Roentgen Radiometer

DP-66

Geiger Counter Operations Manual

Serial No. 7192 Production Year: 1970

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Chapter I

Purpose, General Characteristics and Data

1.1. Uses of the Instrument

The DP-66 is designed to:

-- Detect and quantify the degree of beta contamination of various surfaces,

-- Detect and measure beta and gamma radiation in the Roentgen scale,

-- Charge and illuminate DKP-50 Optical Dosimeters.

1.2. General Characteristics

1.2.1. Radiation Measuring Range

-- Beta Contamination from 10^3 to 10^7 decays/min.*cm^2 in four sub-ranges,

-- Beta and Gamma Radiation from 0.05 mR/hr to 200 R/hr in six ranges.

1.2.2. Radiation Energy Detection Range

This instrument allows radiation detection and measurement from the following energy levels:

-- Beta Radiation from 0.5 MeV to 3 MeV.

-- Gamma Radiation from 0.1 MeV to 3 MeV.

1.2.3. Measurement Sub-Ranges

This instrument has six measurement sub-ranges specified in Table 1 on the next page.

Table 1

Sub-range	Rotary Switch Position	Scale of Sub-range	Measuring range is dependent on location of beta shield. Beta x1(three lengthwise openings) Beta x10 (small circular opening) Gamma (closed)		
			Beta x1 (Contamination)	Beta x10 (Contamination) (Roentgens)	Beta/Gamma (Roentgens)
			decays/min.*cm^2	decays/min.*cm^2	R/hr (mR/h)
1	2	3	4	5	6
I	200 R/hr	0-200	-	-	5-200 R/hr
II	5 R/hr	0-5	-	-	0.5-5 R/hr
III	0.5 R/hr	0.5	-	-	0.05-0.5 R/hr
IV	1M	0-10	100000 – 1000000	1000000-10000000	-
	50 mR/hr	0.5	-	-	5-50 mR/hr
V	100K	0-10	10000 – 100000	-	-
	5 mR/hr	0-5	-	-	0.5-5 mR/hr
VI	10K	0-10	0 – 10000	-	-
	0.5 mR/hr	0.5	-	-	0.05-0.5 mR/h

Note: The white line on the probe is signifying position of beta shield (x1, x10, G).

The selection of sub-ranges are made by rotary switch. Choosing the type of radiation (beta or gamma) and increasing beta range from x1 to x10 is achieved by turning the probe's beta shield to desired position. (Note: if using Beta x10, multiply current readings by 10)

1.2.4. Accuracy of The Instrument

In normal climate conditions (temperature of 20 ± 5ºC, relative humidity 65 ± 15%, and atmospheric pressure of 750 ± 30 mm Hg); does not exceed ± 25% of reading, plus an additional ± 2.5% of full scale value of selected sub-range when measured beta/gamma dose of Co-60 sources in amounts decays / min.*cm^2 or beta/gamma radiation from sources of Sr-90 and Y-90 with a minimum area of 150 cm^2.

1.2.5. Accuracy of Instrument – When Climate Conditions Are Not Ideal

-- Does not exceed 0.6% of measured value to 1 º C temperature range. From +20 º C to +40 º C and a relative humidity of 95 ± 15%.

-- Does not exceed 0.6% of measured value to 1 º C temperature range. From +20 º C to +50 º C and a relative humidity of 65 ± 15%.

-- Does not exceed 0.3% of measured value to 1 º C temperature range. From -40 º C to +20 º C.

1.2.6. Response Time – For Best Accuracy of Readings (see Table 2)

Table 2

Sub-Range	I	II	III	IV	V	VI
Response Time (sec.)	3.5	4	4	4	15	30

1.2.7. Scale Reset Button

The instrument is equipped with a scale reset button. When the range you select for a given source is smaller than the actual value, the scale will be overloaded and switching to higher ranges would create inaccurate readings. Press the "Kas." Button on your meter to reset the scale after transitioning to a higher sub-range.

1.2.8. Optical Dosimeter Jack

The instrument is equipped with a socket with adjustment knob for charging DKP-50 optical type dosimeters. The jack is equipped with an internal source of light during charging, allowing to view the dose rate without interrupting the charging of the dosimeter.

1.2.9. Headphones for Audio Verification of Radiation

The instrument is equipped with a SM-60 handset guaranteeing you audio confirmation of radiation of sufficient audibility in comparison to the average ambient sound. The design of the handset allows for comfortable use without compromising a gas mask.

1.2.10. Check/Calibration Source

Sr-90 + Y-90 have an activity of 10 µCi allowing systematic testing and maintenance of the instrument's components without breeching regulations in the safety manual. (Note: Calibration Source is removed due to US NRC import regulations)

1.2.11. Power Supply

The instrument can be powered by:

-- Two 1.5V R20 (Size D) Batteries – Certified in 1970 for continuous operation up to 70 hours or recharging dosimeters continuously for 50 hours (under normal climate conditions).

-- External sources of 3V, 6V or 12V connected using our AC/DC adapter screwed into the battery compartment instead of the cover. (European Sockets Only!)

1.2.12. Tracking Voltage Drops

When the current operating voltage drops to 1.6V (± 0.1V) from the nominal operating voltage, no additional measurements will be conducted. Battery voltage is checked when setting the rotary switch to position "K" (battery check). Use this function before turning the unit on to any measurement sub-ranges. If the needle is not within the red area marked "K" or to the right of "K", you must replace the batteries before continuing to use the unit.

1.2.13. Scale Features

The instrument has phosphorus (green luminous) paint and a backlight (white illumination) for reading the scale in low light and dark environments.

1.2.14. Climate/Environmental Conditions

The instrument is designed to work in the following climate conditions:

-- In the temperature and the humidity specified in section 1.2.5., preserving the full efficiency of the unit,

-- When exposed to rain of medium intensity and immersion of the probe in a case of polyethylene water to a depth of 50 cm for about 5 minutes.

1.2.15. Physical Resistance

Instrument is resistant to vibration up to 3g and frequencies of 20 to 70Hz. Also resistant to shock during transport.

