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**USER HANDBOOK**  
**FOR**  
**METER, SURVEY, RADIAC**  
**No. 2 EQUIPMENT**

(Supersedes W.O. Code No. 19514)

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## SYNOPSIS

The Meter, Survey, Radiac, No.2 is a portable battery operated instrument used for surveying an area for radioactive contamination. It may also be used in the absence of a Meter, Contamination, No.1 to obtain a rough indication of personal contamination.

The instrument measures dose-rate in three ranges, 0-3, 0-30 and 0-300 roentgens per hour. It can be quickly adapted for the assessment of beta particle activity as well as for the measurement of gamma rays.

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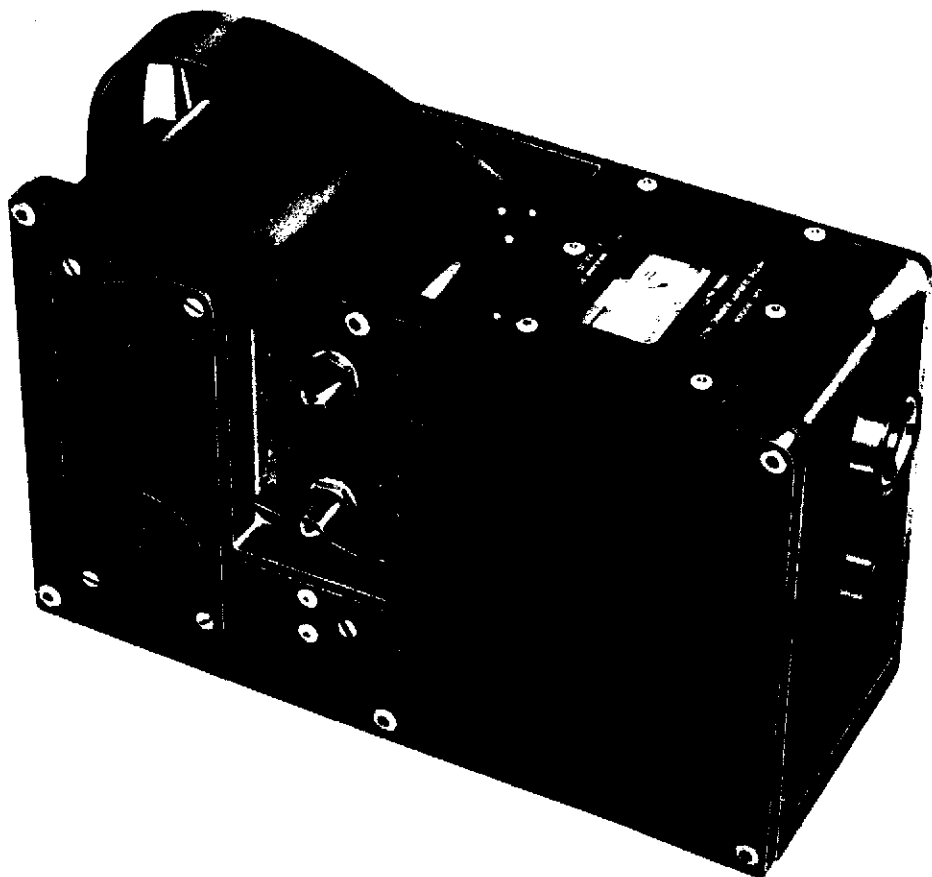
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## CHAPTER ONE

**GENERAL DESCRIPTION****101. PURPOSE AND FACILITIES**

The Meter, Survey, Radiac No.2 is a portable battery operated instrument used for surveying the extent of radioactive contamination in a suspected area. It may also be used to obtain a rough indication of personal contamination in the absence of a Meter, Contamination, No.1.

It employs a built-in ionisation chamber as the detecting element and can be quickly adapted for the assessment of beta particle activity as well as for the measurement of gamma rays. The dose-rate in roentgens per hour is indicated on a direct reading meter which has three ranges, 0-3, 0-30 and 0-300. Provision is made for the illumination of the meter scale, as required.

A haversack is provided, so designed that the instrument can be used whilst being carried in it.

**102. PRINCIPLES OF OPERATION**

The use of an ionisation chamber as a detecting element relies on the fact that air, normally a perfect insulator, becomes ionised when subjected to radioactivity; in this condition it is a partial conductor of electricity.

