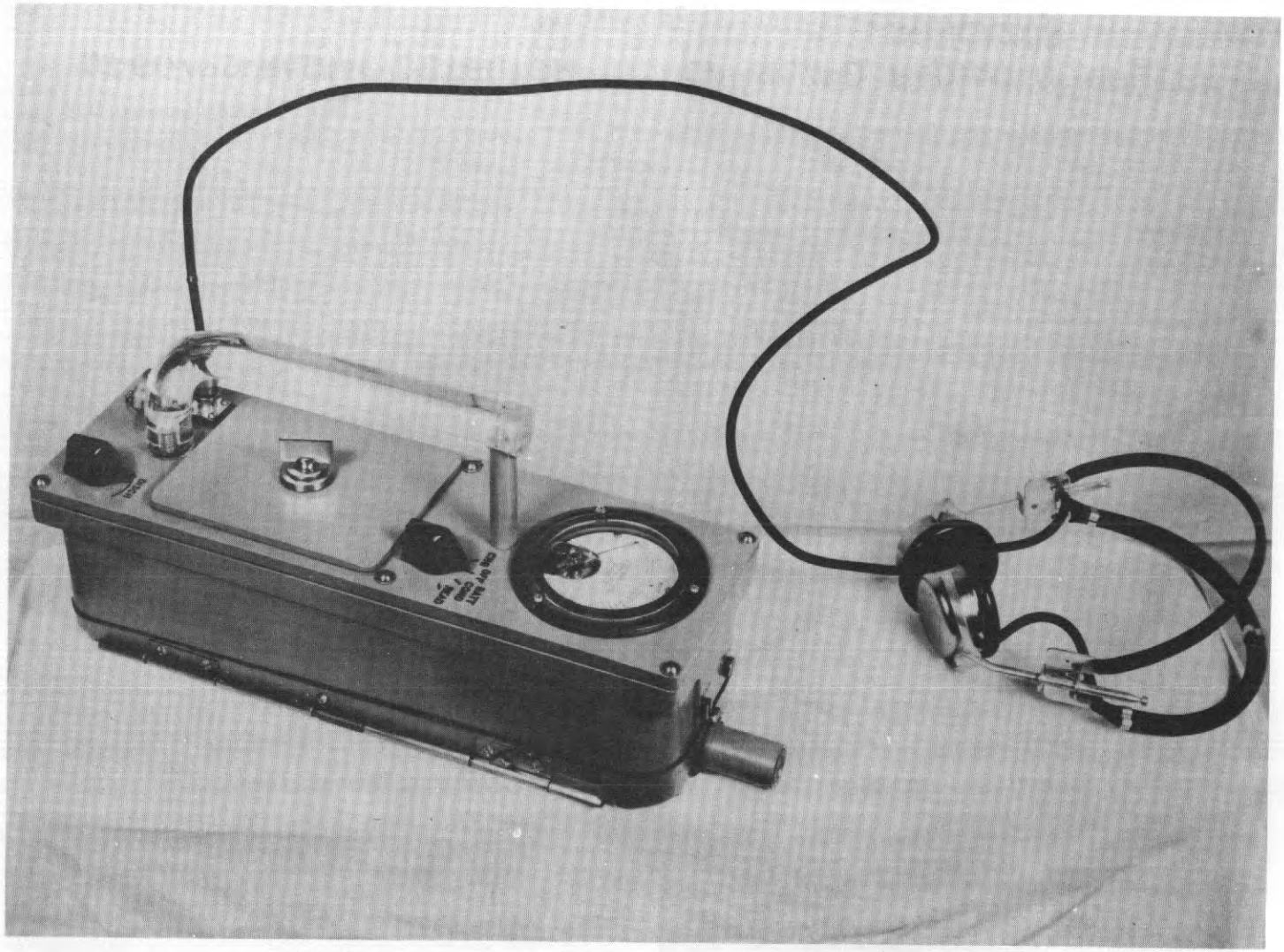
(d) Indication for need of recharging while using instrument.

(1) Will need charging according to climatic conditions.

(a) Every two (2) hours in normal climate.