1.2.16. Overall Dimensions of Instrument

-- Dimensions of Unit 100 x 180 x 120

-- Dimensions of Probe Ø 45 x 300 (With Handle)

-- Dimensions of Transportation Case 269 x 359 x 15

1.2.17. Weight of the Instrument

-- Unit in the Field Carrying Case – 3.8 kg

-- Entire Set in Transportation Case – 7.0 kg

Chapter II

Description of Function and Technical Operation

2.1. General Description of Function With Index of Key Components

Diagram (see Figure 1)

-- Beta and Gamma Detectors	(1)
-- Pulse Counter	(2)
-- Normalizer	(3)
-- Integrator Circuit	(4)
-- Meter	(5)
-- Stabilized Inverter Transistor	(6)
-- Dosimeter Jack	(7)
-- Power Supply	(8) and (9)
-- Headphones	(10)

Features of this radiation detector (1) Three Geiger-Mueller Tubes (STS-5, DOB-50 and DOB-80) detect the radiation. Detection is registered by a pulse counter, the pulses are then amplified by the amplifier. (2) The number of pulses control the normalizer. (3) The pulses are normalized in terms of width and amplitude and then move to the integrator circuit. (4) Average electricity pulses from the normalizer, corresponding to the value of radiation dose, (5) is measured by the meter. (10) Pulses from the normalizer also serve as the impulses to the headphones that become the clicks you hear. (6) The stabilized inverter transistor provides the high voltages for powering the unit and (7) charging/illuminating dosimeters by charging socket and the meter backlight. The stabilized inverter transistor or the HV converter is powered by the (8) internal battery or (9) external sources through our adapter.

2.2. Schematic Diagram

Schematic (circuit) diagram of the instrument is shown in Figure 2.

Due to the wide range of measuring, this unit is equipped with three GM tubes inside the probe which are used according to the set sub-range:

-- For Sub-Ranges I and II, GM Tube DOB-50 is active (L1)

-- For Sub-Range III, GM Tube DOB-80 is active (L2)

-- For Sub-Ranges IV, V and VI, GM Tube STS-5 is active (L3)

The pulses from the counter emitted across the resistor R5 to the strengthening of the transistor T1, controlling normalizer impulses.

Normalizer function meets monovibrator transistor consisting of transistors T2 and T3, Resistors R8, R12, R15 and capacitor C5 switches C9.

Monovibrator produces at an output (collector of transistor T3), rectangular pulses of constant height and width specified for each sub-band the size of the coupling capacitance (C5 C9). The administration of pulse triggering monovibrator by C2, D1 and D2, improves the process of liberating and frees the parameters generated pulses on the shape and level of the trigger signal.

The pulses from the output of the amplifier monovibrator via transistor T4, control handset acoustical radiation, and through transistor T5 load capacitor integrator circuit, with internal resistance of the meter going through capacitor C10 and resistors R19, R20 and R33.

Changing the time constant of the integrating circuit for each range - necessary because of the time limit fluctuations and determining indications - is done by changing the resistance load.

The "KAS", shorting the circuit integrator is used to quickly erase readings. Potentiometers P1 P6 circuit emitter of the transistor T5 determine the magnitude of the current pulse charging and are intended to calibrate the instrument for different sub ranges.

Power device via a stabilized inverter transistor consisting of a transformer, transistor T6 blind keyer, regulating transistor T7, DC amplifier transistor T8 and Zener diodes D7 serving as the reference voltage.
Rectifiers on the secondary side transformer provides the following voltage stabilization:
- 390 V for Tube L3
- 490 V for Tube Ll and L2,
- б V and +4 V to power the whole system.
- The size of these voltages is determined by potentiometer P8.

The capacitor C16 prevents internal resistance battery-power exceeding a certain level. Startup of the inverter circuit (R32 R27 and C15) and coupling the bases of transistors T6 and T7 through T8 provides a reliable start of the inverter under the assumed limit drops the voltage source.

The "OSW" is used to illuminate the bulb under the Z2 gauge scale. 390 V with adjustable divider composed of resistors R23, R24 and the potentiometer P7 produced to the charging socket for charging dosimeters. Slot equipped by a sphincter W1, that the insertion of the dosimeter to the charger turns on the backlight bulb Z1 scale to see the dose.
Turning the device on, check the battery voltage and the change of sub-bands is done with the 8-position rotary switch:

- In the "W" position, it disconnects the main battery power supply, but still allows for the “OSW” to function,

- In the "K" position in series with a resistor R21 and is attached to the battery power, serving as a battery voltage indicator, the position of the power supply is noted on the red scale with a “K” symbol. Resistor R31 will notify on the “K” scale when the batteries need changing.

- Under the individual sub-bands, the rotary switch turns the power inverter, selects the appropriate GM tube (turns to counter high voltage), switching monovibrator coupling capacitors, circuits, calibration and change the time constant of the integrator. Measurement of the corresponding radiation (beta or gamma) and 10 fold increase in the range of beta radiation is done by setting the beta shield on the probe.

Chapter III

Construction of the Instrument

3.1. The Unit and Meter

Unit consists of:

- Faceplate

- An electronic assembly

- The housing of the battery container.

The front plate and the housing are made of molded material with a high strength thermosetting.

The front panel contains the following elements:

- Meter MEA-33, with a special scale,

- The "OSW" Button - highlight the scale, "KAS" - to erase readings and reset the scale,

- P7 potentiometer (inside) to adjust the charging voltage for dosimeters,
- Charging socket for dosimeters,
- Rotary switch
- Jack for headphones
- Probe cable with probe attached.

The housing has a cylindrical lower container for power supply, and sealing cap to cover it. The front plate is connected to the housing by means of four flathead screws. Transitions regulatory elements and the connecting cable contact surfaces of the faceplate and housing security are combined with rubber gaskets to ensure no breech to prevent electronics damage. The rotary switch's plate has the maximum reading for each sub-range shown when a sub-range is selected (ex. max scale for "0.5 mR/hr" setting is 0.5 mR/hr). For sub-ranges VI, V and IV you can alternatively use the bottom three ranges (10K, 100K and 1M respectively) instead when measuring via the contamination scale (top). The K symbol on these special ranges stand for three zeroes (thousand) and the M symbol stands for 6 zeroes (million). The meter has three scales. The top scale is used along with the probe setting to calculate the contamination of an object. The middle is used for the Roentgen scale using sub-ranges from VI to II. Sub-range I uses the bottom scale.