The basic arrangement is as shown in fig.1. The walls of the chamber form an outer electrode and between this and a centre electrode are connected a battery and a meter. If the chamber is now exposed to radioactivity the air will become ionised and a current will flow through the meter; the strength of the current will depend upon the degree of ionisation, which in turn will depend upon the degree of radioactivity.

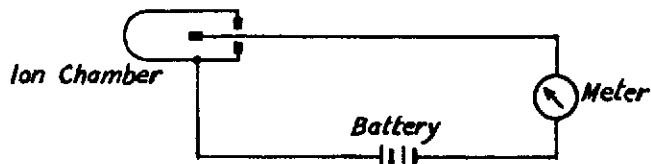


Fig. 1

In the Meter, Survey, Radiac No.2 an electrometer valve (an amplifying valve with exceptionally high insulation) is used in conjunction with the ionisation chamber to obtain an improved indication and the meter is calibrated in roentgens per hour. The roentgen is the basic unit of measurement of radiation dose and is defined in terms of the number of ions per cubic centimeter produced in air under certain standard conditions.

In order to enable a separate measurement of beta radiation to be made a window is provided in the outer wall of the ionisation chamber, and a hinged cover plate is arranged to obscure or expose the window at will. With the cover closed only gamma radiation can penetrate into the chamber, but with it open the thin window allows the entry of beta radiation also; the meter indication is then proportional to the total of gamma plus beta radiations.

### 103. GENERAL CONSTRUCTION

The instrument is built in a rectangular case with two compartments and is provided with a collapsible carrying handle. The main compartment is hermetically sealed and a desiccator is provided to maintain a low relative humidity. The batteries are accommodated in the second compartment which is water-proof.

The Supply and Range control knobs are located in a recess at the side of the case so that they do not project. The settings of both controls are indicated on the meter scale plate by means of movable segments mechanically linked to the controls. The scale plate can be illuminated if so required.

A plate, normally screwed to the bottom of the instrument, covers the Beta Window assembly to exclude dust and dirt. THIS PLATE MUST BE REMOVED WHEN AN ASSESSMENT OF BETA IS REQUIRED.

The haversack is constructed from PVC impregnated cloth which is more easily decontaminated than webbing and is also impervious to the ravages of dampness, oil, grease, etc. It has a window in the top flap for viewing the meter scale and a side flap for access to the control knobs. The haversack is padded to give protection against light mechanical shocks and has an adjustable carrying strap; in addition a cord is provided for securing the instrument close to the hip of the wearer. A small pocket in the top flap of the haversack houses a tool which is used for the adjustment of the pre-set control on the instrument.

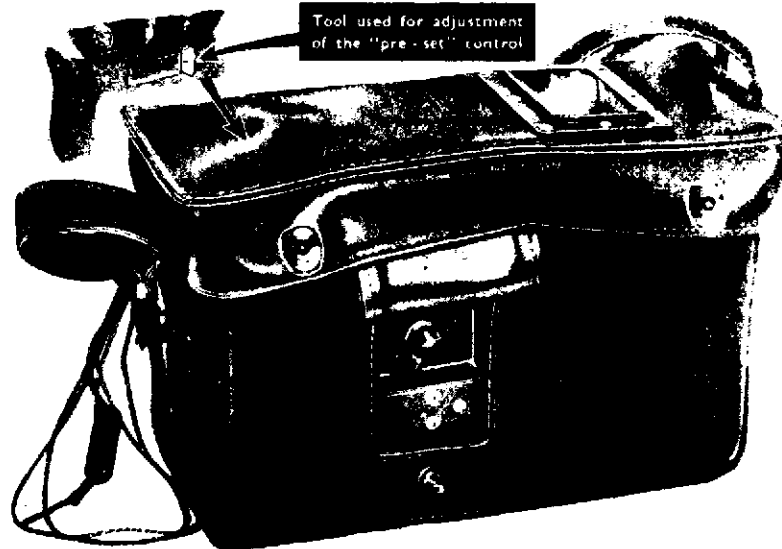


Fig. 2

#### 104. POWER SUPPLIES

The instrument requires one 30 volt dry battery, one 9 volt dry battery and two 1.5 volt cells. Details of these are given in the table below.