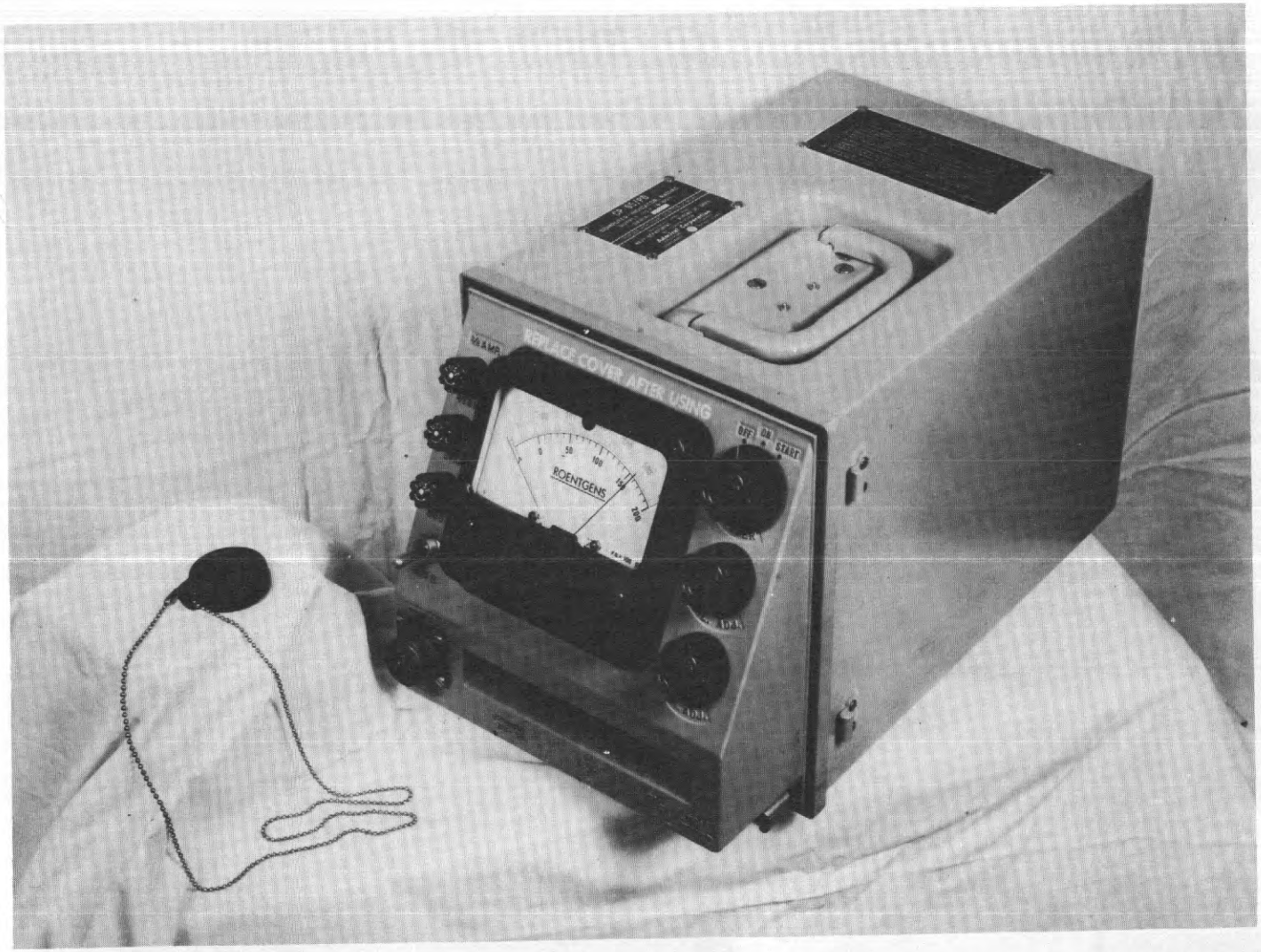
(b) Every five to ten minutes in a hot humid climate.

(2) When in need of charging, the meter will not stop counting on "READ" (the needle will not settle).



3-102A

AN/PDR-10A ALPHA SURVEY METER



DT 60/PD RADIAC DETECTOR

CP-95/PD RADIAC COMPUTER-INDICATOR

(6) Maintenance.

(a) Confine maintenance to the routine checks described above.

(b) When the instrument fails to respond properly to these checks, turn it in to the nearest authorized radiac repair shop ashore at the first opportunity.