3.2. The Probe

The housing of the probe is a cylindrical steel body. The inside has backplane detectors and reinforcing filler. The lateral surface of the probe in the vicinity of the STS-5 tube has a mica window for measuring beta radiation, covered with aluminum foil glued to the part. Beta shield with windows for the STS-5 is a cylindrical steel casing mounted on the body and is able to be rotated. Beta Shield has three fixed position relative to the window. In the "G" position (the measurement of gamma radiation) the window is covered by the shield. In the "B x1" (measurement of beta radiation) the window coincides with the transverse holes in the cover. In the "B x10" holes in the beta shield are reduced accordingly to achieve a 10-fold increase in range. Probe is equipped with a handle, which, depending on the needs may be attached to the probe directly or by using an extension wand.

3.3. Additional Equipment

A complete set of instrument consists of the following members:
a) The unit itself - comprising an electronic circuit
b) Probe - with radiation detectors and a cable (length of 1.47 m),
c) Travel Case,
d) Probe Extension Wand - Telescopic,

e) Sr-90/Y-90 Check Source,
f) Headphones,
g) Dosimeter Charger Cover.

h) probe anti contamination bags,
i) carrying straps,
j) external power adapter,
k) a set of tools for the maintenance of the instrument,
1) a set of spare parts for emergency repairs,
m) owner's manual,
n) notebook operation of the instrument
o) the maintenance book.

External power both in size and shape is adapted to be placed in the battery container. Inside the housing is a resistive divider voltage (see Figure 2) with external voltage on the external switch. Snap is provided with connecting cables length of 6 m for the terminated connector sockets for typical car battery installation work. This is for European Voltage ONLY!

Chapter IV

Operating Procedures

4.1. Preparing for Use

a) Get acquainted with the content of this manual, in particular the description of the operation of and the guide to this instrument.

b) Take out instrument from the travel container (suitcase) and check visually that the external parts of the unit and probe do not carry traces of mechanical damage.

c) Check whether the needle on the meter is zeroed on the scale when upright; if you need to adjust the needle, unscrew the cap protecting the regulator and by turning the adjustment screw to set the needle to the correct position, then secure the screw hole again paying attention to the condition of the sealing washer.

d) Open the battery compartment and insert the two R20 (D) Cells, placing them so that the negative poles are directed toward the cap of the container, and then close the compartment by screwing the cap into the unit.

e) Use the rotary switch to switch sub-bands from the "W" position to the "K" position and check the status of the battery voltage. Note that the meter should be in the field marked

"K" (Note: For new batteries the scale might be to the right of the “K” Field). If the readings are to the left of the K field - cells are not suitable for use. Voltage/battery check should be carried out every time prior to use.

f) If the instrument is to be supplied from external sources, Screw in the AC adapter instead of the batteries and plug it in. The adapter should adjust to the external power source voltage value. The shock-proof sockets supported are marked by "3", "6" or "12" depending on the voltage source (3, 6 or 12 V).

Due to the possibility of accidental reversal of the plug, an LED (D8 - Figure 2) is the electronic system’s security measure against reverse polarization (causes damage if polarity is incorrect). Adapter should be screwed in the battery compartment and plugged into the power source with the correct polarity: the end of the sign "+" (engraved on the plug). Even when you attach an external power supply, check the voltage before turning to any sub-ranges.

g) Test the operation of the instrument. The test is performed on the sub-bands III, IV, V and VI with the Check Source (Sr-90).

To Do This:

-- Turn the Beta shield to position “B x1”,

-- Plug in the Headphones,

-- Uncover the check source in the field carrying case and hold the probe 1cm from the source.

If operation of the instrument is correct, on all sub-ranges there should be crackling in the earpiece signaling radiation. In addition, ranges V and VI, the tip of the meter should be off the scale, and on the right half of the scale on the fourth sub-range. For the third sub-range, readings are negligible, but noticeable.

4.2. Measuring Beta Contamination (decays/min.*cm^2)

In order to measure beta contamination:

a) Set the beta shield in the “B x1” position,
b) Turn the rotary switch to the “1M” setting,
c) Move the probe closer to the source and hold it at a distance of 2-3 cm,
d) Use the rotary switch to select the sub-range at which the meter will enable accurate readings. Selection should be made by switching from sub-ranges sequentially from “10K” to “1M” in order to avoid going off scale. After the response time needed to determine accurate readings (as shown in Table 2). Take the reading using the top scale (scaled 0-10) for each sub-range.

e) Set beta shield to the "G" position and measure the amount of the gamma background radiation. The difference between the two readings specifies the size of the beta contamination in decays/min.*cm^2.

Note!
1M decays/min.*cm^2 = 1 000 K decays/min.*cm^2 = 1 000 000 decays/min*cm^2.

When measuring contamination in excess of 1 000 000 decays/min.*cm^2 (needle off the scale at the “1M” scale), measurement should be carried out with the beta shield set in the "B x10" position and the result (in decays/min.*cm^2) multiplied by 10.

f) After finishing measurements, turn off the instrument (turn switch to "W").

4.3. Measuring Beta/Gamma Radiation (Roentgen Scale)

The measurement of beta and gamma radiation is accomplished in the following manner:

a) Set the beta shield to the “G” or “B x1” position
b) Select the appropriate sub-range sequentially from “0.5 mR/hr” to “200 R/hr” until readings do not max out.

Accurate readings occur after the response time has passed (Table 2).

When the beta shield is set in the "B x1" position, it detects beta and gamma radiation.
c) After finishing measurements, turn off the instrument (turn switch to "W").

4.4. Tips to Taking Measurements

To avoid knocking the meter off the scale, and overload the STS-5 and DOB-80 GM tubes, you should instead look at the rotary switch plate. Each of the sub-ranges correspond to the highest amount of radiation or the highest amount of decay, as described in 4.2. and 4.3 that the ranges can measure. To eliminate inaccuracies caused by human error or variance in source readings, try to take several readings and take the average of that series. To avoid excessive deflections (spiking) causing meter inaccuracies occurring at the time of switching sub-ranges, it is recommended that whenever switching to a higher sub-range to zero the scale by pressing the "KAS" button.