BATTERY	ARMY VOCAB. SECTION & JOINT SERVICE CAT. NO.	APPROX. WORKING LIFE	NEAREST COMMERCIAL EQUIVALENTS
30 volt	Y3/6135-99-910-1163	400 hours	Drydex 523 Ever Ready B123 Pertrix 8123 Siemens S123
9 volt	Y3/6135-99-910-1162	400 hours	--
1.5-V cell (Fil)	Y3/6135-99-910-1101	150 hours	Ray-O-Vac 2LP Ever Ready U2 Drydex T20 G.E.C. BA6103
1.5-V cell (Lamp)∅	Y3/6135-99-910-1101	16 hours	Oldham 532 Siemens T1 Vidor V0002

∅ Used solely for illuminating the meter scale.

#### 105. WEIGHT AND DIMENSIONS

The complete equipment weighs 9 lb., and the dimensions are:-

##### Meter, Survey, Radiac, No.2

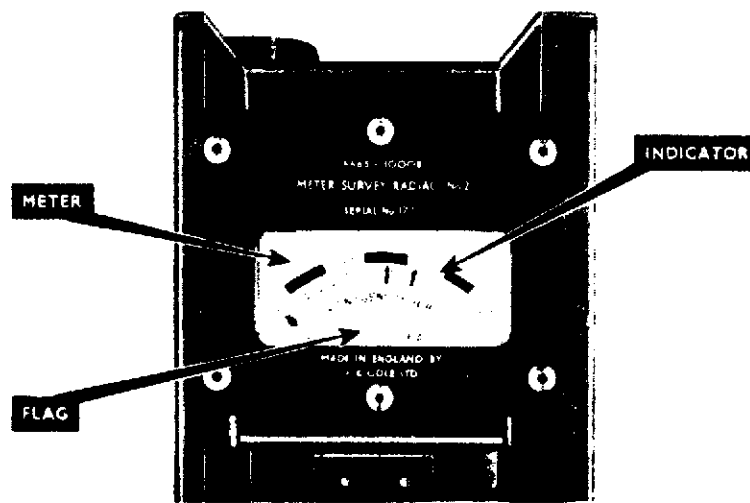
Length .. .. .	9.1/4 in.
Width .. .. .	3.3/4 in.
Height .. .. .	5.3/4 in.

##### Haversack Assembly, Special, No.6

Length .. .. .	11.1/2 in.
Width .. .. .	5 in.
Height .. .. .	7 in.

#### 106. CONTROLS, ETC.

This section of the User Handbook is broadly termed Controls, etc. to include all external details of the Radiac Survey Meter and explain their function.



Item	Function
METER	Indicates dose-rate (gamma or gamma+beta) in roentgens per hour or, with the SUPPLY SWITCH set to Battery Test, the voltage of the 1.5-V filament supply cell. Scale figures are carried on an INDICATOR, mechanically coupled to the RANGE SWITCH and viewed through an aperture in the scale; the figures are thus changed to suit the range in use.
INDICATOR	Indicates the RANGE SWITCH setting, (which may be either 0-3, 0-30, 0-300 roentgens/hr. or Set Zero).
FLAG	Exposes the word ON or OFF according to the setting of the SUPPLY SWITCH.

**SUPPLY SWITCH**

A four-position switch mechanically linked to the FLAG on the METER and providing the following facilities:-

**OFF:** Disconnects the battery supplies to the instrument. (The FLAG indicates OFF).

**BATTERY TEST:** For checking the condition of the 1.5-V valve filament cell.

**ON WITH LAMP:** Switches ON both instrument and dial lamp.

**ON:** Switches ON instrument but not dial lamp.

(FLAG indicates ON for last three settings).