(c) Every six months, take the instrument to the nearest authorized shore radiac repair shop for test, repair, battery change and recalibration.

B. Dosimeters (Personnel Protective Devices) - The dosimeter is probably the most widely used instrument in the nuclear industry. It is an instrument designed to detect and measure an accumulated dose of radiation. There are two basic kinds of dosimeters -- self-indicating and non-self-indicating. Dosimeters are used to indicate the total radiation dosage to which an individual has been exposed.

1. Film Badges. Film badges, as the name indicates, consist of small packets containing photographic film sensitive to gamma radiation and beta particles. Each film is packaged in a light-proof envelope. An external metal shield fits over part of the packet. The unshielded portion will record both beta particles and gamma radiation while the shielded section will record only gamma radiation.

a. Non self-reading film badges have to be sent to a laboratory for developing and processing. This results in a considerable time lapse between exposure to radiation and the final evaluation of dosage.

b. Self-developing film dosimeters based on the principle of Polaroid-Land camera film have been developed.

c. An important requirement for all film dosimeters is that each batch of film should be standardized. Different lots from the same manufacturer differ sufficiently to make it unwise to use them without calibration. A control piece from each lot of film must be developed without exposure and used for comparison with each exposed piece of film in a "densitometer" to determine the dosage absorbed by the individual film badge, and its wearer.

2. Phosphor-Glass Dosimeter (DT-60/PD.) The phosphor glass dosimeter is a small bakelite case slightly larger than an identification tag, containing a specially prepared phosphor glass crystal. Exposure of the glass to gamma radiation produces changes in its internal structure so that when the glass is examined by certain special wave lengths of ultraviolet light, it will glow. The luminescence can be picked up with a photo-multiplier tube, and through an amplifier, can be made to indicate

the radiation exposure of the glass on a meter calibrated in roentgens. The special light source, photo-multiplier tube, meter, etc., required for reading the glass are contained in an auxiliary device called a "computer-indicator". The DT-60/PD is a cumulative device indicating from 0 to 60 DR.

3. Pocket Dosimeter (IM-9/PD). This is a low reading dosimeter shaped like a fountain pen and used for brief periods of exposure. Before wearing, the indicator must be set on zero with a radiac detector charger. It has its own self-contained direct reading scale. These dosimeters detect and measure total GAMMA dosage up to 200 MR.

C. Radiac Computer-Indicator - CP-95/PD.

1. Description. The Radiac Computer-Indicator is a portable instrument designed for computing and indicating the total amount of X-ray and/or gamma radiation to which dosimeter DT-60/PD (and thus the wearer) has been exposed. The computer-indicator is operated from a 120 Volt, 60 cycle AC power source. Its function is to read the exposure registered by the DT-60/PD dosimeter which contains a crystal of phosphor glass, coated with a special silver compound. The DT-60/PD is a cumulative recording device and readings indicate "total cumulative exposure".

2. Measuring Dosage. To measure the total accumulated exposure dosage of a DT-60/PD dosimeter, place the detector in the computer-indicator. It is exposed to a source of ultra-violet light which causes the silver coated phosphor glass to fluoresce, emitting an orange luminescence.