4.5. Charging DKP-50 Optical Dosimeters

Charging DKP-50 optical dosimeters must be carried out inside to protect from rain and excessive moisture. The procedure to charge dosimeters are as follows:

a) Unscrew and remove the cap closing the charging socket and protruding threaded portion.

b) Turn the rotary switch to Sub-Range I (200 R/hr).
c) Turn the knob above the charging socket counter-clockwise until you feel resistance.
d) Unscrew the lens cover (for viewing the scale with other light sources) on the bottom of the dosimeter and insert it into the charging socket and push down. While in this position the interior light should turn on to allow reading of the dose scale.
e) Turn the knob slowly to the right, watching the thread through the eyepiece, until it is on "0" on the scale. After zeroing, remove the dosimeter from the socket and tighten the lens cover. Prior to inserting the next dosimeter, set the knob to the leftmost position.
f) After a period of 30-60 minutes from charging, check dosimeter and make corrections if necessary using this instrument.
g) When charging is complete, turn the rotary switch to the off position (W), close the cap on the charging socket thoroughly to safely protect against the ingress of moisture and dust.

4.6. Instrument Care

To ensure full efficiency of this instrument for its relevant period of use:

-- As much as possible, protect the device from shocks, vibrations and other mechanical exposure.

-- Whenever possible, do not expose the device to strong atmospheric influences, direct intense sunlight, rain, moisture, dust and frost.

-- Do not leave the instrument on during breaks, to prevent unnecessary power consumption from the power source.

-- Do not expose the wires connecting the probe to the unit to strong bending and tensile forces.

-- Manipulation of the controls of the instrument (switches, potentiometers and buttons) are to be carried out as gently as possible without exerting forces which can damage these parts.

-- After working in conditions of rain, moisture or frost, the outer surfaces of the unit and the probe should be carefully wiped and dried. To prevent corrosion of the metal parts wipe with an acid-free cloth using Vaseline, then wipe it off with another acid-free cloth.

Chapter V

Maintenance, Inspection and Calibration Information

The unit should be inspected in terms of possible component damage and its operational status. These tests and fixes should be carried out in a well equipped workshop or a laboratory.

It is recommended to:

-- Check the scale and calibrate after every 200 hours of operation.

-- Check for repairs after about 800 hours of operation.

-- Complete overhaul after 2,500 hours of operation.

The maximum lifetime of this unit is about 10,000 hours of operation. It is also recommended to check the rubber seals on the instrument to see if they are damaged. Even if slightly damaged, please replace them to maximize life of the unit.

5.1. Zeroing the Meter

Check whether the pointer of the meter corresponds to the zero position on the scale: if you need to adjust, unscrew the cap protecting the regulator and by turning the adjusting screw to the correct position, then secure the screw hole again paying attention to the condition of the sealing washers.

5.2. Probe Cover Removal

To facilitate the removal of the probe housing to gain access to the GM tubes and other electronics, loosen the screw and remove the probe and the shield. Avoid using the random pressure on the aluminum foil covering the window casing, susceptible to mechanical damage (dents and cracks), which can cause a leak in the probe housing and possible contamination or mechanical damage to electronics and the GM tubes.

5.3. Meter Calibration for Beta/Gamma Radiation (Roentgen Scale)

Scaling must be carried out using a bench measurement, which indelibly marked the current point scaling specified for the source of radiation. Benchmark should allow easy and accurate assertion of the distance between the source and the probe to calibrate the instrument. The accuracy of the measurement benchmark cannot be worse than ± 5%.

The radioactive calibration source is an isotope of cobalt (Co-60). To calibrate sub-range I (200 R/hr) source should have an activity that gives a dose rate of 400 R/hr at a distance of not less than 75 cm. At the same time, external length benchmarks should allow to obtain from the same source of radiation, a dose rate of 5 R / hr. For scaling the remaining sub-ranges of radiation source should be used for such activity to a distance of not less than 1 m to obtain the powers of the dose of 0.1 mR / hr to 5 R / hr.

The distance the probe has to be from the source and the required dose rate is determined with the following formula:

$$R = \sqrt{\frac{13.5 \times A}{P}}$$

Where: *P* = Calibration Source Readings in R/hr

A = Source's Activity in mCi

R = Distance From Source in cm

To calibrate this unit:

-- Remove the instrument panel from the rest of the unit and set it down to provide comfortable viewing of scale and access to potentiometers P1 and P6.

-- Check the voltage of the power supply.

-- Select desired sub-range to be calibrated.

-- Place the probe on the table making sure the measured distance is corresponding to the desired sub range specified in Table 3.

Table 3

Sub-Range	Rotary Switch Position	Point of Scale	Checkpoint	Potentiometer
1	2	3	4	5
I	200 R/hr	140 R/hr	50 R/hr	P 1
II	5 R/hr	4 R/hr	2.5 R/hr	P 2
III	0.5 R/hr	0.4 R/hr	0.25 R/hr	P 3
IV	50 mR/hr	40 mR/hr	25 mR/hr	P 4
V	5 mR/hr	4 mR/hr	2.5 mR/hr	P 5
VI	0.5 mR/hr	0.4 mR/hr	0.25 mR/hr	P 6

-- When probe is subjected to the correct radiation exposure, set the value of dose corresponding to the point scale, taking the average value of the readings after the time necessary to determine the scale (according to Table 2) using the calibration potentiometers.

-- Check that the indications of the checkpoint correspond to the range desired. Display deviations (average value) shall not exceed the values specified in section 2.4.

-- After the scaling the potentiometers, prevent accidental rotation by covering them with red varnish primer (nitro oxide).

5.4. Meter Calibration for Beta Contamination Scale (decays/min*cm^2)

This device when properly calibrated for the Roentgen scale, does not require additional calibration for the beta contamination scale.

In order to verify calibration of the unit:

-- Set the beta shield to “B x1” or “B x10” depending on the selected sub-range.

-- Check the unit for the correct readings (using the top scale on the display) specified in Table 4.