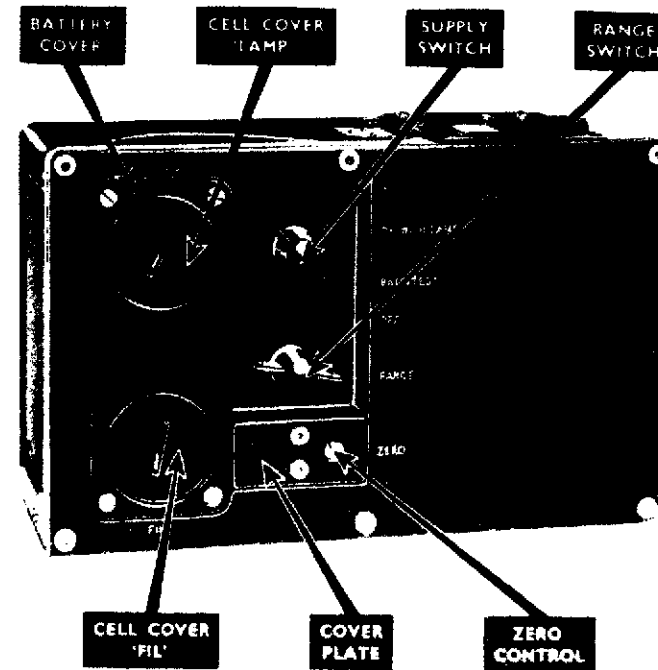
**RANGE SWITCH**

A four-position switch to select the three ranges of sensitivity and also the appropriate meter scale INDICATOR, as below. The fourth position, when Set Zero appears on the indicator, is used in conjunction with the ZERO CONTROL when preparing the instrument for use.

Switch Position	Scale Indicator	
	Range	Colour
First	0-3 r/hr.	White
Second	0-30 "	Blue
Third	0-300 "	Red
Fourth	SET ZERO	White

**ZERO CONTROL**

Used to obtain the correct electrical balance internally, as indicated by the METER when the RANGE SWITCH is set to Set Zero.



**COVER PLATE**

Provides access to the Calibration Control. THE USER MUST NOT REMOVE THIS PLATE.

**CELL COVER 'LAMP'**

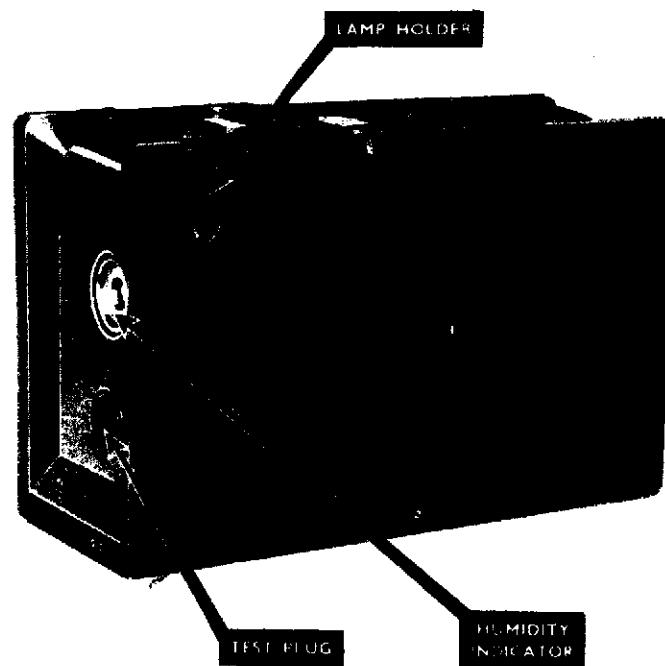
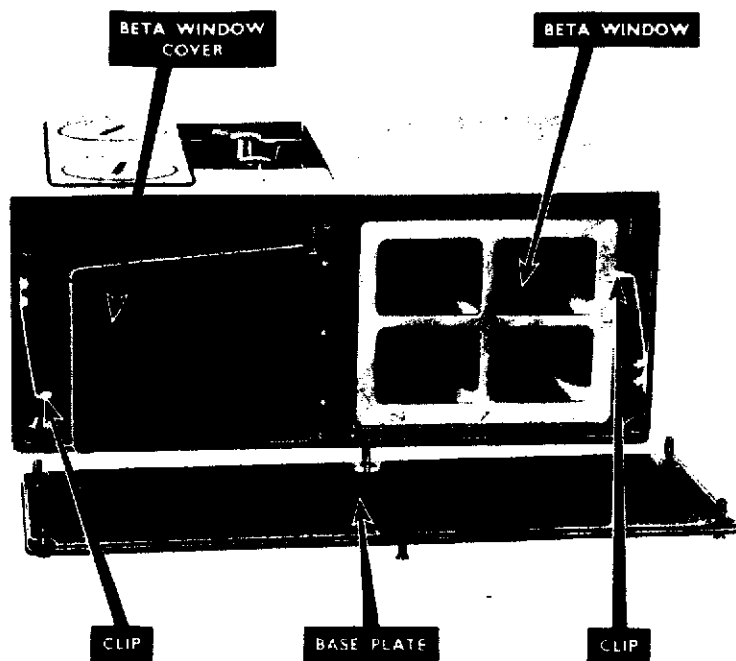
Provides access to the 1.5-V cell used for dial lamp supply.