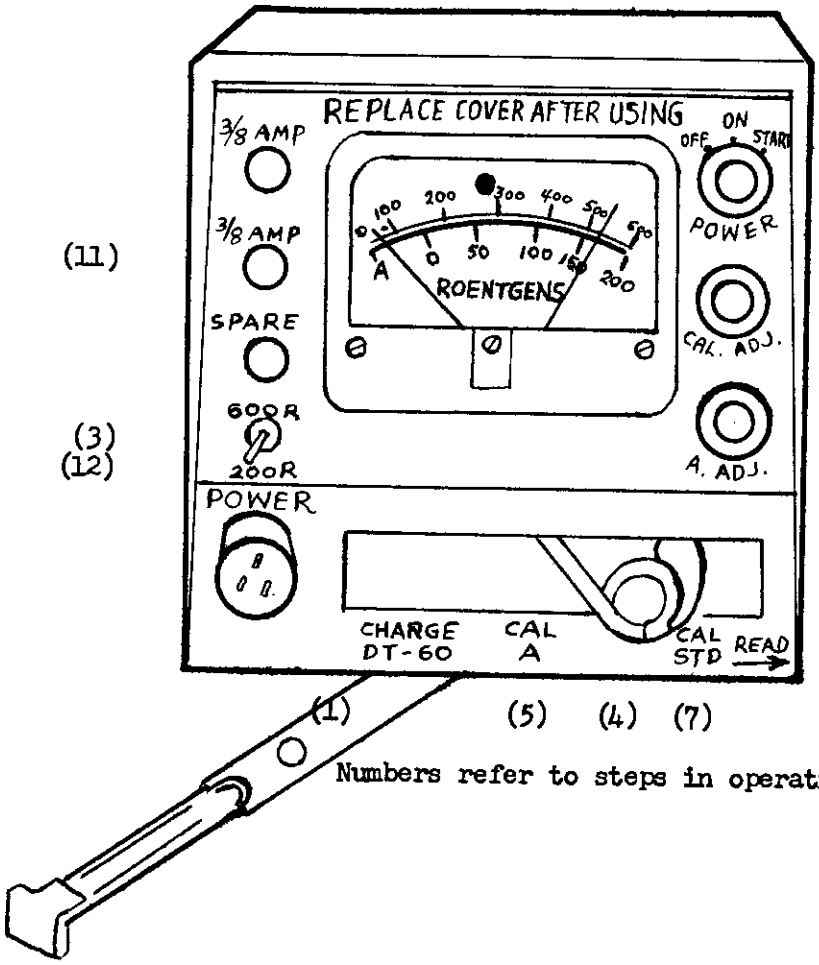
a. A standard crystal that has been exposed to a specified amount of radiation is contained in the skillet of the computer-indicator. The computer-indicator is calibrated to this standard and it compares the DT-60/PD being read with its standard to compute the reading.

b. The luminescence emitted by the DT-60/PD being read is measured by a photo-multiplier tube, fitted with a filter to eliminate passage of blue and green light. The photo-miltiplier tube employs the principle of secondary emission to amplify the initial electron emission caused by the filtered orange luminescence illumination of the light sensitive cathode.

c. The output of the photo-multiplier tube is applied to an indicating circuit to indicate on a dial the accumulated total amount of radiation, to which the dosimeter (and thus the wearer) has been exposed.

3. Operation of Computer-Indicator CP-95/PD (See illustration).

a. Connect power cable to computer-indicator and screw connector sleeve up tight. Then plug into 110-120 Volt, 60 cycle AC outlet. Turn on the power switch and allow five minutes to warm up.



Numbers refer to steps in operating procedures.

COMPUTER - INDICATOR CP-95/PD

(1) Extend operating lever and move left to "Charge" DT-60 position.

(2) Turn "ON-OFF" switch to "ON" position and then further continue to "START" until the red light at the upper center of the dial shows, then release the switch.

(3) Flip the range selector toggle switch (lower left side) to the 200R position.

(4) Insert the DT-60 dosimeter into socket in the skillet.

(5) Move the operating lever to "CAL A" position.

(6) With the lower right side control knob, adjust the black needle to "A" on the dial.

(7) Move the operating lever to "CAL STD" position.

(8) With the center right side control knob, adjust the black needle to coincide with the red needle on the dial.

(9) Repeat (5), (6), (7) and (8) until the black needle coincides successively with "A" and red needle.

(10) Move operating lever to "READ" position.

(11) Read accumulated dose on dial of meter.

(12) If the needle registers past the 200R graduation on the lower (black) scale, throw the selector toggle switch to 600R and read the accumulated dose on the upper (green) scale.

NOTE 1: Operators must limit their maintenance to adjustments on the front panel, i.e., fuses, RED and BLACK pointer adjustments.

NOTE 2: 115 Volt AC power supply only is to be used. It requires about five minutes warm-up period with the selector toggle switch on the 200R setting. Before using a new instrument, remove the skillet stop, check value of STANDARD marked on top of STANDARD, and check to see that the setting of the RED pointer agrees with this value. If not, reset the RED pointer by means of the small screw just below the center of the meter. Move the skillet to the right and replace the skillet stop.

b. Calibration: Always calibrate with the toggle selector switch set on the 200R range scale.

(1) With the lower knob on the right side of the panel, adjust the needle to the "A" position - skillet in first position with shutter closed, marked CAL A.