Table 4

Sub-Range	Rotary Switch Position	Beta Shield Setting	Checkpoint in decays/min.*cm^2	
			1	2
IV	1M	B x10	8000 000	5000 000
IV	1M	B x1	800 000	500 000
V	100K	B x1	80 000	50 000
VI	10K	B x1	8 000	5 000

As a source of beta radiation use a source of Sr-90 / Y-90 with a minimum area of 150 cm^2. These sources should have enough decays/min.*cm^2 to correspond with the checkpoints. Checkpoints are subjected to deflections up to ±20% of given values in the table when calibrating this scale using other sources.

Chapter VI

Storage and Maintenance Checks

This unit is designed for long-term storage. If selected for storage, the unit should be prepared and stored according to the instructions on the storage, inspections, maintenance and repairs of radiation instruments in supply depots Chem. 35/56. Notwithstanding the above, you must adhere to the following protocol:

-- Unit must be stored without a power source in the battery compartment weather it is individual batteries or the power adapter.

-- During longer breaks from use (more than a week) and also when transporting long distances, remove the power source from the battery compartment and store it in the travel container.

-- Exterior surfaces of the unit must be thoroughly cleaned with a cloth dampened slightly in gasoline and the metal that has been exposed to corrosion protected with a thin coating of Vaseline.

For metal parts with description these include: the unit – all leading screws that securing the housing to the body, the probe – springs and components inside as well as the beta shield, and the suitcase – corner fittings.

Chapter VII

Troubleshooting

Signs of Damage	Cause	Solution
1	2	3
1. When in position “K” Needle is not in red field or is not moving at all.	1. Batteries Depleted. 2. Battery contacts are corroded and/or battery acid is leaking. 3. Power source automatically disconnected due to short-circuit in the dosimeter socket.	1. Replace Batteries 2. Clean the battery compartment. 3. Replace the bulb, clean and adjust the dosimeter socket so the contacts are not short-circuited.
2. Scale does not light up even though batteries are fine and it passes voltage check.	Bulb is faulty or burned out	Replace the bulb

1	2	3
3. Meter does not respond when in Sub-ranges IV, V & VI.	Damaged STS-5 GM Tube	Replace the GM tube. (must be done on a workbench or in laboratory)
4. Meter does not respond when in Sub-range III.	Damaged DOB-80 GM Tube	Replace the GM tube. (must be done on a workbench or in laboratory)
5. Meter and audio don't respond on any sub-range.	Most likely, damage to the inverter or electronic measuring system.	Replace the damaged part. (must be done on a workbench or in laboratory)
6. When measuring above 0.5 R/hr (Sub-Range III is spiking) meter doesn't respond on Sub-Ranges II & I.	Damaged DOB-50 GM Tube	Replace the GM tube. (must be done on a workbench or in laboratory)
7. When attempting to charge dosimeters, the backlight of the socket will not light up.	1. Bulb is faulty or burned out. 2. Socket is corroded or is contaminated with dirt, dust or moisture.	1. Replace the Bulb 2. Clean the socket and adjust the socket contacts.
8. When charging dosimeters, cannot reset dosimeter scale to zero.	1. Contaminated with dirt or moisture. (particularly the insulator) 2. Damaged Dosimeter 3. Nonexistent or too low voltage to charge dosimeters due to defective part.	1. Blow into the socket with dry warm air. 2. Check using a new one. 3. Repair or replace the part. (Must be done in a workshop or in a laboratory)
9. When charging dosimeters, the dosimeter needle abruptly shifts directions when zeroing.	Damaged Potentiometer	Replace the damaged part. (must be done on a workbench or in laboratory)

Any other perceived failures should be reported to the state laboratory or to your superiors.

Appendix 1: Equipment List

#	Name	Amount
1	Wooden Transport Case	1
2	Roentgen Radiometer DP-66 w/ Probe	1
3	Leather Field Carrying Case w/ Check Source (Removed)	1
4	Straps for Field Carrying Case	2
5	Extension Wand for Probe	1
6	Adapter Power Supply	1
7	Headset (SM-60)	
	a) Cord with plugs	1
	b) Ear Hook	1
	c) Speaker	1
8	Plastic Anti-Contamination Probe Covers	10
9	DP-66 Operations Manual	1
10	Service/Maintenance Manual	1
11	Electro-Technical Screwdriver No. 2A	1
12	D Cell Batteries	

Appendix 2: Electronic Components List

(As shown in Circuit Diagram – Figure No. 2)

Symbol of Component in Diagram	Name and Type	Technical Information	Notes
1	2	3	4
L1	GM Tube DOB-50		
L2	GM Tube DOB-80		
L3	GM Tube STS-5		
T1, T2, T3	Transistor ASY-37S		
T4, T5, T6			
T5	Transistor BF-520		
T6	Transistor TG-52S		
D1, D2	Germanium Diode DG-51S		
D3, D4	Silicon Diode DK-62		
D5, D6	Germanium Diode DZG-7S		
D7	Zener Diode BZ1C7V5S		
D8	Germanium Diode DZG-4S		
M	Magneto-Electric Meter MEA-33	100 *u*A Rw=4 K	SPECIAL Scale Import of CSRS
"a"+"e"	Switch WK-533-32		
G + W1	Charging Socket Assembly		
TR1	Inverter Transformer		
"MS"	Switch type KW 6A		
"OSW"			
Sł	Headphones SM-60-250	250 Ω	
C1, C4	Capacitor KSE-011	0.01 *u*F ± 20% - 250V	
C2, C7	Capacitor KSO-2-500-G	220 pF ± 2% - 500V	
C3, C15	Capacitor Electrolyte. KTF	5 *u*F + 50%, - 20%, 15V	
C5	Capacitor KSO-1-250-5	680 pF ± 2% - 250V	
C6	Capacitor KSO-2-500-G	1000 pF ± 2% - 500V	
C8, C11	Capacitor KSE-011	0.022 *u*F ± 20% - 250V	
C9	Capacitor KSE-011	0.22 *u*F ± 10% = 250V	2pcs