**CELL COVER 'FIL'**

Provides access to the 1.5-V cell used for valve filament supply.

**BATTERY COVER**

Provides access to the 9-V and 30-V batteries.



NOTE: REMOVAL OF ANY OF THE FOLLOWING THREE ITEMS WILL DESTROY THE HERMETIC SEAL OF THE INTERIOR AND CONSEQUENTLY THESE SHOULD ONLY BE REMOVED BY REME WORKSHOPS WHO ARE EQUIPPED TO ENSURE THE CORRECT SEALING CONDITIONS.

BASE PLATE	Protects the BETA WINDOW AND COVER from dust and dirt. (Must be removed when an assessment of the beta hazard is required).
BETA WINDOW AND COVER	The window provides a comparatively unobstructed path for beta particles into the ionisation chamber. The hinged cover is used to exclude beta particles when a separate measurement of gamma radiation is required.
CLIPS	To retain the BETA WINDOW COVER in the required position.

LAMP HOLDER	Provides access to the 1.5-V, 0.165-W lamp (Cat. No. Y3/6240-99-995-1103) used for meter scale illumination.
HUMIDITY INDICATOR	This should always display a bluish colour, indicating that the instrument is dry internally. If it turns pink the presence of excessive dampness is indicated, which may affect the accuracy of the instrument.
TEST PLUG	This plug is only removed to carry out calibration tests.



The complete equipment is held in Army Vocab. Section Z8 under Joint Service Cat. No. 6665-99-911-0130 and is designated Meter, Survey, Radiac No. 2 Equipment. Nomenclature for the individual items of equipment is given in fig. 3.