C10	Capacitor ETO-1	80 *u*F ± 10% - 6V	Combined Parallel
1	2	3	4
C12	Capacitor KSE-011	0.015 *u*F ±20% - 630V	
C13, C14 C16	Capacitor ETO-1	50 *u*F + 50% - 20% - 15V	
P2, P3, P4 P5, P6, P8	Potentiometer PR-101 10P3	5 KΩ - A-0.25W	
P1	Potentiometer PR-101 10P3	10 KΩ - A – 0.25W	
P7	Potentiometer PR-101 40P1	5 MΩ ± 10% - 1W	In Class/Air cond. 5.6.6
R1	Resistor OMLT-1W	7.5 MΩ ± 10% 0.5W	
R2, R3	Resistor OMLT-0.5W	5.1 MΩ ± 5% 0.5W	
R4	Resistor OMLT-0.5W	120 KΩ ± 5% 0.5W	
R5, R14 R30	Resistor OMLT-0.5W	20 KΩ ± 5% 0.5W	
R6	Resistor OMLT-0.5W	6.8 KΩ ± 5% 0.5W	
R7, R11 R12	Resistor OMLT-0.5W	5.1 KΩ ± 5% 0.5W	
R8, R16 R19, R32	Resistor OMLT-0.5W	33 KΩ ± 5% 0.5W	
R9, R13 R33	Resistor OMLT-0.5W	2.4 KΩ ± 5% 0.5W	
R10, R20	Resistor OMLT-0.5W	10 KΩ ± 5% 0.5W	
R15	Resistor OMLT-0.5W	3.3 KΩ ± 5% 0.5W	
R17	Resistor OMLT-0.5W	1.5 KΩ ± 5% 0.5W	
R18	Resistor OMLT-0.5W	3.6 KΩ ± 5% 0.5W	
R21	Resistor CASE ORO-F-0, 125W	33.2 KΩ ± 1% - 0.125W	
R22, R24	Resistor OMLT-1W	10 MΩ ± 5% - 1W	
R23	Resistor OMLT-1W	10 M ± 5% - 1W 3.3 MΩ ± 5% 0.5W	Combined Series of 2.4 K ±5%- 0.125W
R25	Resistor OMLT-0.5W	5.1 KΩ ± 5% 0.5W	
R26	Resistor OMLT-0.5W	5.1 KΩ ± 5% 0.5W	
R27	Resistor OMLT-0.5W	510 Ω ± 5% 0.5W	
R28	Resistor OMLT-0.5W	390 KΩ ± 5% 0.5W	
R29	Resistor OMLT-0.5W	5.1 KΩ ± 5% 0.5W	
R31	Resistor OWS-221	51 Ω ± 5% - 0.25W II	
R34	Resistor OWS-421	27 Ω ± 5% - 2W - II	
R35, R36	Resistor OWS-421	15 Ω ± 5% - 2W - II	
Z1, Z2	Light Bulb	2.5V 0.075A - E10/13	