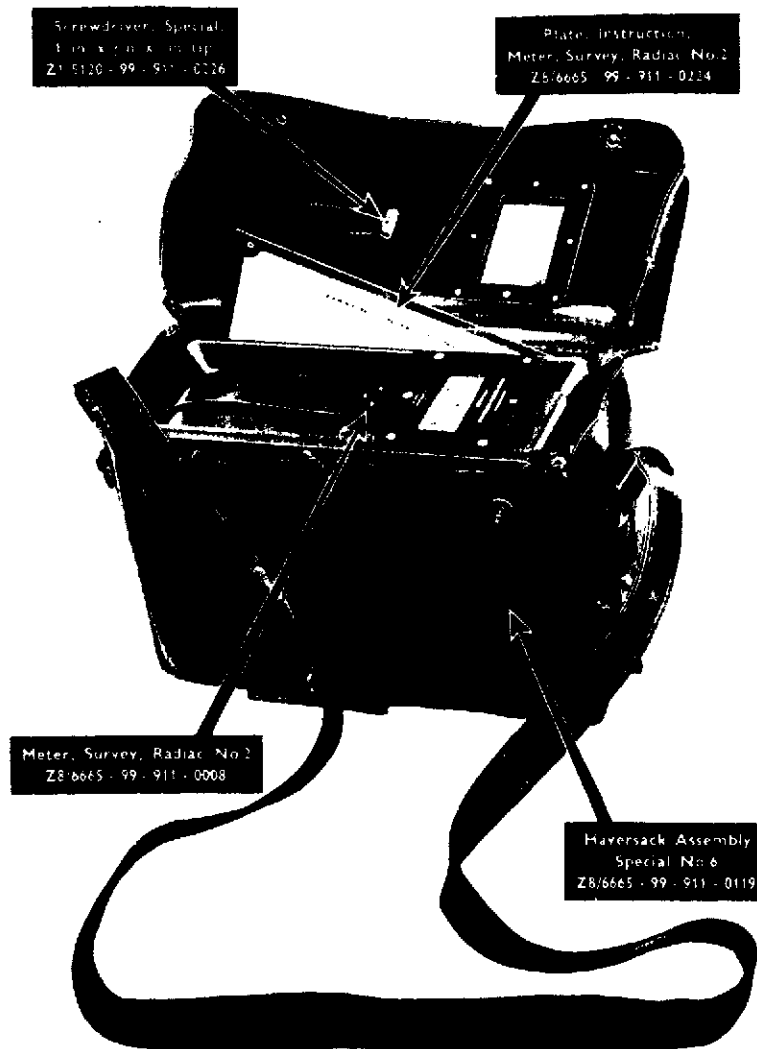


Fig. 3

Complete Equipment Nomenclature

## PREPARATION FOR USE

### 201. CHECKING THE HUMIDITY INDICATOR

Remove the instrument from its haversack and check that the colour of the indicator is blue. If it is pink the instrument is damp internally and unless action is taken to dry out the instrument and to replace the desiccator, the accuracy may be affected. The instrument **MUST BE** returned to REME workshops at the earliest opportunity.

### 202. CHECKING THE BATTERIES

If the batteries are not already in position, instructions for fitting are given in Section 203.

#### a. The Filament Cell

(1) To check the 1.5 volt valve filament cell, set the Supply Switch to 'Batt Test' and observe that the meter pointer comes to rest between the two red lines on the meter scale.

(2) If the meter pointer comes to rest below the lower of the two red lines, set the Supply Switch to 'Off' and replace the filament cell as detailed in Section 203, para. b.

#### b. The Lamp Cell

(1) With the Supply Switch set to 'On with Lamp', check whether the meter scale is illuminated. (It may be necessary in broad daylight to shield the meter scale with the hand in order to observe this).

(2) If the meter scale is not illuminated, replace the lamp cell as detailed in Section 203, para. b.

(3) If the lamp still does not light, DO NOT ATTEMPT TO REPLACE THE LAMP as the removal of the lamp holder will destroy the hermetic sealing of the instrument. - The instrument will function correctly without the lamp.

### c. The 30 Volt and 9 Volt Batteries (Zero Check)

(1) With the Range Switch to 'Set Zero' and the Supply Switch to 'On' or 'On with Lamp' (as required), check whether the meter pointer is at '0'.

(2) If not, take the tool from the pocket in the top flap of the haversack and carefully adjust the Zero Control.

- If the pointer is above '0' and cannot be brought back by adjustment, set the Supply Switch to Off and replace the 9 volt battery, as detailed in Section 203, para. a.

- If the pointer is below '0' and cannot be brought forward by adjustment, set the Supply Switch to Off and replace the 30 volt battery, as detailed in Section 203, para. a.

- If the pointer cannot be brought to '0' after changing the appropriate battery, return the instrument to RENE Workshops.

## 203. FITTING OR REPLACING THE BATTERIES

### a. The 30 Volt and 9 Volt Batteries

(1) Remove the instrument from its haversack and lay it on its side with the controls uppermost.

(2) Remove the battery cover by slackening the four fixing screws and then withdraw the battery holder, as shown in fig. 4(a).

(3) Referring to fig. 4(b), slacken the knurled screw on the battery holder and remove the existing 30 volt battery, if fitted.

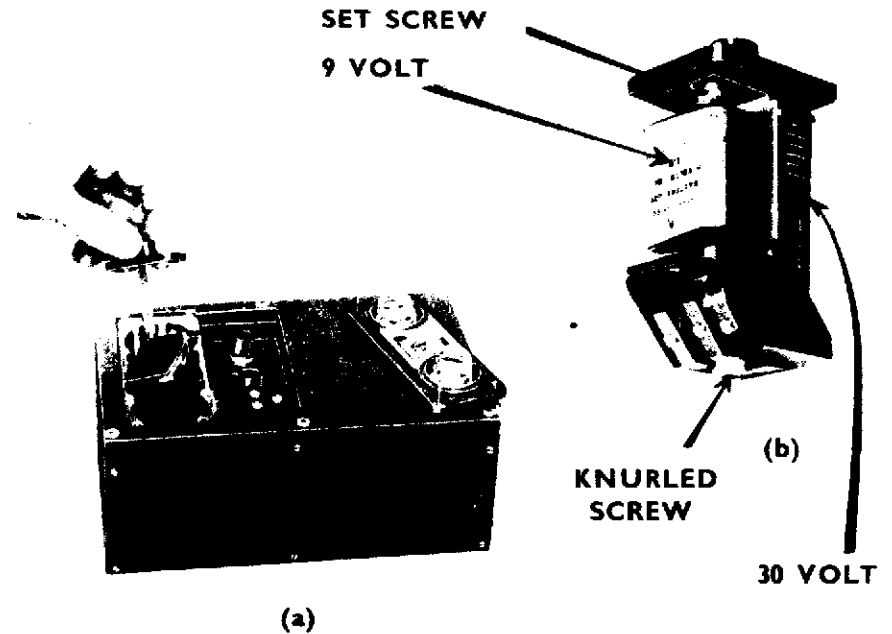


Fig. 4

(4) Insert the new 30 volt battery with its red end (+) facing towards the top (rubber) end of the holder, as illustrated. Tighten the knurled screw sufficiently to ensure good contact - but do not overtighten.

(5) Slacken the set screw on the battery holder and remove the existing 9 volt battery, if fitted.

(6) Insert the new 9 volt battery with its red end (+) facing towards the bottom (moulded) end of the holder, as illustrated. Tighten the set screw sufficiently to ensure good contact - but do not overtighten.

(7) Hold the rubber handle of the battery holder and place the complete assembly into the centre of the battery compartment, ensuring that the three contacts on the holder connect with the corresponding contacts in the battery compartment.

(8) Finally, replace the battery cover and tighten the four fixing screws.

## b. The Filament and Lamp Cells

(1) Remove the instrument from its haversack and lay it on its side with the controls uppermost. Unscrew and remove the appropriate coin-slotted cell cover.

(2) To remove the existing cell (if fitted), turn the instrument over so that the controls are facing downwards, give a gentle shake and the cell should fall out.

(3) Insert the new 1.5 volt cell with its brass cap (+) facing downwards into the battery compartment, as shown in fig. 5. Finally, replace the cell cover.

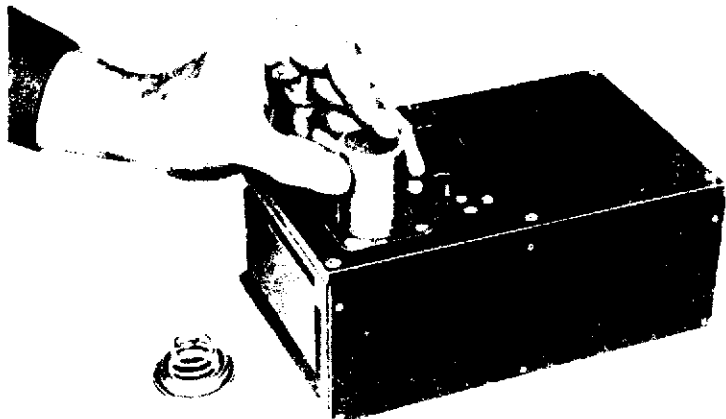


Fig. 5

## OPERATION

### 301. GENERAL

Attention is drawn to Appendix C of the publication 'Precautions Against Nuclear Attack', W.O. Code No. 9466, which contains information of value to those engaged on radiological ground surveys.

Immediately prior to using the instrument, the User must ensure that it is in a satisfactory condition by carrying out the checks detailed in Chapter 2.

### 302. SURVEYING AN AREA

#### a. Gamma Radiation Measurement

The instrument should be used in the haversack and carried in the position shown in fig. 6.

(1) TO AVOID DAMAGING THE METER, set the Range Switch to the least sensitive range first, i.e. 0-300 r.

(2) Set the Supply Switch to 'On' or 'On with Lamp', as appropriate, and the instrument is ready for use.



Fig. 6

## b. Beta Indication

Beta particles are less penetrating than gamma rays and would be absorbed by the case of the instrument or its haversack. A thin window has therefore been provided through which beta particles can penetrate. This must be covered by the hinged flap during gamma measurement, but it must be exposed when an assessment of the beta hazard is required. Therefore, to use the instrument for beta indication, proceed as follows:-

- (1) Remove the instrument from its haversack and slacken the six screws on the underside to remove the base-plate (see fig. 7).