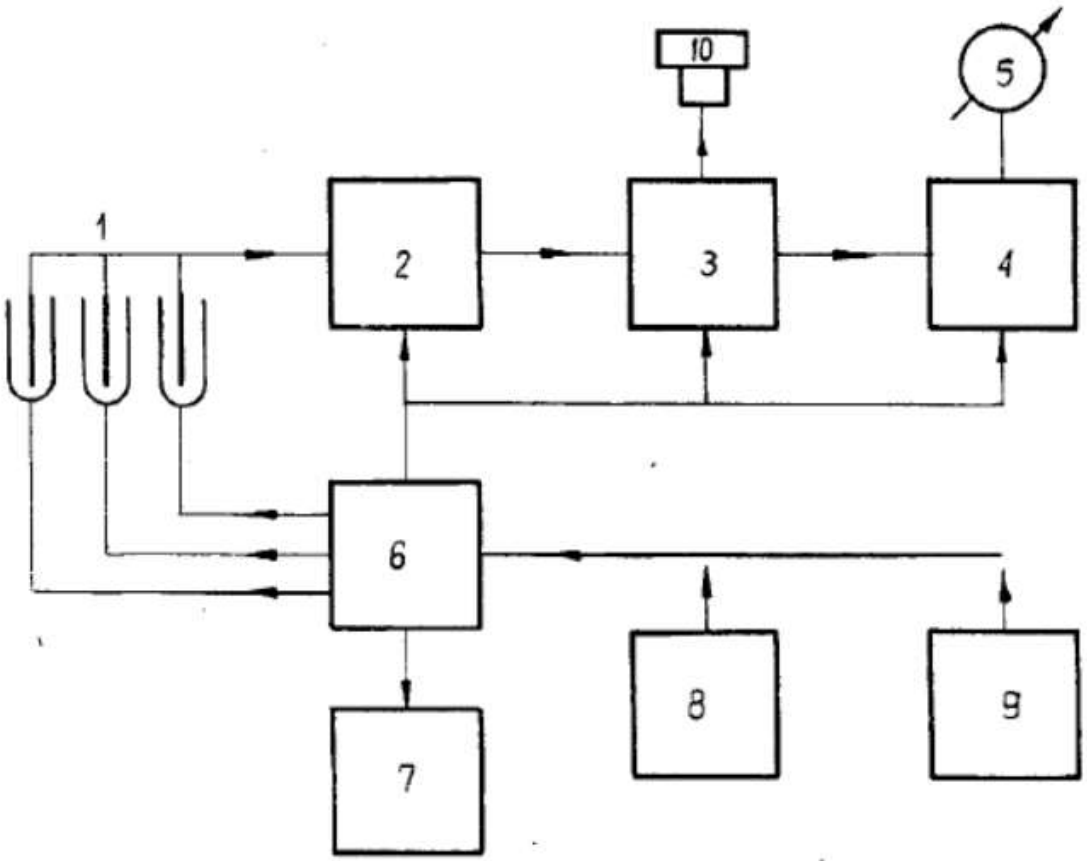


Figure 1: Block Diagram of the Circuit DP-66

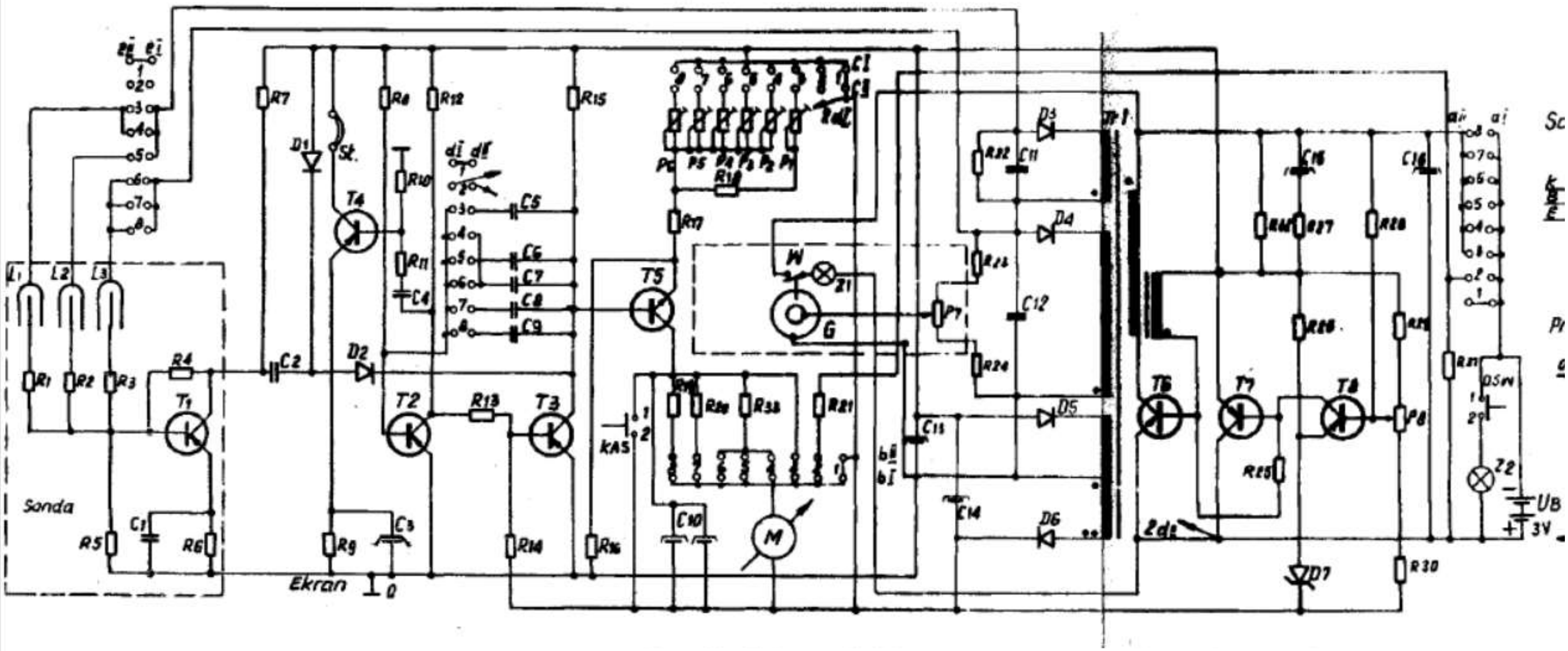
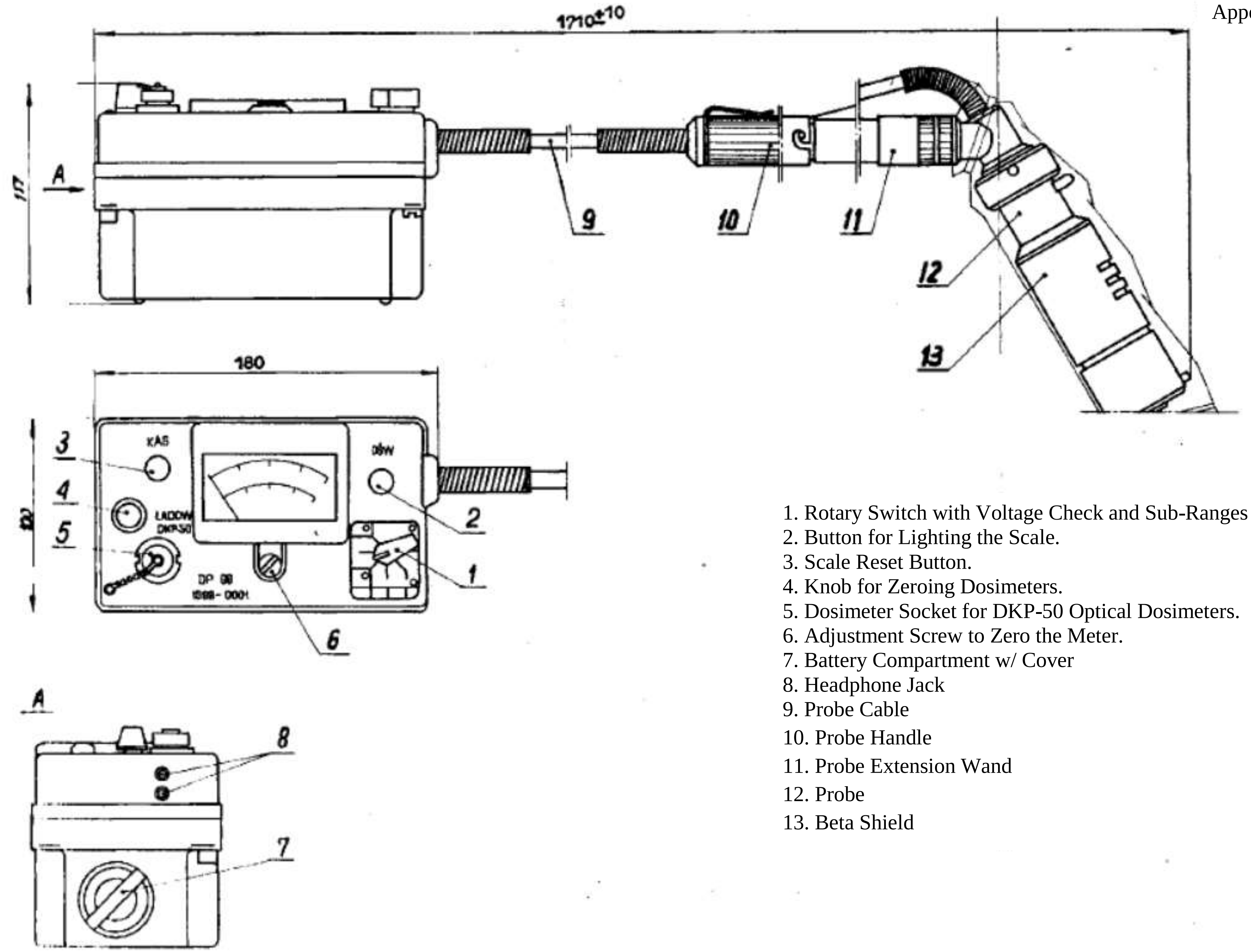