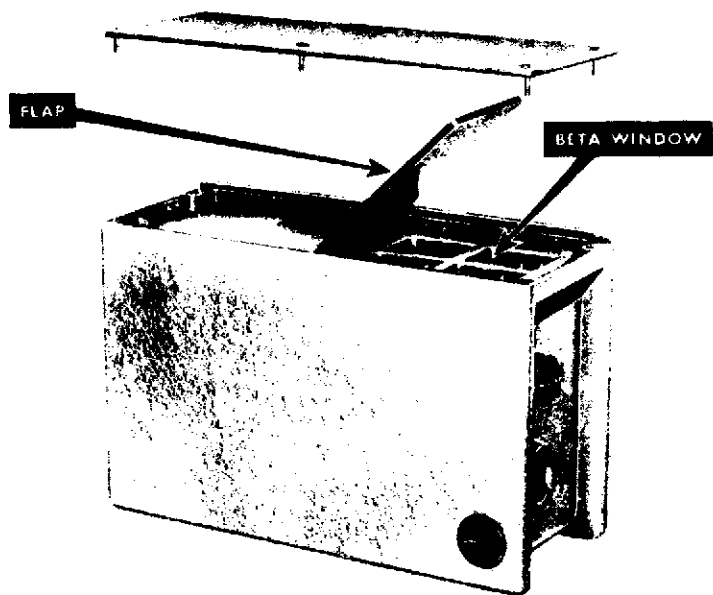


Fig. 7

- (2) TO AVOID DAMAGING THE METER, set the Range Switch to the least sensitive range first, i.e. 0-300 r.
- (3) Set the Supply Switch to 'On' or 'On with Lamp', as appropriate.

(4) First take meter reading with window uncovered (beta plus gamma radiations).

- This reading must be taken with the instrument held not more than 12 inches from and with the window facing in the direction of the suspected contamination. (The response to beta is directional. Readings taken at 12 inches indicate contamination within an area of approximately 1 sq. ft. directly beneath the beta window).

(5) Now take meter reading with window covered (gamma radiation only).

- This reading must be taken with the instrument in exactly the same position as before.

(6) Subtract the second reading from the first to obtain the required assessment of beta activity.

(7) When replacing the base-plate always ensure that the beta window is covered by the hinged flap.

## 303. MONITORING FOR CONTAMINATION OF PERSONNEL AND EQUIPMENT

The Survey Meter was primarily intended for surveying comparatively high levels of radioactivity over an area, but it may be used in the absence of a Meter Contamination No.1 to indicate the much lower levels of contamination on clothing and the body. It has a much lower sensitivity to gamma radiation at these levels, but has the advantage of being sensitive to beta radiation. Hence, if the instrument is held close to the subject, a satisfactory indication can be obtained.

If a background reading is obtained, due to other sources of contamination, this might easily mask any indication of personal contamination and it will be necessary to either shield the instrument and subject or to choose a new site free from background interference.



**Fig. 8**

(1) Remove the instrument from its haversack, slacken the six screws on the underside to remove the base-plate and then fasten back the hinged flap to expose the beta window (see fig. 7 on page 16).

(2) Set the Range Switch to the most sensitive range, i.e. 0-3 r.

(3) Set the Supply Switch to 'On' or 'On with Lamp', as appropriate, and then ensure that there is no background reading before proceeding further.

(4) Hold the instrument with the beta window not more than 4 inches from the subject (see fig. 8), and then proceed moderately slowly over the whole surface of the subject.

**WARNING:** On no account must the instrument come into contact with the subject, otherwise the instrument itself may become contaminated.

(5) After use, close the beta window by means of the hinged flap and replace the base-plate.

### **304. CARE OF THE INSTRUMENT**

(1) Although the Meter, Survey, Radiac No.2 has been designed to withstand conditions of normal usage, it is a delicate electronic measuring instrument and should be treated as such.

(2) In no circumstances should the User remove the instrument from its cast metal case. This would destroy the hermetic seal and might result in damage.

(3) The base-plate on the underside of the instrument should only be removed when an assessment of the beta hazard is required, and it should be replaced after use. Great care should be taken to avoid damaging the thin aluminium foil on the beta window, as this will also destroy the hermetic seal of the instrument. Always place the hinged flap over the beta window before replacing the base-plate.

(4) In no circumstances should any part of the instrument come into direct contact with the suspect radioactive contamination, otherwise the instrument itself may become contaminated.

(5) Check the humidity indicator frequently and return the instrument to REME Workshops should the colour change from blue to pink.

(6) After use, ALWAYS check that the Supply Switch is set to Off. Only use the dial lamp facility when necessary.

(7) Check the condition of the batteries frequently, (see Section 202) and replace where necessary. When the instrument is out of use for long periods, i.e. during storage, ALL BATTERIES SHOULD BE REMOVED TO PREVENT CORROSION.

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