Figure 2: Detailed Circuit Diagram of DP-66



1. Rotary Switch with Voltage Check and Sub-Ranges I-VI.
2. Button for Lighting the Scale.
3. Scale Reset Button.
4. Knob for Zeroing Dosimeters.
5. Dosimeter Socket for DKP-50 Optical Dosimeters.
6. Adjustment Screw to Zero the Meter.
7. Battery Compartment w/ Cover
8. Headphone Jack
9. Probe Cable
10. Probe Handle
11. Probe Extension Wand
12. Probe
13. Beta Shield

Figure 3. Annotated General View Diagram

Appendix 6

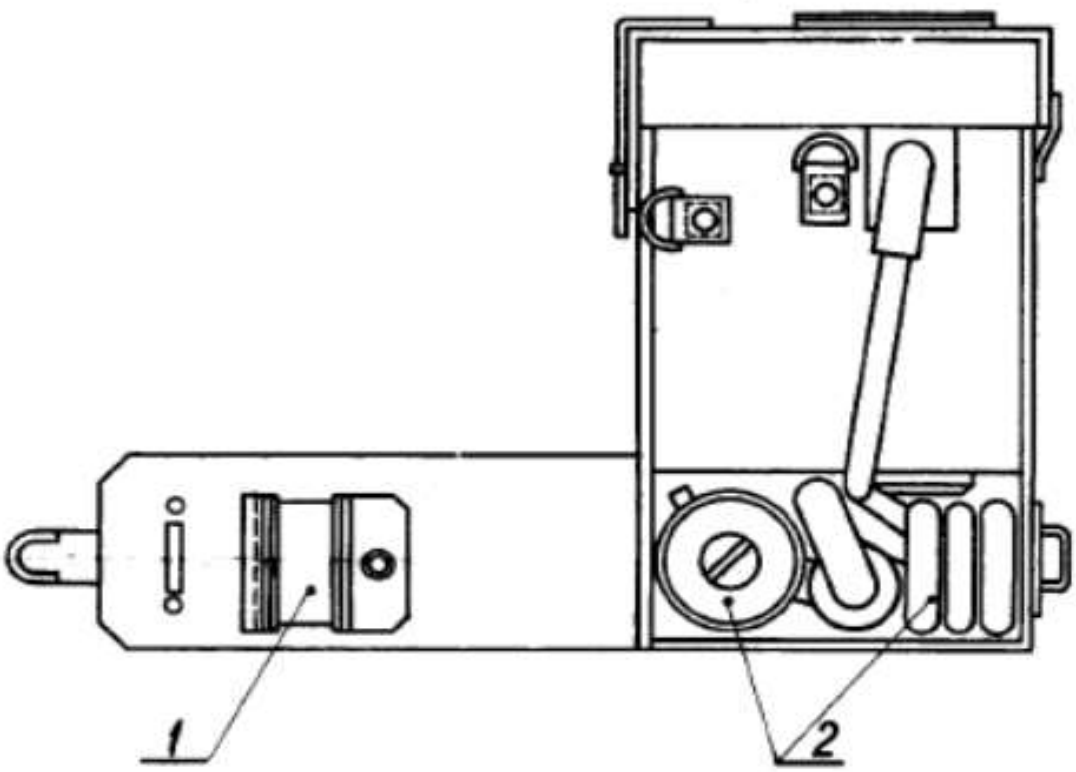


Figure 4. DP-66 Field Carrying Case Annotated General View Diagram

1 – Pocket for headphones.

2 – Correct position for storage of probe and cord in case.

Appendix 7:

Historical and Technical Information about the DP-66/DP-66M

The DP-66 and DP-66M were developed alongside the Russian Military DP-5 series of Geiger counters under the Warsaw Pact for Poland, a satellite state of Soviet Russia. These survey meters were built for local and state civil defense in case of disasters and/or nuclear holocaust.

The DP-66 and DP-66M are both able to measure beta and gamma radiation from 0.05 mR/hr to 200 R/hr in 6 ranges and are both able to charge the DKP-50 series of optical pen dosimeters (measuring up to a 50 Roentgen dose). They also have the ability to zero the scale when going up to a higher range which is a reoccurring problem in the design of the American CDV-700. Another unique feature that is different from the Russian DP-5 is that they have 3 GM tubes that are turned on based on the range selected, the Russian DP-5 only has two which are running all the time. Both the DP-66 and DP-66M come with an operational 10 μCi Sr-90/Y-90 check source, but it has since been removed per NRC regulations. Another notable feature is that they come with an extension wand to prevent contamination of your skin when measuring possibly contaminated/radioactive materials. They are powered by 2 D cells which is different than the custom DP-5 batteries that are made only for the instrument and are so hard to find you have to dangerously modify existing batteries or use a DIY AA battery adapter to make it work.

The DP-66 is able to measure in decays/min per every square centimeter which is done by reading the top scale of the meter and dividing the readings by the average measured background gamma radiation. This unique contamination scale is a defining feature of the DP-66. The DP-66 is also notable to have more functionality with a better probe design and a unique Beta times 10 position in which the maximum in decays/min*cm^2 range of 1 million being the max to increase to about 10 million decays/min*cm^2. The DP-66 saw service until the early 1970's when it's circuit design was improved and the DP-66M was born.

The DP-66M was the second iteration of the DP-66 which featured a spring loaded probe to "pop" the beta shield if measuring beta radiation. The contamination scale and the beta times 10 function were removed and replaced by newer electrical components. The audio was improved in response to complaints of the audio getting higher in pitch for each higher range.

The only downside to these units is that they are somewhat temper-mental and that some units are sensitive to agitation of the cord connecting the unit to the probe. Bulky as they are, they are not as bulky to carry around as a CDV-700 since they can be carried around your neck and the probe can be safely stored while not in use. Overall an excellent very sensitive unit with a history that unparallel any other of its kind.